National Research and Development Centre
for adult literacy and numeracy

Skills for Life Teachers' Qualifications and their Learners' Progress in Adult Numeracy

Results from the Teacher and Learner Studies

Research report

Olga Cara and Augustin de Coulon

July 2009

Published by the National Research and Development Centre
for Adult Literacy and Numeracy, Institute of Education, University of London

For information on alternative formats, or to give feedback on the content and accessibility of this publication, please contact:

Publications
NRDC
Institute of Education
20 Bedford Way
London WC1H 0AL
Telephone: +44 (0)20 7612 6476
Fax: +44 (0)20 7612 6671
Email: publications@nrdc.org.uk

Contents

Acknowledgements

Preliminary results from this research project were presented at the NRDC International Conference in March 2008 and at the NRDC quality management group. We thank the participants for their helpful comments. We also thank Greg Brooks for his thorough reading and comments together with David Mallows.

1. Introduction

1.1 The focus of the study

This report addresses the important question of how teachers' qualifications affect their learners' progress in the adult Skills for Life sector. The combined data sets of teachers' characteristics and learners' test scores and attitudes allowed us to shed light on some under-studied areas of further education in England.

The three main questions we addressed were:

1. Are teachers' qualifications related to improvement of learners between pre- and post-course assessments?
2. Do such relationships differ according to the type of qualifications held?
3. Are teachers' qualifications related to changes in learners' self-confidence and other attitudes?

1.2 The policy background

This study is set within the context of the government's Skills for Life strategy to improve adult literacy and numeracy in England (DfEE 2001). The problems of low numeracy and literacy levels for a large proportion of the UK adult population have been documented at key points in the last two decades (e.g. the 1999 Moser Report (DfEE 1999), the 2003 *Skills for Life Survey* (DfES 2003a) and the 2006 *Leitch Review of Skills* (Leitch 2006)). In 2003, it was documented that approximately 47 per cent of working-age individuals had severe numeracy difficulties and 16 per cent had literacy difficulties (at Entry levels).

Having poor literacy and/or numeracy has a negative impact both on low-skilled individuals (who face higher probability of unemployment, unstable jobs and fewer prospects for career advancement) and on the economy at large (which increasingly needs a more highly qualified workforce). Poor skills also have intergenerational effects as parents with low skills have children who perform lower in early test scores (de Coulon et al. 2008).

The Skills for Life strategy aims to make sure that England has one of the best adult literacy and numeracy rates in the world, and, its long-term vision is ultimately to eliminate the problem of poor levels of adult literacy and numeracy. Skills for Life emphasises the needs of priority groups at risk of exclusion, including unemployed people and benefit claimants; prisoners and those supervised in the community; public sector employees; low-skilled people in employment; and younger adult learners aged 16–19.

The initial target of improving the literacy, language and numeracy skills of 750,000 adult learners was achieved in 2004 and the second target of improving the skills of 1.5 million adults was achieved in 2007. The subsequent aim of improving the skills of 2.25 million individuals by 2010 was achieved ahead of time in 2008.

A core component of the Skills for Life strategy has been a new national learning, teaching and assessment infrastructure. New national literacy, numeracy and ESOL core curricula for adults have been introduced based on national standards at each of five levels (Entry 1, Entry 2, Entry 3, Level 1, Level 2), as well as assessments, both diagnostic and summative.

From 2001 for the first time, all new teachers in the lifelong learning sector were required to complete a generic teaching qualification, such as a Postgraduate Certificate in Education (PGCE) or Certificate in Education (CertEd). From 2002 further requirements were introduced for teachers of adult literacy and numeracy to also undertake a new subject-specialist teaching qualification in the subject they were teaching. Similar measures were announced for ESOL teachers in 2003. These separate Level 4 qualifications were in place at the time of this research, but had been only recently introduced.

In the late 2007 teacher education reforms, new standards and qualifications were introduced. The modular format of these new qualifications includes subject specific elements for teachers of adult literacy, numeracy and ESOL. This allows new teachers to take a single integrated qualification rather than the additional qualification model in place during the period from 2002–7.

1.3 The numeracy workforce

Information on the number of Skills for Life teachers and their profile is provided by a recent NRDC report commissioned by Lifelong Learning UK (Cara et al. forthcoming). It estimated that 18,800 individuals were teaching Skills for Life subjects in 2004/5, the most recent year for which full Learning and Skills Council data are available. Approximately 37 per cent of these were involved in the provision of literacy, 35 per cent ESOL and 28 per cent in numeracy. Those who taught two or more subjects were represented more than once in these figures, thus the total number of teachers in the three subjects adds up to more than the number of Skills for Life teachers in the workforce as a whole.

A report by the inspectorate in 2003 found that there was a need for greater expertise in teaching numeracy, which was too often taught by rote rather than by understanding numerical concepts (ALI/OFSTED 2003). The Smith Report acknowledges that the adult numeracy strategy is challenging and demanding for teachers and learners alike (Smith 2004). Data on the teaching qualifications of adult numeracy teachers in the NRDC report (Cara et al. forthcoming 2009) suggest that in 2005/6 29 per cent of numeracy teachers were fully qualified, while almost one-fifth (18 per cent) of numeracy teachers did not have any teaching qualifications. In this report the focus is on both the teaching qualifications of numeracy teachers and on their personal skill levels in maths, and on how these qualifications are related to the progress and change in the attitudes of their learners.

1.4 Evidence from previous studies

As Croninger et al. (2007) mention in their paper, the qualities and qualifications that need to be promoted in teachers in order to achieve better educational outcomes is a fundamental question. Many practitioners, policymakers and researchers argue that teacher quality is vital to student achievement and progress.

Some researchers have suggested that teacher quality is a powerful predictor of student achievement and progress. Hanushek (1992) showed that the difference between having a good teacher and a bad one could exceed one grade-level equivalent in annual educational progress. Rivkin

et al. (1998) concluded that teacher quality is the most important predictor of student achievement. Darling-Hammond (2000) argued that the effects of teacher quality on educational outcomes could be more important than student background characteristics, such as economic deprivation or ethnic minority status. Moreover, in the same studies she suggested that well-prepared teachers are more strongly associated with student outcomes than reduced class sizes or even teacher salaries. Sanders and Rivers (1996) came to very similar conclusions about teacher quality. They also suggested that the effect of teacher quality on lower achieving students is even stronger.

Evidence from published research undoubtedly suggests that teacher quality is vital to student achievement and progress. However, there have been many challenges to this type of research. One of the reasons for this is the difficulty in defining what teacher quality is, what characteristics have to be measured in order to look at it and what has to be promoted in teachers to improve it.

Some studies looked at teachers' qualifications, degree level and certification status as a proxy for teaching quality. Yet, these studies have some inconclusive findings or no significant effect when looking at general teaching qualifications or certification status (Croninger et al. 2007). However, other research that looked specifically at the subject area of teachers' qualifications has found that students' achievement gains in high school for mathematics and science are associated with teachers holding a mathematics or science undergraduate or Master's degree (Goldhaber and Brewer 1997, 1998, 2000; Rowan et al. 1997). In addition, when Croninger et al. (2007) looked at specific teaching degrees in elementary education, they discovered that this positively correlates with pupils' achievement in reading in elementary school. They also discovered, interestingly, that over-qualified teachers sometimes appear to do a poorer job. Thus, teachers holding a Master's degree can have a negative effect on elementary school student achievement (Rowan et al. 2002, Croninger et al. 2007).

While existing research provides some guidance regarding the potential importance of teachers' qualifications, there is still a lack of evidence in the UK, particularly for the FE sector. So far most of the literature comes from the compulsory sector, with the vast majority of published studies hailing from the US.

NRDC researchers have started addressing some aspects of the effect of teacher quality on learner performance in studies of effective practice in numeracy, ESOL, reading and writing (Coben et al. 2007, Baynham et al. 2007, Brooks et al. 2007, Grief et al. 2007). The data did not show significant correlation between teachers' qualifications and/or experience and learners' outcomes. However, the question was not the main focus in these studies, data on teacher qualifications was not consistently collected and only very basic correlational methods were used.

Other UK-based research does suggest some significant association between teacher qualifications and learner achievement, both in the further and compulsory education sectors. For example, Brooks et al. (2001) found that one of the factors associated with better progress in

reading for adult learners was that all tutors in an FE provider area had qualified teacher status. In another study, Askew et al. (1997) argued that highly effective numeracy teachers in primary schools in England were much more likely than other teachers to have undertaken mathematics-specific continuing professional development over an extended period. This report builds on existing research carried out on both sides of the Atlantic, by investigating further the relationship between teachers' qualifications and the progress of adult learners in Skills for Life.

1.5 Method

We made use of two very comprehensive data sets gathered by the NRDC with the help of funding from the then Department for Education and Skills (DfES). Tests and questionnaires were collected from learners at the beginning and then again at the end of some Skills for Life courses in 2003/4. This data set allowed for a thorough investigation of any changes in the performance and attitudes of learners. This information was combined with detailed questionnaires collected from the teachers of these learners as part of the Teacher Study (Cara et al. 2008).

In particular, it was possible to look at the effect of teaching and subject-specialist qualifications together with the highest qualifications obtained in any subjects.

The full Teacher Study sample consisted of approximately 1000 teachers, interviewed twice: first in 2004/5 and then again in 2006. A very large array of questions were asked with regards to the teachers' socio-economic characteristics (age, gender, ethnicity, etc.), and with regards to their qualifications (whether currently in the process of being obtained or already obtained). Some questions were also asked about their motivations to teach and their attitude on various aspects of Skills for Life (see Cara et al. (forthcoming 2009) for a detailed investigation of these questions).

Together with this data set, 270 teachers were randomly selected and asked to provide names of learners chosen at random. These learners were then tested twice, first early on in their Skills for Life courses and then at a later stage towards the end of their courses. More details and raw results on the learners' assessments are provided in Warner and Vorhaus (2008).

This report focuses on 84 numeracy teachers and 237 of their learners to investigate the important question of whether numeracy teachers' qualifications and experience affect their learners' progress.

We implemented a random effect analysis (a standard estimation method in the literature) where the results of later tests scores were regressed on a baseline (early test performance) and a series of variables that captured various influences on learners' progress. In particular, we differentiated between variables describing learners' and teachers' characteristics. We also introduced some variables for the institutions in which the courses were taking place.

Our research used matched student and teacher data, where students' skills were measured before and after their courses. This credible identification and use of panel data helped us to focus on the differences between students taught by different teachers and separate out variation

in students' achievement and progress due to their cognitive abilities and other constant characteristics.

2. Descriptive statistics on teacher and learner characteristics

2.1 Learners' profiles

The sample consisted of 227 learners who attended numeracy classes and were tested for their numerical skills before and after their course. These learners also had no missing data for other variables (their own or their teachers' characteristics) used in the analysis. The characteristics of the learners can be seen in Table 1 below.

Table 1: Learners' characteristics

Male	43.6%
Female	56.4%

Age	
16–19	41.4%
20–49	46.3%
50+	12.3%

First language English	89.4%
White British	83.7%

Highest qualifications	
Above Level 2	6.6%
Level 2	28.2%
Below Level 2	30.8%
None	34.4%
Other	-

Have dyslexia	15.4%
Health-related problems	23.8%

2.2. Learners' test scores

Table 2 shows summary statistics for the tests in numeracy that the learners took. The means of the tests increased between the pre- and post-tests. In the row entitled mean progress, individual mean progress is shown. The line underneath indicates whether individuals' progress was significantly different from zero. However, this table only provides descriptions of the means of the distributions. It could be that some part of the distribution progressed while another part regressed, therefore cancelling each other out in the calculation of the mean.

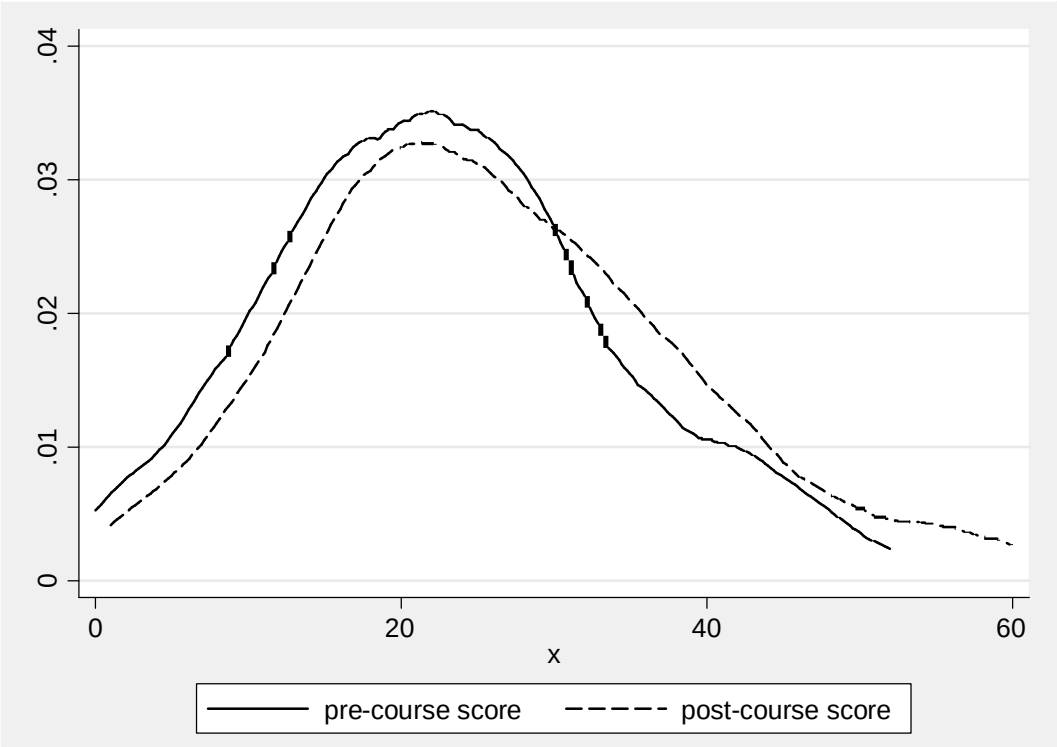
Table 2: Learners' test scores

	Numeracy
N	237
Minimum score	0
Maximum score	60
Mean score pre-course	22.9 (11.1)
Mean score post-course	26.1 (12.3)
Mean progress	3.2
	$t(226) = 6.04$, $p < .001$

Note: standard deviations are given in parenthesis.

To check how the entire distributions have moved, we therefore needed to provide more descriptive investigations by displaying the whole distribution of the pre- and post-tests. This is done in Figure 1.
We produced the distribution of test scores at the beginning and the end of the course (pre- and post-). In Figure 1 the continuous line is for pre-course tests and the dotted one is for post-course tests. This graph is similar to a histogram (i.e. the area below a particular score is the percentage of learners who achieved up to this point). The dotted line for post-test scores lies to the right of the continuous line for pre-test scores. This means that for low scores (displayed on the left hand side of the x horizontal axis) learners were more numerous before the course than after. The opposite is observed for high scores. This implies that the course did have an effect of moving learners from the bottom of the distribution to higher up ('pushing the curve'). This means that the whole distribution moved to the right after the course was completed.
Generally, the move to the right is quite clear for numeracy (Figure 1), indicating a clear positive shift of the distribution to the right.

Figure 1: Distribution of pre- and post-course scores in numeracy



2.3 Teachers' profiles

This section summarises the available information on the numeracy teachers who participated in this study. The teachers were predominantly White British, females. On average they were in their forties and had seven years' experience of teaching adult numeracy.

Given that teachers' qualifications are at the centre of this study, it is important to devote attention to the type of qualifications held. We gathered data on four different types of qualifications: highest qualification held in any subject; highest qualification in maths; highest qualification in English and teaching qualifications held as shown in Table 3 below.

On the non-teaching qualifications held it was interesting to note that while 70 per cent of teachers were graduates of one subject or another, 44 per cent had a highest qualification in maths at Level 2 or below.

Only 14.6 per cent of the teachers were classified as fully qualified and 33 per cent unqualified. We used three main categories to describe the qualification status of teachers: 'fully qualified', 'part qualified' and 'unqualified'. In this context, 'fully qualified' means teachers who have gained the two qualifications currently required, that is: a full generic teaching qualification (a Certificate in Education/ PGCE or Certificate in Further Education Teaching Stage 3) and a subject-specialist qualification in numeracy. 'Part-qualified' means that a teacher has one of the two qualifications required. 'Unqualified' means that a teacher has neither of the currently required qualifications. These 'unqualified' teachers may or may not have other qualifications, including 'legacy' qualifications. Legacy qualifications are those that pre-date the availability of currently required qualifications. It should be remembered here that at the time of collecting data for this study, the new subject qualifications had only been available for two years, therefore many experienced teachers may have appeared as 'unqualified'.

Table 3: Numeracy teachers' qualifications profile

Highest qualification overall	
Level 7 (Master's, PhD etc.)	26.2
Level 4, 5, 6 (undergraduate degree)	70.2
Level 3 or below	3.6
Highest qualification in maths	
Level 4 and above	28.6
Level 3	27.4
Level 2 or below	44.1
Highest qualification in English	
Level 4 and above	26.2
Level 3	16.7
Level 2 or below	57.1
Teaching qualifications	
Have a subject-specialist qualification in relevant subject	17.9
Have a generic teaching qualification (e.g. CertEd; PGCE)	71.4
Qualified status	
Fully qualified to teach numeracy	14.6
Part qualified to teach numeracy	52.5
Unqualified to teach numeracy	32.9

3. Main research findings

In the following chapter we will explain the variation in learners' numeracy test scores as well as their attitudes, after taking into account their skills and attitudes measured before or at the beginning of their course. We are looking at learners' progress and change in attitudes related to teachers' qualifications. By including the pre-course test measures, we controlled for the potentially misleading effect of the inclusion of learners with differing abilities and/or skills in the different courses. Some teachers could have had a higher proportion of learners with low skills in their classrooms, or some providers might have had a disproportionably high number of learners with learning difficulties and thus lower skill levels. Also learners with given attitudes towards learning and their numeracy skills may not be randomly distributed. Introducing the initial measures allowed us to interpret the additional variables in the analysis as related to the observed progress between the initial and final assessments.

As explanatory variables of main interest to this report, we use the qualifications of teachers. In most of the tables, we follow an approach where we start with one type of qualification and test its effect on the learners' performance. As we move to the right of the tables, we introduce other qualifications or qualifications in different combinations, each of which have been shown in published studies to be related to learners' achievement and/or attitudes. We also include those qualifications which are of particular interest for the current policy context.

First we introduce the level of teachers' highest qualification in general. For some, it was their teaching qualification (e.g. PGCE) and for others their highest general qualification (Master's, PhD etc.) whether this was in a subject related to their teaching or not (Model 1). Then, while keeping the previous variable in our regressions, we introduced teachers' highest qualification in mathematics for numeracy teachers.

Then in a subsequent step, we introduce two variables. The first is whether the teacher holds the new numeracy subject-specialist teaching qualification and the second is whether s/he has a generic teaching qualification. To allow any effects of these qualifications to appear in learners' performance, we remove the highest qualification in English or maths from these estimations.

In Model 4, rather than testing these two variables separately we introduce subcategories of qualified status – fully, partially and unqualified. Then in Model 5, we add the highest qualification in maths together with qualification status of teachers. Finally in Model 6, we introduce teaching experience in the subject taught. From previous research we know that it is very hard to measure teaching quality. It is most probably wrong to assume that teaching quality is fully measured by the teaching qualifications. We therefore introduce teaching experience as an additional factor that is probably closely related to teaching quality. It is also interesting to see if teaching experience can compensate for the lack of qualifications in teachers, and whether it increases learners' performance beyond the qualification status.

All the models in the following sections also include numerous controls for learners' characteristics (gender, age, first language, learning or health

difficulties) and teachers' characteristics (age, gender, ethnicity). We do not give detailed comments on the effect of these variables as they are not the main focus of the study. However, they are reported fully in Appendix B.

Similar data were analysed for literacy and ESOL teachers and learners. However, the results were inconclusive and no clear patterns were found. This may show an absence of such relationships or it may be due to a number of additional complicating factors. There are greater limitations on the relevance of teachers' qualifications in the subject titled 'English' than for maths. The knowledge needed for teaching literacy and ESOL may equally, if not more likely, be evidenced through qualifications in languages or linguistics. A second factor may be the impact of the complex range of teaching qualifications held by literacy and ESOL teachers at the time of this research. This led teachers with masters level qualifications in teaching ESOL, for example to be classified as 'unqualified' in the LLUK survey data. A third and not insubstantial factor was the mix of ESOL and literacy learners within the analysis of learners' progress and the difficulty in then matching the ESOL teachers, the literacy teachers and their respective learners.

3.1 Learners' progress

Models 1 to 6 in Table 4 introduce the pre-course test score as the baseline in our regressions. We can see that the pre-course tests are always strongly statistically significant. In a related NRDC report using the same data, Brooks and Pilling (forthcoming) found that learners had indeed progressed in numeracy between the initial and later assessments. Our report's main focus is on the possible causal link between teachers' qualifications and their learners' progress. Once the initial assessments have been introduced to the regressions, it is then possible to interpret the other variables as related to the progress from the initial to the later assessments.

Our regressions control for the other characteristics of teachers and learners, most notably: the learners' and teachers' age and gender, learners' first language and learners' initial assessment in numeracy. We do not report their coefficients in Table 3 (they are reported in Appendix B), as we want to focus on the coefficients measuring teachers' qualifications.

First of all we include the highest overall qualification of teachers (Model 1). Its coefficient implies positive, but not statistically significant effects on learners' progress in numeracy. The level in maths for numeracy teachers is introduced in Model 2. The variables are whether the teacher holds an A level in maths and also whether s/he holds a degree or postgraduate degree in maths, and this is compared to teachers who hold a lower level in maths (GCSE or lower). Both coefficients are positive and strongly statistically significant. This means learners make more progress when their teachers have a qualification at A level or higher, but not at GCSE or lower.

Then these effects on learners' performance are assessed in comparison with those of a generic teaching qualification (e.g. CertEd, PGCE) and the numeracy subject-specialist qualification. The data suggest that both

qualifications, separately and in combination, have a positive but not statistically significant effect on learners' progress.

Table 4: Progress in numeracy[1]

	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*
Pre-course test score	0.809*** (0.051)	0.792*** (0.052)	0.808*** (0.053)	0.800*** (0.052)	0.787*** (0.053)	0.784*** (0.054)
Learners' characteristics (gender, age, first language, health status)	Y	Y	Y	Y	Y	Y
Teachers' characteristics (gender, age, ethnicity)	Y	Y	Y	Y	Y	Y
Teachers' qualifications						
Highest level qualification – postgraduate degree, doctorate *(Reference category – lower level)*	1.244 (1.395)	1.121 (1.370)	1.230 (1.497)	0.927 (1.523)	0.885 (1.505)	0.388 (1.567)
Qualification in maths – degree or postgraduate degree *(Reference category – Level 2 or below)*		3.562** (1.598)			3.495** (1.677)	3.119* (1.762)
Qualification in maths at Level 3 (A level) *(Reference category – Level 2 or below)*		3.275** (1.447)			3.319** (1.556)	4.280*** (1.591)
Has a subject-specialist qualification in numeracy			0.074 (1.888)			
Has a generic teaching qualification (e.g. PGCE, CertEd)			0.763 (1.497)			
Part qualified to teach numeracy *(Reference category – fully qualified)*				-1.325 (2.085)	-0.850 (2.079)	-0.879 (2.046)
Unqualified to teach numeracy *(Reference category – fully qualified)*				-2.321 (2.377)	-0.596 (2.442)	0.638 (2.547)
Teaching experience in numeracy (years)						0.215* (0.125)
Number of observations	237	237	237	237	237	225

Finally in the last column (Model 6), the number of years teaching numeracy is introduced. It is found that learners make more progress when their teacher has greater experience at teaching the subject. This result is obtained controlling for teachers' levels in maths and teaching qualifications.

3.2 Change in learners' self-confidence and other attitudes

In this section, the report includes additional investigations of the relationship between teachers' qualifications and learners' outcomes other than strict academic progress. In particular, other interesting and relevant

[1] Dependent variable: achievement in numeracy after the course.Standard errors (clustered by teacher) in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

questions for policy and practitioners were included in the questionnaire; most notably, the learners' confidence and attitude towards their numeracy skills and/or use in their everyday life. However, compared to the association between learners' progress and teachers' qualifications, results are less clear.

3.2.1 Change in attitudes of numeracy learners

Results of the analysis summarised in Table 5 suggest that learners tend to have a greater positive change in their perception of maths[2] when their teachers have a degree or postgraduate degree in maths compared to those teachers who have a GCSE or lower level in maths (Models 1, 5 and 6). Yet, there is some indication that learners experience less improvement in their attitudes when their teachers have more teaching experience in numeracy (Model 6).

Another aspect of interest is monitoring changes in learners' enjoyment of maths3. The results in Table 6 suggest that learners tend to show a greater increase in enjoyment of maths when their teachers have a degree or postgraduate degree in maths compared to those teachers who have a GCSE or lower level in maths, and that maths enjoyment is decreased if the teacher is not qualified to teach.

[2] The scale was constructed using the following statements in the questionnaire: I can use the maths I learn in class to help me solve everyday problems; I use maths a lot in my everyday life, including at home and/or work; maths helps you to understand today's world; It is difficult to find a good job unless you have passed your maths exams.

[3] The scale was constructed using the following statements in the questionnaire: I find learning maths boring (reverse item); The more you learn about maths, the more interesting it becomes; I enjoy learning maths.

Table 5: Change how maths is perceived[4]

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Pre-course attitudinal score	0.502***	0.508***	0.501***	0.499***	0.505***	0.519***
	(0.057)	(0.056)	(0.057)	(0.057)	(0.056)	(0.058)
Learners' characteristics (gender, age, first language, health status)	Y	Y	Y	Y	Y	Y
Teachers' characteristics (gender, age, ethnicity)	Y	Y	Y	Y	Y	Y
Teachers' qualifications						
Highest level qualification – postgraduate degree, doctorate *(Reference category – lower level)*	-0.193	-0.196	-0.278	-0.306	-0.258	-0.345
	(0.285)	(0.272)	(0.312)	(0.316)	(0.305)	(0.308)
Qualification in maths – degree or postgraduate degree *(Reference category – Level 2 or below)*		0.932***			0.929***	1.056***
		(0.324)			(0.343)	(0.337)
Qualification in maths at Level 3 (A level) *(Reference category – Level 2 or below)*		0.391			0.416	0.302
		(0.291)			(0.316)	(0.311)
Has a subject-specialist qualification in numeracy			0.265			
			(0.389)			
Has a generic teaching qualification (e.g. PGCE, CertEd)			0.098			
			(0.306)			
Part qualified to teach numeracy *(Reference category – fully qualified)*				-0.366	-0.178	-0.379
				(0.423)	(0.413)	(0.390)
Unqualified to teach numeracy *(Reference category – fully qualified)*				-0.434	-0.062	-0.464
				(0.480)	(0.486)	(0.486)
Teaching experience in numeracy (years)						-0.042*
						(0.024)
Number of observations	220	220	220	220	220	209

[4] **Notes:** Robust standard errors (clustered by teacher) in parentheses. *** p<0.01, ** p<0.05, * p<0.1.The dependent variable included the following statements in the questionnaire: I can use the maths I learn in class to help me solve everyday problems; I use maths a lot in my everyday life, including at home and/or work; maths helps you to understand today's world; It is difficult to find a good job unless you have passed your maths.

Table 6: Change in enjoying maths[5]

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Pre-course attitudinal score	0.638*** (0.057)	0.641*** (0.057)	0.632*** (0.058)	0.628*** (0.057)	0.634*** (0.057)	0.610*** (0.061)
Learners' characteristics (gender, age, first language, health status)	Y	Y	Y	Y	Y	Y
Teachers' characteristics (gender, age, ethnicity)	Y	Y	Y	Y	Y	Y
Teachers' qualifications						
Highest level qualification – postgraduate degree, doctorate *(Reference category – lower level)*	-0.060 (0.242)	-0.061 (0.237)	-0.168 (0.264)	-0.143 (0.268)	-0.111 (0.262)	-0.098 (0.315)
Qualification in maths – degree or postgraduate degree *(Reference category – Level 2 or below)*		0.500* (0.280)			0.377 (0.284)	0.389 (0.345)
Qualification in maths at Level 3 (A level) *(Reference category – Level 2 or below)*		0.110 (0.252)			-0.069 (0.264)	-0.044 (0.319)
Has a subject-specialist qualification in numeracy			0.288 (0.325)			
Has a generic teaching qualification (e.g. PGCE, CertEd)			0.395 (0.262)			
Part qualified to teach numeracy *(Reference category – fully qualified)*				-0.234 (0.353)	-0.153 (0.344)	-0.141 (0.405)
Unqualified to teach numeracy *(Reference category – fully qualified)*				-0.720* (0.405)	-0.661 (0.410)	-0.802 (0.509)
Teaching experience in numeracy (years)						-0.008 (0.025)
Number of observations	236	236	236	236	236	225

An interesting and contrasting picture appears in the investigation of the effect of teachers' qualifications on learners' self-confidence (Table 7). There is some evidence that learners experienced less increase in their self-confidence related to maths if the teacher had a degree or a postgraduate degree in maths compared to those teachers who have a GCSE or lower level in maths. This is an interesting result that relates to previously published studies on lower outcomes for teachers who hold high-level qualifications (i.e. an over-qualification effect). It may also indicate a changing learner perspective on how much more there is to learn.

[5] Robust standard errors (clustered by teacher) in parentheses. *** p<0.01, ** p<0.05, * p<0.1 The dependent variable included the following statements in the questionnaire: I find learning maths boring (reverse item); The more you learn about maths, the more interesting it becomes; I enjoy learning maths.

Table 7: Change in self-confidence in maths[6]

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Pre- course attitudinal score	0.573*** (0.055)	0.578*** (0.055)	0.577*** (0.055)	0.574*** (0.055)	0.580*** (0.055)	0.570*** (0.058)
Learners' characteristics (gender, age, first language, health status)	Y	Y	Y	Y	Y	Y
Teachers' characteristics (gender, age, ethnicity)	Y	Y	Y	Y	Y	Y
Teachers' qualifications						
Highest level qualification – postgraduate degree, doctorate *(Reference category – lower level)*	0.072 (0.456)	0.095 (0.453)	0.114 (0.505)	0.049 (0.510)	-0.008 (0.508)	0.010 (0.573)
Qualification in maths – degree or postgraduate degree *(Reference category – Level 2 or below)*		-1.023* (0.542)			-0.970* (0.578)	-1.144* (0.641)
Qualification in maths at Level 3 (A level) *(Reference category – Level 2 or below)*		-0.503 (0.481)			-0.366 (0.524)	-0.454 (0.572)
Has a subject-specialist qualification in numeracy			-0.075 (0.631)			
Has a generic teaching qualification (e.g. PGCE, CertEd)			-0.552 (0.505)			
Part qualified to teach numeracy *(Reference category – fully qualified)*				-0.109 (0.684)	-0.357 (0.696)	-0.330 (0.738)
Unqualified to teach numeracy *(Reference category – fully qualified)*				0.585 (0.778)	0.173 (0.815)	0.529 (0.916)
Teaching experience in numeracy (years)						0.018 (0.046)
Number of observations	218	218	218	218	218	207

[6] Robust standard errors (clustered by teacher) in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The dependent variable is a scale constructed from the following statements in the questionnaire: I find lots of areas of maths difficult to understand; I find learning maths quite easy (reverse item); I usually get most of my maths questions right (reverse item); Many things we do in maths do not make sense to me; I often forget things that I have learnt in maths; Learning maths can make me feel that I am a bit of failure.

4. Conclusions and implications

The main aim of this research was to investigate how teachers' qualifications are related to learners' progress in literacy and numeracy, their self-confidence and their attitudes to learning. We made use of a comprehensive data set consisting of 237 learners, whose 84 teachers were also interviewed. The learners were assessed twice, at the beginning and at the end of their courses. This unusually rich source of information allowed for a robust investigation of the principle research questions:

- Are teachers' qualifications related to improvement of numeracy learners between pre- and post-course assessments?
- Do such relationships differ according to the type of qualifications held?
- Are numeracy teachers' qualifications related to changes in learners' self-confidence and other attitudes?

Our findings shed new light on the relationship between numeracy teachers' qualifications and their learners' progress. Most significantly, the answer to the first question is positive; there is clear evidence that learners of better qualified numeracy teachers made more progress between pre-course and post-course tests. Learners' improvements in numeracy were mostly associated with teachers who held qualifications in maths at Level 3 and above (that is, A level or first/postgraduate degrees in maths). The number of years of teaching experience in numeracy was also found to have a positive effect on learners' progress.

We also examined the relationship between teachers' qualifications and changes in learners' attitudes and self-confidence. Here the picture is more complicated. On the one hand learners have a greater positive change in their perception of maths when taught by teachers holding first or postgraduate degrees in maths; on the other hand, learners have a smaller positive change in their perception of maths when taught by teachers with more rather than less experience. This last finding, in particular, calls for an explanation.

There is some evidence that teachers' possession of a maths degree has a positive impact on how much learners enjoy using their own maths skills. However the report also suggests that learners' self-confidence in maths grows less with teachers who are highly qualified in maths (that is, having a degree in maths or a still higher qualification), as compared with teachers having qualifications at Level 2 or below. The suggestion that higher qualifications amongst maths teachers tends to inhibit the growth of learners' self-confidence is also a finding in need of explanation; perhaps it is in relation to the more highly qualified teachers that learners are most keenly aware of how much they have yet to learn. Or perhaps teachers with lower levels of maths are more able to empathise with the numeracy challenges faced by their adult learners. Those graduate and postgraduate maths teachers with little or no experience or memory of struggling with their own maths may need to develop a greater understanding of the adult learner experience as part of their initial teacher education. This is consistent with Morton et al.'s (2006, p.58) finding of 'a consensus in the

literature that teachers should take part in practical professional development activities to help them to "see" the subject from their learners' point of view'. And Jane Imrie, from the National Centre of Excellence in Teaching Mathematics, has described how in professional development teachers need to 'move beyond their comfort zone' and 'feel like a learner again' (Honey 2009, p.17).

We summarise the impact of teachers' qualifications and experience in Table 8 below:

Table 8: Summary of the impact of teachers' qualifications and experience

Changes in:	Teachers with A level maths or higher	Teachers with degree level maths or higher	Teachers with more experience
Progress between pre and post tests	Strong positive association	Strong positive association	Positive association
Learners' perception of maths		Strong positive association	Weak negative association
Learners' enjoyment of maths		Positive association	
Learners' self-confidence with maths		Negative association	

There are clear implications of these findings in the context of recent policy developments. The teacher education reforms of September 2007 introduced a new requirement for prospective numeracy teachers to evidence Level 3 mathematics at entry to teacher education programmes. The strong positive association between learner progress and their teachers having at least a Level 3 qualification in maths offers direct support for this policy development. A priority for future research would be an analysis of the impact of the introduction of subject-specific teaching qualifications on learners' progress, attitudes and confidence.

References

ALI/Ofsted (2003) Literacy, Numeracy and English for Speakers of Other Languages: A review of current practice in post-16 and adult provision. Coventry: Adult Learning Inspectorate, Ofsted and Her Majesty's Inspectorate.

Askew, M., Brown, M., Rhodes, V., Johnson, D. and Wiliam, D. (1997) *Effective teachers of numeracy.* London: King's College London.

Baynham, M., Roberts, C., Cooke, M., Simpson, J., Ananiadou, K., Callaghan, J., McGoldrick, J. and Wallace, C. (2007) *Effective teaching and learning: ESOL.* London: NRDC.

Brooks, G., Burton, M., Cole, P. and Szczerbinski, M. (2007) *Effective teaching and learning: Reading*. London: NRDC.

Brooks, G. and Pilling, M. (forthcoming) *Stepping Stones: Progression from non-counting provision to counting provision – quantitative strand.* London: NRDC.

Brooks, G., Davids, R., Duckett, L., Hutchinson, D., Kendall, S. and Wilkin, A. (2001) *Progress in Adult Literacy. Do Learners Learn?* London: The Basic Skills Agency.

Cara, O., Litster, J., Swain, J. and Vorhaus, J. (2008) *The Teacher Study: The impact of the Skills for Life strategy on teachers*. Summary report. London: NRDC.

Cara, O., Litster, J., Swain, J. and Vorhaus, J. (forthcoming 2009) *The Teacher Study: The impact of the Skills for Life strategy on teachers*. Full report. London: NRDC.

Cara, O., Carpentieri, J.D. and. Casey, H. (forthcoming) *The Skills for Life teaching workforce in England 2006: Summary Report*. London: LLUK.

Coben, D., Brown, M., Rhodes, V., Swain, J., Ananiadou, K., Brown, P., Ashton, J., Holder, D., Lowe, S., Magee, C., Nieduszynska, S. and Storey, V. (2007) *Effective teaching and learning: Numeracy*. London: NRDC.

Croninger, R.G., Rice, J., Rathbun, A. and Nishio, M. (2007) 'Teacher qualifications and early learning: Effects of certification, degree, and experience on first-grade student achievement'. *Economics of Education Review*, 26, pp. 312–324.

Darling-Hammond, L. (2000) Teacher quality and student achievement: A review of state policy evidence. *Journal of Education Policy Analysis*, 8(1).

de Coulon, A., Meschi, E. and Vignoles, A. (2008) *Parents' basic skills and their children's test scores*. London: NRDC.

DfEE (1999) *A Fresh Start: Improving literacy and numeracy. The report of the Working Group chaired by Sir Claus Moser*. London: Department for Education and Employment.

DfEE (2001) *Skills for Life: The national strategy for improving adult literacy and numeracy skills*. London: Department for Education and Employment.

Goldhaber, D. D. and Brewer, D. J. (1997) 'Why don't schools and teachers seem to matter? Assessing the impact of unobservables on educational productivity'. *The Journal of Human Resources*, 32(3), pp. 505–523.

Goldhaber, D. D. and Brewer, D. J. (1998) 'When should we reward degrees for teachers?'. *Phi Delta Kappan*, 80(2), pp.134–138.
Goldhaber, D. D. and Brewer, D. J. (2000) 'Does teacher certification matter? High school teacher certification status and student achievement'. *Educational Evaluation and Policy Analysis,* 22(2), pp. 129–146.
Grief, S., Meyer, B. and Burgess, A. (2007) *Effective teaching and learning: Writing.* London: NRDC.
Hanushek, E. A. (1992) 'The trade-off between child quantity and quality'. *Journal of Political Economy*, 100, pp. 84–117.
Honey, N. (2009) 'Taking the national numeracy challenge forward', *Update*, Spring 2009, Issue 27, pp.16–17.
Leitch, S. (2006) *Leitch Review of Skills: Prosperity for all in the global economy – world class skills. Final Report.* London: HM Treasury.
Morton, T., McGuire, T. and Baynham, M. (2006) *A literature review of research on teacher education in adult literacy, numeracy and ESOL.* London: NRDC.
Rivkin, S.G., Hanushek, E.A. and Kain, J.F. (1998) *Teachers, schools, and academic achievement*. National Bureau of Economic Research, Working Paper 6691.
Rowan, B., Chiang, F. and Miller, R. J. (1997) 'Using research on employees' performance to study the effects of teachers on students' achievement'. *Sociology of Education,* 70(October), pp. 256–284.
Rowan, B., Correnti, R. and Miller, R.J. (2002) *What large-scale, survey research tells us about teacher effects on student achievement: Insights from the Prospects study of elementary schools.* Philadelphia: CPRE Publications.
Sanders, W. L. and Rivers, J. C. (1996) *Cumulative and residual effects of teachers on future student academic achievement*. Knoxville, TN: University of Tennessee Value-Added Research and Assessment Center. Retrieved 6 December 2007 from www.mccsc.edu/~curriculum/cumulative and residual effects of teachers.pdf

Smith, A. (2004) *Making Mathematics Count: The Report of Professor Adrian Smith's Inquiry into Post-14 Mathematics Education*. London: The Stationery Office.
Warner, R. and Vorhaus, J. (eds) (2008) *The Learner Study: The impact of the Skills for Life strategy on adult literacy, language and numeracy learners.* London: NRDC.

Appendices

Appendix A: Teachers' and learners' characteristics

Table A 1: Learners' characteristics

	Reading		Writing	
	Literacy	**ESOL**	**Literacy**	**ESOL**
N	186	133	93	114
Age				
16–19	38.7	8.2	35.5	6.1
20–49	48.4	85.8	52.7	86.9
50+	12.9	6.0	11.8	7.0
Female	54.3	63.2	61.3	62.3
First language English	-	-	-	-
White British	88.2	-	94.6	-
Have dyslexia	23.1	1.0	23.7	2.6
Health-related problems	-	-	-	-
Highest qualifications				
Below Level 2	37.0	10.7	34.1	14.3
Level 2	28.7	17.4	23.1	15.3
Above Level 2	6.1	43.2	8.7	47.9
None	28.2	28.8	34.1	22.5
Other	-	-	-	-

Table A 2: Teachers' characteristics

	Reading		**Writing**	
	Literacy	**ESOL**	**Literacy**	**ESOL**
N	76	66	63	64
Female	81.6	73.9	85.7	81.3
White British	97.4	89.2	96.8	85.9
Age (years)	45.7 (10.5)	42.5 (9.9)	45.7 (10.6)	43.7 (9.8)
Teaching experience in relevant subject (years)	6.3 (4.8)	6.8 (5.7)	5.8 (4.7)	7.4 (6.5)
Highest qualification overall				
Level 7	18.4	38.5	19.1	37.5
Level 4, 5, 6	73.7	58.5	74.6	59.4
Level 3 or below	7.9	3.0	6.3	3.1
Highest qualification in maths				
Level 4–7	4.0	10.7	3.2	12.5
Level 3	15.8	20.0	19.1	15.6
Level 2 or below	80.2	69.3	77.7	71.9
Highest qualification in English				
Level 4–7	42.1	53.8	46.0	54.7
Level 3	19.7	33.9	19.1	28.1
Level 2 or below	38.2	12.3	34.9	17.2
Have a subject-specialist qualification in relevant subject	14.5	10.8 52.3 – have a certificate in ESOL (e.g. CELTA) 15.4 – have a diploma in ESOL (e.g. DELTA)	12.7	12.5 53.1 – have a certificate in ESOL (e.g. CELTA) 21.9 – have a diploma in ESOL (e.g. DELTA)
Have a generic teaching qualification (e.g. CertEd,PGCE)	65.8	61.5	69.8	56.3
Fully qualified to teach a relevant subject	17.1	6.2	15.9	4.7
Part qualified to teach a relevant subject	59.2	59.9	58.7	59.4
Unqualified to teach a relevant subject	23.7	33.9	25.4	35.9

Appendix B: Same models as Tables 4–7 in the main report but all estimated coefficients are reported.

Table B 1: Progress in numeracy (Table 4 in main report but with all variables reported)

	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*
Constant	6.732	4.118	6.288	8.419	4.716	5.119
	(4.874)	(4.897)	(4.992)	(5.292)	(5.427)	(5.363)
Pre-course test score	0.809***	0.792***	0.808***	0.800***	0.787***	0.784***
	(0.051)	(0.052)	(0.053)	(0.052)	(0.053)	(0.054)
Learners' characteristics						
Learner is male	1.216	1.563	1.284	1.239	1.506	1.253
	(1.128)	(1.124)	(1.145)	(1.151)	(1.147)	(1.162)
Age 20–29	1.196	1.431	1.213	1.098	1.386	1.684
	(1.475)	(1.464)	(1.502)	(1.486)	(1.479)	(1.496)
Age 30–39	2.690	3.038*	2.658	2.518	2.989*	2.327
	(1.713)	(1.701)	(1.743)	(1.731)	(1.727)	(1.734)
Age 40–49	0.604	1.005	0.590	0.495	1.004	1.083
	(1.918)	(1.902)	(1.933)	(1.930)	(1.924)	(1.907)
Age 50+	3.036*	3.425*	2.952	2.745	3.363*	3.216*
	(1.838)	(1.828)	(1.872)	(1.872)	(1.877)	(1.877)
First language English	1.095	0.880	1.130	1.238	0.953	0.459
	(1.840)	(1.824)	(1.860)	(1.854)	(1.844)	(1.825)
Has health problems	-0.388	-0.734	-0.419	-0.543	-0.794	-1.145
	(1.338)	(1.333)	(1.359)	(1.352)	(1.346)	(1.353)
Has dyslexia	-0.736	-0.666	-0.656	-0.684	-0.701	-0.287
	(1.479)	(1.464)	(1.492)	(1.490)	(1.478)	(1.481)
Teachers' characteristics						
Teacher is male	0.184	0.941	0.248	0.311	0.932	0.841
	(1.437)	(1.448)	(1.461)	(1.460)	(1.469)	(1.523)
White British	-3.208	-1.756	-3.063	-2.765	-1.570	-1.115
	(3.204)	(3.190)	(3.279)	(3.282)	(3.264)	(3.172)
Age	0.025	0.009	0.019	0.014	0.011	-0.034
	(0.064)	(0.063)	(0.067)	(0.067)	(0.066)	(0.073)
	0.693	0.890	0.781	0.835	0.871	0.640
Teachers' qualifications						
Highest level qualification – postgraduate degree, doctorate	1.244	1.121	1.230	0.927	0.885	0.388
	(1.395)	(1.370)	(1.497)	(1.523)	(1.505)	(1.567)
Qualification in maths – degree or postgraduate degree		3.562**			3.495**	3.119*
		(1.598)			(1.677)	(1.762)
Qualification in maths at Level 3 (A level)		3.275**			3.319**	4.280***
		(1.447)			(1.556)	(1.591)
Has a subject-specialist qualification in numeracy			0.074			
			(1.888)			
Has a generic teaching qualification (e.g. PGCE, CertEd)			0.763			
			(1.497)			
Reference category (fully qualified)						
Part qualified to teach numeracy				-1.325	-0.850	-0.879
				(2.085)	(2.079)	(2.046)
Unqualified to teach				-2.321	-0.596	0.638

numeracy				(2.377)	(2.442)	(2.547)
Teaching experience in numeracy (years)						0.215*
						(0.125)
Number of observations at Level 1 (learners)	237	237	237	237	237	225
Number of observations at Level 2 (teachers)	84	84	84	84	84	84
Intra-class correlation	11.8%	11.0%	12.8%	12.7%	11.9%	11.3%

Note: Dependent variable: achievement in numeracy after the course.
Standard errors (clustered by teacher) in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table B 2: Change in how maths is perceived (Table 5 in main report but with all variables reported)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Constant	7.741***	7.217***	7.636***	8.078***	7.301***	6.918***
	(1.195)	(1.177)	(1.218)	(1.258)	(1.262)	(1.224)
Pre-course attitudinal score	0.502***	0.508***	0.501***	0.499***	0.505***	0.519***
	(0.057)	(0.056)	(0.057)	(0.057)	(0.056)	(0.058)
Learners' characteristics						
Learner is male	0.117	0.185	0.100	0.095	0.163	-0.026
	(0.239)	(0.236)	(0.244)	(0.245)	(0.242)	(0.243)
Age 20–29	-0.002	0.040	-0.031	-0.028	0.031	0.152
	(0.313)	(0.309)	(0.317)	(0.315)	(0.312)	(0.313)
Age 30–39	-0.004	-0.018	-0.039	-0.032	-0.015	-0.077
	(0.374)	(0.370)	(0.380)	(0.377)	(0.375)	(0.373)
Age 40–49	-0.105	-0.084	-0.122	-0.128	-0.084	-0.090
	(0.412)	(0.405)	(0.415)	(0.414)	(0.409)	(0.399)
Age 50+	0.735*	0.683*	0.679*	0.666	0.679*	0.613
	(0.402)	(0.399)	(0.410)	(0.411)	(0.410)	(0.408)
First language English	-0.588	-0.734**	-0.562	-0.563	-0.721*	-0.632*
	(0.377)	(0.372)	(0.380)	(0.379)	(0.376)	(0.370)
Has health problems	0.535*	0.474	0.509*	0.505*	0.465	0.431
	(0.294)	(0.290)	(0.296)	(0.296)	(0.293)	(0.296)
Has dyslexia	-0.420	-0.353	-0.422	-0.428	-0.371	-0.331
	(0.324)	(0.321)	(0.327)	(0.327)	(0.324)	(0.325)
Teachers' characteristics						
Teacher is male	-0.727**	-0.528*	-0.709**	-0.711**	-0.532*	-0.526*
	(0.293)	(0.289)	(0.297)	(0.297)	(0.293)	(0.289)
White British	-0.989	-0.677	-0.902	-0.873	-0.637	-0.682
	(0.637)	(0.621)	(0.653)	(0.655)	(0.635)	(0.591)
Age	-0.008	-0.012	-0.009	-0.009	-0.011	0.006
	(0.013)	(0.013)	(0.014)	(0.014)	(0.013)	(0.014)
Teachers' qualifications						
Highest level qualification – postgraduate degree, doctorate	-0.193	-0.196	-0.278	-0.306	-0.258	-0.345
	(0.285)	(0.272)	(0.312)	(0.316)	(0.305)	(0.308)
Qualification in maths – degree or postgraduate degree		0.932***			0.929***	1.056***
		(0.324)			(0.343)	(0.337)
Qualification in maths at Level 3 (A level)		0.391			0.416	0.302
		(0.291)			(0.316)	(0.311)
Has a subject-specialist qualification in numeracy			0.265			
			(0.389)			
Has a generic teaching qualification (e.g. PGCE, CertEd)			0.098			
			(0.306)			
Reference category (fully qualified)						
Part qualified to teach numeracy				-0.366	-0.178	-0.379
				(0.423)	(0.413)	(0.390)
Unqualified to teach numeracy				-0.434	-0.062	-0.464
				(0.480)	(0.486)	(0.486)
Teaching experience in						-0.042*

numeracy (years)						(0.024)
Number of observations at Level 1 (learners)	220	220	220	220	220	209
Number of observations at Level 2 (teachers)	78	78	78	78	78	73
Intra-class correlation	9.2%	6.5%	9.9%	9.9%	7.2%	3.2%

Note: Dependent variable: attitudes after the course.
Robust standard errors (clustered by teacher) in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table B 3: Change in enjoying maths (Table 6 in main report but with all variables reported)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Constant	5.780***	5.494***	5.569***	6.296***	6.069***	6.299***
	(1.013)	(1.019)	(1.016)	(1.058)	(1.077)	(1.210)
Pre-course attitudinal score	0.638***	0.641***	0.632***	0.628***	0.634***	0.610***
	(0.057)	(0.057)	(0.058)	(0.057)	(0.057)	(0.061)
Learners' characteristics						
Learner is male	-0.039	-0.004	-0.030	-0.007	0.018	0.009
	(0.217)	(0.218)	(0.219)	(0.220)	(0.220)	(0.236)
Age 20–29	-0.151	-0.157	-0.181	-0.175	-0.196	-0.128
	(0.290)	(0.289)	(0.292)	(0.290)	(0.289)	(0.311)
Age 30–39	-0.241	-0.253	-0.303	-0.296	-0.332	-0.230
	(0.338)	(0.338)	(0.340)	(0.338)	(0.339)	(0.364)
Age 40–49	0.127	0.141	0.092	0.092	0.080	0.154
	(0.388)	(0.387)	(0.387)	(0.386)	(0.386)	(0.410)
Age 50+	0.430	0.406	0.329	0.329	0.279	0.414
	(0.376)	(0.376)	(0.378)	(0.378)	(0.380)	(0.408)
First language English	-0.932***	-1.025***	-0.899***	-0.904***	-0.998***	-0.951***
	(0.348)	(0.349)	(0.347)	(0.346)	(0.347)	(0.369)
Has health problems	0.438*	0.408	0.399	0.402	0.385	0.385
	(0.259)	(0.259)	(0.260)	(0.259)	(0.259)	(0.274)
Has dyslexia	-0.073	-0.053	-0.035	-0.031	-0.012	-0.011
	(0.288)	(0.288)	(0.289)	(0.289)	(0.289)	(0.301)
Teachers' characteristics						
Teacher is male	-0.704***	-0.598**	-0.670***	-0.660***	-0.584**	-0.639**
	(0.254)	(0.257)	(0.253)	(0.253)	(0.252)	(0.304)
White British	-0.744	-0.599	-0.605	-0.614	-0.552	-0.600
	(0.559)	(0.557)	(0.561)	(0.562)	(0.552)	(0.634)
Age	-0.021*	-0.021*	-0.025**	-0.026**	-0.025**	-0.025*
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.015)
Teachers' qualifications						
Highest level qualification – postgraduate degree, doctorate	-0.060	-0.061	-0.168	-0.143	-0.111	-0.098
	(0.242)	(0.237)	(0.264)	(0.268)	(0.262)	(0.315)
Qualification in maths – degree or postgraduate degree		0.500*			0.377	0.389
		(0.280)			(0.284)	(0.345)
Qualification in maths at Level 3 (A level)		0.110			-0.069	-0.044

		(0.252)			(0.264)	(0.319)
Has a subject-specialist qualification in numeracy			0.288 (0.325)			
Has a generic teaching qualification (e.g. PGCE, CertEd)			0.395 (0.262)			
Reference category (fully qualified)						
Part qualified to teach numeracy				-0.234 (0.353)	-0.153 (0.344)	-0.141 (0.405)
Unqualified to teach numeracy				-0.720* (0.405)	-0.661 (0.410)	-0.802 (0.509)
Teaching experience in numeracy (years)						-0.008 (0.025)
Number of observations at Level 1 (learners)	236	236	236	236	236	225
Number of observations at Level 2 (teachers)	83	83	83	83	83	78
Intra-class correlation	2.9%	1.7%	2.5%	2.5%	6.7%	9.6%

Note: Dependent variable: attitudes after the course.
Robust standard errors (clustered by teacher) in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table B 4: Change in self-confidence in maths (Table 7 in main report but with all variables reported)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Constant	3.789** (1.753)	4.405** (1.781)	4.046** (1.806)	3.547* (1.857)	4.340** (1.924)	4.857** (2.038)
Pre-course attitudinal score	0.573*** (0.055)	0.578*** (0.055)	0.577*** (0.055)	0.574*** (0.055)	0.580*** (0.055)	0.570*** (0.058)
Learners' characteristics						
Learner is male	-0.517 (0.400)	-0.568 (0.400)	-0.544 (0.407)	-0.580 (0.409)	-0.627 (0.409)	-0.597 (0.428)
Age 20–29	0.446 (0.501)	0.414 (0.501)	0.447 (0.508)	0.449 (0.505)	0.412 (0.506)	0.229 (0.528)
Age 30–39	0.243 (0.591)	0.247 (0.593)	0.254 (0.600)	0.266 (0.596)	0.263 (0.600)	0.059 (0.624)
Age 40–49	1.130* (0.662)	1.111* (0.662)	1.145* (0.667)	1.154* (0.666)	1.131* (0.669)	0.884 (0.686)
Age 50+	-0.326 (0.641)	-0.293 (0.646)	-0.222 (0.657)	-0.247 (0.656)	-0.256 (0.664)	-0.403 (0.688)
First language English	0.866 (0.605)	0.979 (0.606)	0.835 (0.610)	0.839 (0.608)	0.972 (0.612)	0.943 (0.628)
Has health problems	-0.859* (0.457)	-0.812* (0.456)	-0.817* (0.461)	-0.834* (0.460)	-0.820* (0.460)	-0.699 (0.476)
Has dyslexia	0.685 (0.521)	0.606 (0.520)	0.659 (0.523)	0.649 (0.522)	0.574 (0.523)	0.723 (0.537)
Teachers' characteristics						
Teacher is male	0.687 (0.473)	0.446 (0.486)	0.637 (0.486)	0.611 (0.485)	0.409 (0.496)	0.262 (0.552)
White British	1.257 (1.020)	0.877 (1.033)	1.151 (1.062)	1.197 (1.061)	0.953 (1.066)	0.930 (1.118)
Age	0.002 (0.021)	0.005 (0.021)	0.007 (0.022)	0.008 (0.022)	0.008 (0.022)	0.001 (0.026)
Teachers' qualifications						
Highest level qualification – postgraduate degree, doctorate	0.072 (0.456)	0.095 (0.453)	0.114 (0.505)	0.049 (0.510)	-0.008 (0.508)	0.010 (0.573)

Qualification in maths – degree or postgraduate degree		-1.023*			-0.970*	-1.144*
		(0.542)			(0.578)	(0.641)
Qualification in maths at Level 3 (A level)		-0.503			-0.366	-0.454
		(0.481)			(0.524)	(0.572)
Has a subject-specialist qualification in numeracy			-0.075			
			(0.631)			
Has a generic teaching qualification (e.g. PGCE, CertEd)			-0.552			
			(0.505)			
Reference category (fully qualified)						
Part qualified to teach numeracy				-0.109	-0.357	-0.330
				(0.684)	(0.696)	(0.738)
Unqualified to teach numeracy				0.585	0.173	0.529
				(0.778)	(0.815)	(0.916)
Teaching experience in numeracy (years)						0.018
						(0.046)
Number of observations at Level 1 (learners)	218	218	218	218	218	207
Number of observations at Level 2 (teachers)	79	79	79	79	79	74
Intra-class correlation	8.8%	8.3%	10.8%	10.6%	25%	13.8%

Note: Dependent variable: attitudes after the course.
Robust standard errors (clustered by teacher) in parentheses. *** p<0.01, ** p<0.05, * p<0.1.