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"I remember the whole board being full of different calculations and trying to make some sense of it."

The influence of significant moments in adult numeracy teachers' own learning experiences on their teaching practice.

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Abstract

In researching how adult numeracy teachers actively motivate and enable learners to apply the numeracy skills they learn to their own real life practices, a case study of two adult numeracy teachers and their learner groups was undertaken. This paper compares the teachers' contrasting personal experiences of mathematics learning to consider how significant moments in their own learning experiences may have influenced their beliefs about, and approaches to, their adult numeracy teaching practice. Similarities and differences between teachers' approaches are explored and compared, to conclude that teachers' learning experiences greatly influenced their beliefs and teaching practices.

Key words: mathematics; numeracy; learning; experience; teaching; practice

Introduction

The transfer of mathematics skills from classroom to real life contexts is both complex and problematic (Kanes, 2002; Kelly, 2011; Nunes & Lave, 1988; Schliemann & Carraher, 1993), but that is what teachers of Functional Mathematics⁹, in the UK, are required to facilitate in order to "help people to gain the most out of life, learning and work" (Qualifications & Curriculum Authority, 2007, p.3). When researching the specific ways in which adult numeracy teachers actively motivate and help learners to apply the numeracy skills they learn to their own real life practices, a case study of two adult numeracy teachers and their learner groups was undertaken. Prior to the research both teachers had successfully completed their specialist teaching qualification, the Numeracy Diploma in Teaching in the Lifelong Learning Sector, with me, the researcher, as their tutor, on a part-time basis over two years. The data identified both similarities and differences in teachers' practices and approaches. Having asked the teachers about their own mathematics learning experiences, I became curious about the ways in which their previous experiences may have shaped their numeracy teaching practices, and that is the focus of this research paper.

⁹ Functional Mathematics is a qualification available in compulsory and non-compulsory education in the UK, which is designed, for learners to acquire skills, which enable them to apply mathematical skills in work and life situations.

Research identifies beliefs, contexts, thought processes and development programmes as influences on teachers practices, suggesting that teachers' own learning experiences are just one factor in shaping their teaching approaches. Ernest (1994) suggests the practice of teaching mathematics depends primarily on the teacher's system of beliefs about mathematics and mathematics' learning and teaching, the constraints and opportunities provided by the social context of the teaching situation, and the teacher's reflection and level of thought processes, including their ability to reconcile their practice with their beliefs. The social context includes the adopted curriculum and assessment systems as well as learners', peers', and managers' expectations, and these factors can be highly influential in affecting a teacher's approaches in the classroom. The teacher's level of consciousness of his or her own beliefs about and approaches to mathematics, and the learning and teaching of mathematics, is also important; Ernest (1989) suggests that having an awareness of what the alternative beliefs and approaches might be, as well as the teacher's ability to "reconcile and integrate classroom practices with beliefs" (p.253), are key to determining a teacher's practice.

Swan and Swain (2010) used a teacher development programme and resources, which became available nationally as Thinking Through Mathematics (Swan & Wall, 2007), to challenge and change adult teachers' beliefs and teaching practices. The programme's aims were to engage teachers in using challenging and 'connected' approaches in which students were more collaborative and active in their learning, focussing on activities which enabled learners to develop their conceptual understanding. Some teachers on the programme reported that pressures from management hindered their use of the approaches, which supports Ernest's (1994) suggestions about the influence of the social context. Overall, the teachers developed a more connectionist orientation, moving away from transmission and discovery views of teaching and learning mathematics. Swan and Swain (2010) concluded that changes in teachers' beliefs were instigated by the changes in practice which teachers tried out, discussed and reflected upon.

The approaches and activities promoted within Swan's Thinking Through Mathematics resources were modelled by the tutor/researcher on the case study teachers' qualification courses, and the teachers were actively encouraged to try out the activities in their own practice, and to reflect on their effectiveness. In addition a social practice approach was also promoted, and teachers were encouraged to take account of their learners' real-life uses of numeracy, and to use authentic materials (Appleby & Barton, 2008) to help learners make links between the concepts they were learning and their potential application outside of the classroom. Therefore, during their courses, their tutor challenged and may have influenced the two case study teachers' beliefs about numeracy and about numeracy teaching and learning.

But, how were their beliefs formed in the first place? Who else shaped their ideas and beliefs about numeracy and about numeracy teaching and learning? What other experiences may have helped determine the kind of teacher they have become? These are some of the questions that arose during the data analysis stage of the primary study.

The following section considers a range of researchers' views about what, in a person's background and experiences, affects their beliefs and practices as teachers. Then, the research methodology is outlined before the findings are presented in terms of teachers' experiences and their methods and approaches. Finally the findings are analysed to draw conclusions about the way in which personal learning experiences influence teachers' practice.

The effect of teachers' backgrounds on their teaching practice: a literature review

Guillaume and Kirtman (2010) undertook a study of 144 pre-service elementary (primary) teachers in the USA, to investigate how previous mathematics “experiences contribute to teachers’ images of themselves as teachers and notions of what it means to teach well” (p.121). The authors point out that mostly, “teachers are products of the school systems that they pass through as students and re-enter as professionals” (p.124) and that both school and non-school experiences influence the beliefs and values they have. The research showed that most of the trainees’ stories identified both “powerfully positive” and “poignantly negative” (p.128) peaks and troughs in their self-reported performance levels in, and attitudes towards, mathematics over time. The peaks and troughs were often linked to participants’ reactions to: particularly powerful teachers, specific content, or by significant experiences such as examinations or phases in their own social or emotional development. A subset of the respondents received messages, whether intended or unintended, about their own intelligence and ability (or lack of it) to do mathematics. Ninety-eight (68%) of the participants identified the power that a teacher had on their self-esteem and their outlook on mathematics. Of these, 73 (around half the total sample) identified that a teacher had changed their views of mathematics in a way which had a long lasting effects. Guillaume and Kirtman (2010) suggest that because out-of-school experiences (for their participants) were limited in mathematics, the role of teachers in shaping students’ attitudes towards mathematics, and their ability to learn it, was particularly prominent.

Williams (2011) also considers teachers’ experiences of learning throughout their schooling, as well as the influence that other teachers may have had on their teaching approaches, as trainees and as qualified teachers. Both the teachers Williams researched worked as ‘A’ Level¹⁰ mathematics teachers in sixth form colleges, and were recommended as highly successful teachers.

In Williams’ research, John (pseudonym for a participant), focusses primarily on “finishing the syllabus and getting the grades” (2011, p.133). His lessons focus on presenting the mathematics and examples followed by learners practising questions, giving one-to-one support as well as further group explanations where necessary. In addition, John supports struggling students on a one-to-one basis outside the classroom. Williams’ findings are that John’s beliefs about learning and teaching are significantly shaped by his experiences as a learner. For example, a personal tutor helped John to realise that with practice he could master the procedures involved (p.134); and his own A-level (Mechanics) teacher, who had a very traditional approach, inspired him. At university John became unable to understand much of the mathematics he was taught and instead explains that he learnt by “tricks” (p.135). Williams discovered that although during his career John spent some time being a more innovative teacher, focussing on implementing approaches encouraged by his teacher education course, over time his focus reverted to a more traditional approach, influenced by both his social context and by his personal role models or “heroes” as Williams calls them.

Sally (pseudonym of another participant in Williams, 2011) focusses primarily on conceptual development. Her lessons involve “group work, problem-solving and discussion as well as whole-class activity where group work is communicated” (2011, p133). Sally explained that when she was a learner, she would take home her notes from lessons taught by rote, to work on until she was able to make sense of the ideas herself. Her experiences as a private tutor helped her understand how essential self-confidence and self-belief are to enable learners to think things out for themselves. As a sixth form teacher she went back to her working class roots to offer herself as something of a role model to her learners: someone who can achieve success despite their low socio-economic background. Williams’ (2011) findings are that Sally, too, draws powerfully on her own learning experiences, and also that both teachers teach in a way that would support their own approaches to

¹⁰ Advanced Level (‘A’ Level) qualifications follow compulsory schooling in the UK, and prepare learners to go onto further academic study (e.g. university degrees).

learning as learners of mathematics themselves. Williams explains: “the stories crucially figure learners-in-general as being like the learners they used to be” (p.140). Sally does not draw much on her own teachers’ styles; the few teacher experiences she does draw on shows them as “anti-heroes” (Williams, 2011) i.e., figures she does not wish to emulate.

Amin (2012) explores the stories of three mathematics teachers’ experiences of their own mathematics learning in South Africa, where they grew up “in the shadows of apartheid” (p.2), subject to socio-political and racial adversity, and economic deprivation, resulting in limited access to education and career choices. Amin explores their memories of their own education and the significant others that helped them achieve success in mathematics, and also explores their own approaches to teaching.

In her research, Amin analyses the stories of one male and two female teachers. Aziz, male, had a father who pointed out the mathematics in the everyday things around them. For example, whilst shopping they had to calculate the sales tax on items, and he would explain “how mathematics was used in the construction of roads and buildings” (2012, p.5). Aziz explains that due to his father’s teaching, rather than his school teachers’ lessons, he sailed through mathematics at school. He now sees parents rather than teachers as those who most affect the outcome of the children he teaches, and Amin suggests that as a result of this, Aziz “resisted the role of inspiring, creative teacher” (p.7), instead teaching “vague and abstract” mathematics (p.6). In the absence of parental involvement, he does not have high expectations for his learners.

Sindiswe, one of the female teachers in Amin’s (2012) research, was taught by a teacher who “spoke a lot about Pythagoras” (p.4) but never told his learners what made Pythagoras such a great mathematician. He told the learners that only he (the teacher) knew about mathematics and that they “were too stupid to do mathematics” (p.4). Sindiswe recounts: “I believed him, for a while” (p.4). However a change of job for her father meant the family moved to another city and Sindiswe went to a new school where she was able to learn mathematics and be successful in her examinations. Therefore Sindiswe experienced both poor and good teaching and, perhaps as a result of this, sees the role of the teacher as crucial to learner success.

Nisha, the second female teacher in Amin’s (2012) research, explained that she was, overall, a very good learner, but weak in mathematics because of the “unkind and very unsocial” (p5) maths teachers she had: one who spent much time focussing on just writing numbers, another “killed [them] with mental tests” (p.5), stressing the importance of speed, and another was unable to explain how he solved the problems he gave them. At the interview, Nisha reflects that she is probably trying to be the kind of teacher that her own teachers were not (i.e., she spends time explaining things and she tries to make maths fun so that she is not a bad maths teacher herself). Nisha was a self-reliant and independent learner (2012); she explains that she basically taught herself, and as a result of this, she, unlike her own teachers, wants “to make it work for kids” (p.5).

Skovsmose (2012), on whom Amin (2012) draws, suggests that whilst social, economic, political and cultural factors influence a person, the “person’s experiences and interpretations of possibilities, tendencies, propensities, obstructions, barriers, hindrances” (p.2) also shapes their ever-developing “foreground”. I interpret Skovmose’s concept of a person’s foreground to mean someone’s self-perceived opportunities or potential. Skovsmose explains that both external and subjective factors shape a person’s foreground. I suggest that those subjective factors might be a mixture of both cognitive and affective responses, and it is these which define a person’s perceptions. Skovsmose proposes that the construction of meaning may be supported by creating classroom activities which relate to scenarios relevant to learners’ backgrounds, but that showing an active interest in a student is more powerful in helping establish meaningfulness.

Skovsmose explores the idea of “ruined foregrounds” (p.5) where a lack of social and economic resources, and stereo-typing, crush the opportunity of a person reaching their aspirations. In terms of a learning situation it could simply be something that appears unattainable to a learner or to a group of learners, and Skovsmose (2012) suggests that such a “ruined foreground[s] can be the most direct cause of failure in school” (p6).

Wedge explores Bourdieu’s concept of habitus, which she describes as “a system of dispositions which allow the individual to act, think and orient him or herself in the social world” (1999, p211). Skovmose’s concept of ‘foreground’ has some resemblance to this. Wedge points out that the system of dispositions that Bourdieu explores are durable (Bourdieu, 1980 – translated by R. Nice, 1990 – as cited in Wedge, 1999), so although they are strong, they can nonetheless be changed, i.e. they are not permanent. Skovsmose’s concept of foreground is that of an ever-developing perception of one’s own potential, i.e. something that is changeable, although at times potentially quite impenetrable. Therefore, this suggests that teachers’ beliefs, although strong, can change; Guillame and Kirtman (2010), and Williams (2011) suggest that other teachers can effect such change.

The literature described above suggest that teachers’ beliefs, social teaching contexts, and level of thought processes all influence a teacher’s practice. Teachers’ own experiences of the school system, as learners, and in identifying teaching approaches, are thought to help shape their beliefs about teaching and learning. Research also suggests that use of alternative teaching approaches, through development programmes, can influence a change in teaching beliefs and approaches. These ideas were drawn upon when trying to analyse and interpret whether, in the case study data, there appeared to be any connections between teachers’ learning experiences and their teaching approaches. The methodology is outlined below before the findings and analysis are discussed.

Methodology and Methods

A collective case study of two adult numeracy teachers from the further education sector was undertaken, as part of a wider MA study. The two teachers (Anne and Katie) were selected by purposive sampling (Cohen, Manion & Morrison, 2011), i.e., they were specifically chosen because I had previously observed them actively seeking to make links between mathematical concepts and real-life contexts in which the mathematics could be used. Having obtained ethics approval from Anglia Ruskin University, permission from the participants’ learning organisations, and informed consent from the two teachers and their learners, data were collected from discrete numeracy classes in two different Adult and Community Learning settings during May-June 2012. One learner group was working towards an adult numeracy qualification, the other was a family learning group, there to learn how to support their children’s mathematics learning.

Semi-structured interviews were held with each teacher to discuss their backgrounds, aims and methods; these were audio-recorded then fully transcribed for the purpose of analysis. The use of open questions (e.g., ‘what was your own experience of learning maths at school?’) helped maximize data integrity. For each teacher, two two-hour observations of their teaching were carried out, to observe the methods teachers use to help learners make links between their numeracy learning and the use of numeracy outside the classroom. The purpose of carrying out the observations was to enable me to verify what teachers said they did at the interview stage (Robson, 2011), and to capture approaches that may not have been voiced. Field notes were made during the observation to record non-audio information and audio-recordings were made using a digital recorder. Relevant parts of the audio recordings were transcribed for the purpose of analysis, and integrated with the field notes.

During analysis of the primary study I was interested to note that the teachers’ own experiences of learning mathematics contrasted, and therefore for this paper I used the data I had already collected to investigate this further. As identified in the Introduction, questions which arose were: How were the

teachers' beliefs formed in the first place? Who else shaped their ideas and beliefs about numeracy and about numeracy teaching and learning? What other experiences may have helped determine the kind of teacher they have become? The interviews did not explore the teachers' personal backgrounds (e.g., how their beliefs about mathematics and their views of themselves as learners may have been influenced by their own parental role models, and their childhood and adult experiences outside of school), therefore the first question remains outside the scope of this paper. Given the available data, the focus was to investigate how previous mathematics teachers and mathematics and numeracy learning experiences may have shaped these teachers' beliefs and practices. The findings of the research are intended to contribute to the work of teacher educators and teachers in considering the development of teaching practice.

A thematic coding approach was used as the basis for analysing the transcribed interviews and observation notes, to identify themes arising (Robson, 2011). To identify the types of activities used in practice, some pre-determined codes were identified at the outset, informed by a review of the literature (e.g. Kelly, 2011) and prior experience, but these were amended and other codes arose during data analysis. Corbin and Strauss (2008, p66) liken the process of coding data to “‘mining’ the data, digging beneath the surface to discover the hidden treasures contained within data.” This approach was essential in minimising researcher bias and in seeking to represent the data as truly as possible. The types of teaching and learning activities were categorized according to how ‘abstract’ they were, i.e., devoid of any non-mathematical context, and, at the other extreme, how ‘situated’ they were, i.e., immersed in a real-life context. Categories that sat between these two extremes were also identified during coding and analysis, e.g., ‘Quasi’ methods, which include the kinds of mathematical word problems which are included in mathematics and numeracy textbooks, worksheets and test/exam questions, but which commonly bear little resemblance to real life (Dowling, 1998). The number of occurrences of different types of activities that were either observed or outlined by teachers during their interviews was used to establish the extent to which the two teachers used similar or different types of activities. The order in which different types of activities were sequenced, during classes, was also analysed.

Having gained a picture of the similarities and differences between teachers' approaches, instances where teachers had talked about their own mathematics learning experiences were analysed to identify themes and connections arising from these memories, which might inform teachers' beliefs, and possibly their practices. These instances were considered alongside those where they talked about their learners, again helping to discover their underlying beliefs. Having identified very contrasting personal learning experiences, I analysed the possible relationship between teachers' learning experiences and their respective teaching approaches, as arising from the data, then turned to the literature to support further analysis of this.

The next sections outline the findings, starting with teachers own learning experiences, then considering their teaching approaches, before moving onto analysis of possible relationships between them.

Teachers' experiences of learning mathematics

Anne

Anne is a numeracy tutor in an adult community college, working on a sessional basis, and she supports family learning classes in the community as well as general adult Functional Mathematics classes in her college. Anne left school at sixteen with qualifications which include CSE¹¹

¹¹ The Certificate of Secondary Education (CSE) was, prior to 1988, a qualification available for those learners in compulsory education who were not deemed sufficiently academic to achieve the alternative 'O' Level qualifications.

Arithmetic, to work in the investment banking sector in London. During her parental career break she gained a GCSE¹² in Mathematics and an AS¹³ level in English Literature, before achieving her teaching qualification, and is currently undertaking an MA¹⁴ in Education.

Anne found her experiences of learning mathematics at school largely abstract, explaining: “I don’t ever remember it being anything to do with...everyday life. I can only ever remember chalk and talk type approach – on the board and then you do it”. She recalls a mental image of one of her teachers:

She was going through multiplication...the column method...through the rules of this is how you do it. I remember, kind of, the whole board being full of different calculations and trying to make some sense of it. That’s...my real memory of maths at school.

This negative memory of the impenetrable wall of abstract algorithms is an important one for Anne.

Anne says she “lagged behind” at primary school and she specifically remembers feeling “quite worthless”, explaining: “I remember actually sitting there thinking I really don’t get it, I really don’t get it, but I can’t put my hand up...”. This compared to a more positive experience in secondary school, where for the first three years she explains: “I had quite a good teacher, and I quite enjoyed it, and even though it was quite abstract, she was kind of gentle, and it was a different approach”. However, as a rebelling teenager, other factors affected her learning and ultimately she was entered for a CSE rather than an ‘O’ Level¹⁵ exam. Her school explained to her that “because [she] wasn’t clever enough in maths, [she] had to take arithmetic...” (p2); Anne feels she could have done better. As an adult learner she became a much more independent learner, seeking information from books and websites in addition to her teachers.

Anne expanded on the idea of feeling quite worthless:

...that feeling of not being good enough. You’re not good enough for that set, or you’re not good enough for that level...It’s not a positive message about learning in general because I think it does go to other things. People think if you’re good at maths then you’re good at everything, don’t they?

Here Anne is drawing on the idea of maths as a signifier of intelligence, suggesting that because she wasn’t very good at maths, people (including her teachers and perhaps herself) thought she wasn’t very clever generally. Her words also suggest that being told she wasn’t good enough in maths shaped her beliefs about herself more generally. In her role as a parent she supports her children with their learning to try to ensure they do not experience the same negative feelings.

Katie

Katie is a numeracy tutor in an adult community college, supporting adult Functional Mathematics groups within her college, working on a sessional basis. She stayed on at school to take Physics, Chemistry, Mathematics and Further Mathematics at A level, before achieving a BA¹⁶ in Engineering from the University of Cambridge. Following graduation she became a management consultant and then had several management roles in a large international company. Following a parental career break, she achieved her teaching qualification.

¹² General Certificate of Secondary Education (GCSE). GCSEs are currently the most common form of qualification available in compulsory schooling. They replaced the CSE and ‘O’ Level qualifications.

¹³ AS Level qualifications form the first half of an Advanced Level (‘A’ Level) qualification. These are academic qualifications aimed at 16-19 year olds to prepare them for university. (They follow on from GCSEs).

¹⁴ Master of Arts degree

¹⁵ The Ordinary Level (‘O’ Level) was, prior to 1988, an academic qualification available to learners in compulsory education which prepared them to go onto further study.

¹⁶ Bachelor of Arts degree

Katie's overriding memory of school mathematics was also that it was largely abstract: "I remember learning rules and routines, with very little application to real life", with the possible exception of primary school where she remembers: "doing basic measurement and things like that". She describes her later experience of Further Mathematics as "horrendously abstract", explaining: "I actually knew that I was having difficulty, thinking how on earth can this be used in real life?". Nonetheless, Katie's qualification choices and successes suggest that she was very good at mathematics throughout her schooling, and that she had few problems learning it.

A particularly memorable event for Katie was her entry test for university. She explains:

I can remember very specifically one question; it was about working out moments and momentum, and we'd done that in a purely abstract fashion, and the question was if you twiddled a Rubik's cube into different shapes and formats how that changed it...It was a real, real challenge to actually apply it to a real object that you were familiar with.

During her engineering degree, which started to "put things in a practical context", this difficulty continued. She explains:

I actually found it very difficult to link the kind of pure mathematics with an actual application. It's not that I couldn't see the purpose of it, but I actually found doing the maths was hard in that context...it was difficult to see why that bit of maths was the relevant maths to use.

Katie found her mathematics knowledge useful to her in many of her jobs, including as a management consultant, where she was required to analyse company accounts and project present value into the future along with other types of modelling. In a later job, as a Marketing Manager for a multinational organisation, she was required to undertake market research and explains that she "had to learn maths on the job to be able to do that" as she had not previously studied statistics. She describes this as "a very practical application of maths, in order to make very expensive decisions based on the analysis".

Teachers' methods and approaches: findings

Similarities and differences: methods

Two types of activities stood out as being the most commonly used by both teachers. The most common was where teachers and/or learners made links between real-life contexts and the mathematics they were exploring in the classroom, through discussion. The next was where the focus was on the abstract, either the numbers themselves, or on the underlying patterns, relationships and concepts.

The third most frequent category differed between the two teachers. Katie used 'Quasi' methods, which include the kinds of mathematical word problems which are included in mathematics and numeracy textbooks, worksheets and test/exam questions, but which commonly bear little resemblance to real life (Dowling, 1998). In contrast, 'Situated' methods was the next category in Anne's practice, where learners and/or teachers provided examples of their actual uses of mathematics within a real life context, e.g. a learner, who is a care worker, unable to check her pay-slip because it was presented to her in hours and decimals of hours rather than in hours and minutes.

The sequences of activities observed in the classroom and discussed at interview were also analysed to identify any patterns emerging from the order of different types of activities. What emerged from this analysis was that the teachers have converse approaches to teaching overall. In general, Anne tends to start with real life contexts, using these to identify the maths within, and then addresses the mathematics identified using more abstract activities. In contrast, Katie generally starts

with more abstract concepts and calculations and then makes the links between these concepts and real life contexts.

Approaches: Anne

Themed analysis of the interview data provided a deeper exploration of these differences. Anne always starts with what her learners know, explaining “I don’t see that I can make any connections if I don’t do that”, regularly getting learners to produce mind maps to pool their knowledge. Her approach is for the learning to come from the learners, rather than her, or from text books. She avoids “being autocratic”, and explained her dismay when one of her volunteers ‘took over’ an activity that a group of students were doing, saying: “before I know it, he’s writing different fractions on the board and it’s really busy, and I didn’t even want to write a fraction – I wanted them to write the fraction!”. She explained that this incident upset a student as well as herself.

Her drive is to help learners to feel good about themselves and their ability to learn mathematics. She takes time to value her learners: “Each week without fail I always make sure I share what students are doing, to look at different approaches, to praise the diversity of what students bring in”. She articulates: “it’s about how they [learners] feel about themselves...about their own self concept...that’s what I feel”, and later she draws on this idea again, relating it to her own experiences, saying: “It’s about what’s inside and how you feel about yourself”.

Anne discussed the importance of being learner focussed, and identifying contexts that are relevant to all learners. She identified that each learner has different numeracy needs and contexts, e.g. one learner needs to understand her wage statement, others wish to learn the mathematics they couldn’t master at school so they can help their own children, and others do not live independently. She explains it is challenging, but possible, to find contexts that are relevant to all learners. It is evident she knows all her learners and their life contexts well. Her overall style for her scheme of work is topic-based teaching (Ness & Bouch, 2007), mapping the learning to the curriculum, within the umbrella topic. For example, using the broad topic of Energy Use, her learners chose to explore aspects that were of specific interest to them such as electrical units used by a hairdryer or a kettle, or hot water used in a bath.

Approaches: Katie

Katie identifies the difficulty of balancing her own aims for learners with her organisation’s aims:

I know I won’t have a job if they don’t get funding, so it’s absolutely in my interest for people to pass the qualifications and take them. Whereas...I know that some of the learners don’t actually need the qualification; they’re only in the class for their own personal gain.

Here Katie voices some of the conflicting aims that teachers seek to mediate. This perhaps explains why, although Katie is sensitive to learners’ individual needs, the curriculum drives the organisation of her schemes of work. Her style is to spend periods of three to four weeks developing knowledge, methods and concepts of some aspects of the curriculum, then to consolidate this by using a carousel of activities, which are designed to stretch learners to apply their learning to real-life problem solving scenarios. The time pressure of covering all the necessary mathematics skills and concepts drives the pace of learning, which at times may be too fast for some learners, which Katie is uncomfortable with. However she tends to revisit subjects throughout her scheme of work, in different ways, to enable learners to gradually make their own sense of concepts.

Katie suggests that starting with the abstract concept, rather than a situated context can help learners. As an example she refers to the place value system and using it to make sense of

multiplying and dividing by 10, 100, etc., explaining that sometimes “putting it into a context isn’t necessarily a helpful thing to do straight off...[because] metric measurement is so confusing for some people”. She also suggests that when starting off in a context-free way, learners are often motivated to relate it to a context they know, e.g. money, to help explain their thinking, during discussions.

Nonetheless Katie tries to regularly incorporate real life contexts that are meaningful to learners, but suggests that this is not straight forward: “You pick any one thing that’s right for one person and it might not be right for anyone else”, so although she tries to put things into context, “whether it’s the learners’ own contexts is another question”. She admits that “if I understand everyone well enough I can try and do that [put it into their contexts], but I don’t really understand all their backgrounds and what they’re doing”. Her solution to this is to give multiple examples that people are likely to be familiar with in some way, to hopefully prompt them to make their own links. An example of this is using the weather forecast and temperature, as well as a bank balance and a profit and loss account, to show how positive and negative numbers can be related to real-life contexts.

Analysis of the links between teachers' own mathematics learning experiences and their approaches to teaching numeracy

Following data analysis it occurred to me that the different course outcomes (I observed Anne’s family learning class and Katie’s general numeracy class) may account for the teachers’ different methods and approaches. However a brief follow up telephone interview with Anne identified that her approaches are consistent across both her family learning and her general adult numeracy classes. This suggests that the differences are more to do with personal approaches to teaching than course outcomes.

Anne

Anne experienced both peaks and troughs in her performance and attitude towards mathematics during her schooling, perhaps not dissimilar to some of the other teachers in Guillame and Kirtman’s (2010) research, and like those teachers, the changes were influenced by her reactions to teachers as well as to phases in her own development. Despite being told she wasn’t clever enough to take higher level mathematics, she retained a perception of herself that she could have done better, so perhaps the balance of positive as well as negative experiences prevented her foreground from being ruined (Skovsmose, 2012).

Nonetheless the feeling of not being good enough formed part of her foreground. She acknowledges that it was not solely her school experiences that prevented her from reaching her full potential, but clearly her teachers had a significant impact. Perhaps this taught her that she could not rely totally on her teachers to help her reach her full potential, which made her a more independent learner as an adult. However, like Sindiswe (Amin, 2012), Anne sees the role of the teacher as very important to her learners’ success. It is evident that she also sees her learners themselves as a very important learning resource.

Her most prominent memory of learning mathematics from school is of struggling to make sense of a board full of multiplication calculations. In contrast, a teacher she liked she described as ‘kind of gentle’. In her own teaching practice I would argue that Anne draws on the former teacher as an “anti-hero” (a figure she does not wish to emulate) and the latter as a “hero” (Williams, 2011). This is demonstrated by her learner-led approach throughout her practice, including her high attentiveness to her learners’ feelings, and her dismay at her volunteer writing fractions all over the board.

Katie

Katie was successful throughout her mathematics education, and was likely to have experienced a consistently high level of performance and a positive attitude towards mathematics (Guillame & Kirtman, 2010). Although not explicit in the data, I suggest that in contrast to Anne, Katie was identified as ‘clever’, contributing to a very positive foreground (Skovsmose, 2012) which helped her to become a high achiever.

Nonetheless she was aware of the limitations of her knowledge and her teachers, as her “horrendously abstract” Further Mathematics learning meant that at times she struggled to apply the mathematics to real objects and to her Engineering degree. Therefore, like Sindiswe (Amin, 2012) and Anne, I think Katie also sees the role of teacher as important to her learners’ success.

It is clear that Katie is very aware of the contrasting experiences her learners had to her own, with most unsuccessful in achieving mathematics qualifications at school. She acknowledges that she doesn’t understand all her learners’ backgrounds, but she genuinely believes that “everybody has a lot of capability in numeracy, but they don’t always realise they’ve got it” and she sees it as her role to help learners to realise this and to believe in themselves. In this way Katie is different to Aziz (Amin, 2012), who was also very successful in mathematics learning, but who saw the family rather than the teacher as having the main role in facilitating mathematics learning.

Katie did not mention specific teachers in her interview, but she makes significant efforts in her own practice to help learners relate the abstract concepts to practical, real life problem solving. Therefore I suggest that to some extent she draws on her Further Mathematics teacher, at least, as a kind of anti-hero (Williams, 2011), i.e. as the kind of teacher she does not wish to emulate. This is demonstrated in the way that she gives her learners multiple examples of real-life uses of concepts such as negative numbers, and also in the problem solving carousel activities which are a regular feature in her schemes of work.

Both teachers

In contrast to Anne, Katie is perhaps less resistant to the influences of her organisation and management goals, or perhaps the culture of qualification success is more prevalent in her college than in Anne’s (Ernest, 1994). Consequently Katie tries to maintain a balance between situating the learning in real life contexts and preparing her learners for their test.

Williams (2011) suggests that teachers see “learners-in-general as being like the learners they used to be” (p140), and there is evidence to suggest that, to some extent, this is the case for Anne, who seems to understand, and empathise with, her learners on several levels, but less so by Katie, who recognises that the learners she is working with are different to the kind of learner she was. Nonetheless, as a learner, being able to apply the mathematics was important, and she tries to help her learners to do this, so perhaps in this way she sees them as like her.

Conclusion and Recommendations

This paper has explored ways in which teachers’ own mathematics and numeracy learning experiences have influenced their system of beliefs about numeracy and numeracy learning and teaching. It seems that their own mathematics learning experiences have been highly influential in shaping their beliefs about mathematics learning and teaching, and in cultivating their underlying approaches to their own teaching practice, including the influence of previous teachers providing roles as ‘heroes’ and ‘anti-heroes’. There was also some evidence to support the idea that teachers teach

learners in a way that would support teachers' own approaches to learning, and that their work context may influence their practice.

Therefore it is important to raise numeracy teachers' awareness of the influences on their practice. Teachers should be supported to explore the links between their own life and learning experiences and their teaching practice approaches, to discuss and challenge their beliefs, and to support them to test and evaluate alternative approaches, to see which work best for their own learners. In this way it might be possible to enhance teachers' practices, despite their seemingly deep-rooted beliefs, to find a balance that maximizes learners' learning as well as meets their organisation's goals.

References

- Amin, N. (2012). Excavating memories: A retrospective analysis of mathematics teachers' foregrounds. *Pythagoras*, 33(2), 1–9. Retrieved from <http://dx.doi.org/10.4102/pythagoras.v33i2.178>.
- Appleby, Y. & Barton, D. (2008). *Responding to people's lives*. Leicester: NIACE.
- Cohen, L., Manion, L. & Morrison, K. (2011). *Research methods in education*. Abingdon, UK; New York, USA: Routledge.
- Dowling, P. (1998). *The sociology of mathematics education: Mathematical myths/ pedagogic texts*. London: Routledge.
- Ernest, P. (1989). The impact of beliefs on the teaching of mathematics. In P. Ernest (Ed). *Mathematics teaching: The state of the art* (pp. 249–254). London: The Falmer Press.
- Guillame, A.M. & Kirtman, L. (2010). Mathematics stories: Preservice teachers' images and experiences as learners of mathematics. *Issues in Teacher Education*, 19(1), 121–143.
- Kanes, C. (2002). *Towards numeracy as a cultural historical activity system*. In P. Valero & O. Skovsmose (Eds.). *Proceedings of the 3rd International Mathematics Education and Society Conference*. Copenhagen: Centre for Research in Learning Mathematics. April 2nd – 7th 2002. Retrieved from <http://www.mes3.learning.aau.dk/Papers.htm>
- Kelly, B. (2011). Learning in the workplace, functional mathematics and issues of transferability. In T. Maguire, J. J. Keogh, & J. O'Donoghue (Eds). *Proceedings of the 18th International Conference of Adults Learning Mathematics (ALM) – A Research Forum: Mathematical Eyes – A Bridge between Adults, the World and Mathematics*. Dublin, Ireland, June 2011.
- Lave, J. (1988). *Cognition in practice: Mind, mathematics and culture in everyday life*. Cambridge: Cambridge University Press.
- Lewis, G. (2013). Emotion and disaffection with school mathematics. *Research in Mathematics Education*, 15(1), 70–86.
- Ness, C. & Bouch, D. (2007). *Topic-based teaching*. London: National Research and Development Centre for adult literacy and numeracy (NRDC).
- Nunes, T., Schliemann, A.D., & Carraher, D.W. (1993). *Street mathematics and school mathematics*. Cambridge: Cambridge University Press.
- Qualifications & Curriculum Authority (2007). *Functional skills standards*. London: Qualifications and Curriculum Authority.
- Robson, C. (2011). *Real world research: A resource for users of social research methods in applied settings*. (3rd ed). Chichester: Wiley.
- Skovsmose, O. (2012). Students' foregrounds: Hope, despair, uncertainty. *Pythagoras*, 33(2), 1–8. Retrieved from <http://dx.doi.org/10.4102/pythagoras.v33i2.162>
- Swan, M. & Swain, J. (2010). The impact of a professional development programme on the practices and beliefs of numeracy teachers. *Journal of Further and higher Education*, 34(2), 165–177.

- Swan, M. & Wall, S. (2007). *Thinking through mathematics: Strategies for teaching and learning*. London: National Research and Development Centre for adult literacy and numeracy (NRDC).
- Wedge, T. (1999). To know or not to know – mathematics, that is a question of context. *Educational Studies in Mathematics*, 39(1-3), 205-227.
- Williams, J. (2011). Teachers telling tales: the narrative mediation of professional identity. *Research in Mathematics Education*, 13(2), 131–142.