Roles of Research in the Professional Development of Mathematics Teachers

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This paper reports on an empirical study which investigated ways in which research is presented in CPD initiatives and the impact research utilisation in professional development has on teachers. Data consisted of qualitative responses to on-line and electronic questionnaires, field notes of discussions and observations which were validated by the participants. Data was analysed using a process of constant comparison (grounded theory). The analysis offers descriptive categories for ways in which research is used in CPD and for effects research utilisation has on teachers. We conclude that using research is an effective means, although perhaps not the only one, for teachers to becoming aware of different perspectives about teaching and learning, to engage in deep thinking and to gain confidence in their thinking.

Keywords: research utilisation, professional development

Introduction

Hargreaves (1996) opened the annual lecture to the Teacher Training Agency in 1996 with the statement "Teaching is not at present a research-based profession" and he argued that teachers were not using research in their professional decision making as they considered research to offer little help with or give useful insights into the practical issues of the classroom.

There is a wealth of recent research on professional development for mathematics teachers. Joubert and Sutherland (2008) conducted a review of such literature including some 200 publications and categorised the literature in five sections: what is meant by CPD, complexity of professional knowledge; professional knowledge for teachers of mathematics; change and professional development; and important characteristics of 'effective' CPD. None, however, seemed to address research utilisation. In a broader context of education in general, there seems to be some although limited research about the use of research in the professional development of teachers. This is confirmed in the systemic literature review on the use of research to improve professional practice in education by Hemsley-Brown & Sharp (2003) who argue "while the subject of practitioners' use of research has attracted considerable debate, there is limited empirical evidence on this subject" (Hemsley-Brown & Sharp, 2003, p454). They considered Zeuli's work (1994) on how 13 US teachers use research findings as offering the most pertinent evidence based study. Zeuli suggests teachers only consider using research findings or find research credible when it matches their own personal experience in classroom practice. He therefore advocates more sustained opportunities to link findings from research with classroom practice. Rhine (1998) argues similarly when he explores the value of research for the development of teachers' knowledge base in professional development, referring to research-based professional development programs such as the American Cognitively Guided Instruction (CGI) and Integrating Mathematics Assessment (IMA). He also suggests that as research offers so much knowledge and

teachers can not retain, process and utilise this at one moment in time, research should be an available resource for teachers when they feel they need to and teachers should be offered professional development to help them accumulate that knowledge.

The study we report on in this paper was part of the Researching Effective CPD in Mathematics Education (RECME) project, a large research project funded by the National Centre for Excellence in the Teaching of Mathematics (NCETM) and explored factors of effective CPD for mathematics teachers. One of its five aims was to identify the different roles, if any, research plays in professional development undertakings. In this paper we aim to give further insights into these roles through descriptive categorisation of empirical evidence we obtained from researching 30 ongoing CPD initiatives.

The Study

The RECME project was a short term (15 months) project with a data collection period from January to July 2008. The non-interventionist project investigated 30 ongoing CPD initiatives representing different models of CPD for teachers of mathematics in England. Four of these initiatives did have some other involvement with the NCETM: one had received a grant, in two the NCETM was involved as one of several organisations supporting a network, and one concerned a network that was being led by the regional NCETM coordinator. However, no one of the RECME research team was involved in these NCETM activities. Overall, about 250 teachers in pre-primary, primary, secondary, further and adult education settings were involved in these initiatives. The project adopted the theoretical framework that all human activity, including the learning of teachers, is historically, socially, culturally and temporally situated (Vygotsky 1978). This suggests that the experiences and contexts of teachers will have a major influence on their learning and implies a need to pay attention not only to the situation, the opportunities and the context of sites of learning (in this case initiatives of professional development), but also to the individuals taking part in professional development. Importantly, the philosophical underpinning of the project was one of co-constructing meaning with teachers, researchers and other stakeholders. The data we obtained for the study we report on in this paper reflects this and contains self-reported data from teachers and CPD organisers. We are very aware that such data should be treated with caution, however we feel its use is appropriate here because we wanted to find out how participants to CPD were experiencing research utilisation. Details and descriptions of the full data set, the research design and case studies can be found in the final RECME report and other publications (NCETM 2009; De Geest *et al* 2008).

To find out the different roles of research in professional development for teachers of mathematics we addressed the following research questions:
1. What is the effect of 'research involved CPD' on teachers taking part in the PD?
2. In which ways is research presented and used by participants in the CPD initiatives?

Different data sets were used to address the two research questions. The study was conducted using a constant comparison approach from grounded theory with clearly defined analysis questions (mentioned later) looked at from a social constructivist theoretical perspective (Vygotsky 1978), i.e. what are the opportunities and the context of the initiatives of professional development and what are the experiences of the individuals taking part in professional development.

Data collected and analysed for the first research question consisted of qualitative answers to questions in the online questionnaire, which was completed by

92 of the teachers participating in the RECME project. It had one specific section related to research: "Are you aware of any research evidence underpinning any CPD which you have been involved in?" If yes, the follow-up question was asked: "You indicated that you are aware of research underpinning some of the CPD you have undertaken. We are interested in whether this influenced the way you felt about the CPD. Please explain here". Further data was found by searching for the word 'research' in all the qualitative responses to this questionnaire. The analysis question used in the constant comparison of this self-reported data was: "what change are teachers reporting as a result of working in a research based or research informed CPD initiative?"

Data collected and analysed for the second research question consisted of information supplied by the thirty organisers in electronic questionnaires, notes of discussions, and observation notes of the CPD meetings made by the research team which were sent back to the organisers and participants for validation and amendments. The analysis question used in the constant comparison was: "in what format(s) does 'research' present itself in the participating CPD initiatives?"

Findings

Overall, about three-quarters of the CPD initiatives (23) in the sample entailed some form of research in their set-up and running. We call this 'research–involved CPD'. About half of these 23 initiatives that involved some form of research also had HEI involvement. Of the 92 respondents to the on-line questionnaire precisely half stated that they were aware of research underpinning the CPD and offered insights in how this had influenced the way they felt about the CPD. We will first report on our findings regarding the effect of research-involved CPD on teachers. Then we will consider in which ways research was presented and used by participants in these CPD initiatives.

The effect of 'research involved CPD' on teachers

As a result of taking part in a research-involved CPD initiative, teachers reported changes in various ways relating to their classroom practice, their further professional life and their knowledge development. In particular, using research seemed to offer teachers effective means of becoming aware of different perspectives about teaching and learning, to engage in deep thinking, to gain confidence about their own thinking, to trust the validity of the ideas offered and to have thus the courage to try out these ideas on the classroom, and to give status and credibility to the CPD initiative itself and to the teacher. We expand on these descriptive categories in more detail:

Raised awareness
Teachers reported raised awareness about research, current thinking and information on existing practice is 'out there' relating to teaching and learning which can also be of use in the classroom. For example:

> I am taking part in a Masters in Maths Education and it has made me realise what a wealth of research there is to read and use in teaching.

> I liked knowing that I am aware of current thinking, research and best practice.

> I have taught for 21 years and have become a far better teacher in the last few and am only now becoming more aware of what is going on out there [as a result of using research]!

Stimulate thinking about teaching and learning

Teachers reported feeling stimulated in their thinking about teaching and learning, feeling stimulated to research their own practice and to engage with research literature as a result of the research-involved aspect of their PD. For example:

> "It's like a zoom lens that is based around everyday practice and involves observations and recording that I would do in any case. It has stimulated my own thoughts re practice and introduced me to academic research I might not otherwise have accessed. It has stimulated thinking and debate amongst us three participants in the research"

> "I have read about how Chinese teachers are taught how to enable children to learn mathematics, particularly with regard to ensuring that their own subject knowledge is sufficiently developed to enable them to explain concepts correctly. This has caused me to question my own subject knowledge and develop it further in the context of enabling me to teach maths more effectively"

> "The National Strategies made very explicit some of their source materials. I like this. There's an integrity about it and it also invites challenge and different viewpoints. To simply be told a way of doing something without acknowledging the source feels patronising. I like it when people expect me - and trust me - to think"

Affirm and/or develop the professional self

The teachers reported how the research aspect of their CPD affirmed their perceptions of their professional self: how they think about and evaluate themselves as teachers, leading to confidence in their professional self. They also reported how working on their existing interests and understanding led to a deepening development of their professional self which felt satisfying. For example:

> "The research validated what I already knew and therefore gave me increased confidence to use new techniques, for example Swan"

> "I found [some previous CPD that used research] so fulfilling, leading to me doing some class based research into self esteem. This was definitely a high in my professional career and I was asked to write part of a national strategy as a result of this work"

> "It has made me research an area of the curriculum about which I am strangely passionate, reflect on my own understanding and practice, collect and collate evidence and share this with fellow maths enthusiast within my school and the group"

Confidence to act

Teachers reported that knowing that the CPD they were undertaking was underpinned by evidence from research made them feel confident to act: to take further part in CPD and to apply research ideas to their practice as it has been shown to 'work'. For example:

> "I feel much more motivated by CPD that is underpinned by research as I know that people have really tried things out with children rather than made something up and hoped for the best!"

> "XXX [name of project] project provided the evidence that Collaborative practice was the way forward in improving mathematics teaching - gave me and the other teachers confidence"

> "Having research that underpins the CPD that we are doing shows us that there are already results which will prove that what were doing is likely to benefit both teachers and pupils"

Gain status and credibility

Teachers reported that research-involved CPD gives credibility and status to the CPD initiative itself and to the teacher's professional thinking and activities. For example:

> "I think it gives the programme more status it isn't just a maths club it is something important"

> "It adds more credibility to what you are learning"

> "It makes me feel that I can justify my interest in the approach to those above me in the line management structure"

What surprised us in this study was the lack of negative responses to research utilisation by the teachers– only one response contained a negative element and mentioned not finding it easy to read papers. Perhaps a question such as 'what do you consider barriers to engaging with research evidence in your professional development' would have given more insights into negative aspects of research utilisation.

'Research–involved CPD'

This section reports descriptive categories of how research presented itself to the participants of the CPD in the 30 professional development initiatives that were part of the RECME project. Our analysis suggests five descriptive categories: reading research literature; using resources that have been developed based on research; research-inspired CPD; being part of a research project; doing research as CPD and research-informed CPD which we will discuss next in more detail. These categories are not mutually exclusive and indeed in several initiatives a combination of these were present.

Reading research literature

This refers to participants reading specific research literature. This literature can be in the form of published research papers for example Hallam & Ireson (2006); summaries of learning theories compiled by organisers of the CPD who have a background of working in HEIs, for example on Piaget (J. Piaget 1950, 1953; J. Piaget & Szeminska 1952); summaries from other documents, for example from Swan (Swan 2006, 2005); chapters from books or short publications, for example Black *et al*. (2002). The literature tended to be selected by the organisers of the CPD who had more (expert) knowledge of existing research than the other participants. The data indicated that in most cases the selected literature was of immediate and clear relevance to issues worked on in the CPD initiative and was often chosen as a result of issues raised, or interests declared in certain topics by the participants. In a few cases the readings included also non mathematics-teaching research, such as research methods and other more academic research. Although this was not therefore 'directly relevant' to issues raised by the participants, organisers of the CPD considered this relevant to the aims of the CPD initiative, for example the reading of research methodology was part of a masters course and thus required by university standards and regulations. 'Reading' varied from reading literature as 'gap'[1] task between

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[1] 'gap' tasks are activities that the teachers were asked to engage with between their CPD sessions. These gap tasks might involve trying out an activity with students in their classrooms, looking at students' work or reading something related to the CPD, such as in this instance, a research article.

sessions to reading in meetings, discussing and interpreting the text, and discussing how it applied to practice.

Using resources that have been developed based on research

These are resources that have been developed as part of research into pedagogies and didactics related to the learning and teaching of mathematics and/or have been refined and evaluated as being effective learning resources through a research process. Examples of these resources and the research they are based on are an 'active' learning approach (Swan 2006), Realistic Mathematics Education originating from the Freudenthal Institute in The Netherlands (Van Den Heuvel-Panhuizen 2003).

Research inspired CPD

These are instances where research findings and literature are used implicitly rather than explicitly. Often these concern theories about 'ways of working', such as learning collaboratively, without making explicit reference to which research or publications it was based on. An example is when the organiser of the CPD, who might have in-depth knowledge of the research that inspired the CPD, plans the CPD activities by building on that research but without exploring the research itself with the other participants of the CPD. At other times ideas from research papers were used as a starting point, as a vehicle for triggering discussion, exploration, reflection and experimentation. Although the findings of the research could be mentioned, it does not involve the reading of papers by all participants. In these cases the original meaning of the research and its findings might get re-constructed.

Being part of a research project

Three of the initiatives involved teachers taking part in research projects. One was an action-research project funded by an outside organisation and led by an HEI which offered optional accreditation towards a Masters degree. The research project focused on teachers evaluating the introducing of an ICT resource on their teaching practices and students' learning. The second research project consisted of being part of a doctoral research study. In this case, the doctoral researcher who was also the organiser of the CPD worked collaboratively with the teachers who are acting as research assistants. The third case concerned a two-year Master's in mathematics education course that at the same time was a research project. The project researched teachers' professional and personal development while undertaking postgraduate research study with teachers acting as co-researchers.

Doing research as CPD

We could identify clearly eight initiatives where teachers were given the opportunity to develop professionally by doing research. In these instances doing research was part of the organisation and planning of the initiative in that they led or could lead to accreditation towards a Master's degree which required the candidates to conduct their own research projects. Three were part of a Master's degree, five were potentially so in that the teachers could opt for masters level accreditation. There also was one initiative that was without accreditation but part of a research project and involved the teachers as active co-researchers (this initiative is also described in the category 'being part of a research project). Although other initiatives included, to different extents, trying out new ideas and reflecting on professional activities we did not include these in this category of 'doing research as CPD' because we could not ascertain these activities were systematic.

Conclusion and limitations of this study

We found that three quarters of the CPD initiatives which were researched as part of the RECME project entailed some form of research in their set-up and running, offering a different picture to the one Hargreaves reported on in 1996 of little research utilisation in the teaching profession and professional development. This could indicate that professional development provision has changed since the mid 1990s and research now has entered its discourse. We found that the use of research in CPD does not present itself in one format, but that there are wide-ranging ways. Our analysis suggests five descriptive categories. Interestingly, only half of the initiatives that involved some form of research also had HEI involvement, suggesting research is also considered useable and relevant by those who are not part of the research community which tends to be based at HEIs.

Contrary to observations from the mid 1990s (Hargreaves 1996) teachers in this study considered the use of research to be helpful in ways that relate to their classroom practice, their further professional life and their knowledge development which could be because in all cases in this study research was used from a practical point of view, confirming research findings from Zeuli (1994) and Rhine (1998). The analysis suggests that in the CPD initiatives that involved a research aspect, the teachers were asked to think and reflect about the research that was presented in the CPD and were as such cognising and reflective agents (Brown and Burko, 1992 reported in Cooney, 1994). Teachers evaluated such opportunity to think and reflect positively. Of course, these findings do not mean that similar effects could not be achieved in other ways than through research utilisation. However, we suggest that using research is an effective means, although perhaps not the only one, for teachers to becoming aware of different perspectives about teaching and learning, to engage in deep thinking, and to gain confidence in their thinking.

Our analysis flagged up four major issues for discussion:

- We found that at times the original meaning of the research and its findings may have been reconstructed, interpreted or 'watered down' without the original text being studied by all the participating teachers. Although such interpreted research was still used as a starting point or vehicle for exploring of and reflecting on issues in the classrooms, it raises the question to which extent this can still be considered as the use of research, and how the reconstructing of research findings affects the teachers' knowledge base.
- We identified effects of the use of research in CPD as reported by teachers. The question remains to which extent these differ from CPD that does not involve research aspects.
- The study did not identify barriers to engage with research utilisation in professional development. What are these and can they be overcome?
- What is meant by 'doing research'? For example, when does trying out new ideas in the classroom, reflecting on the effects of the changes become research? What are the boundaries between reflective practice and doing 'research'?

Acknowledgements

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