Teachers of Mathematics: those who Mediate and those who are Mediated.

Judy Sayers
Stockholm University

The notion of an autonomous teacher has long been accepted as an important characteristic of a good mathematics teacher. In this paper, the beliefs and practices of six primary teachers, all of whom are construed against various criteria as autonomous, were examined. Data, which derived from multiple interviews with and observations of each teacher, were analysed using constant comparison and yielded three themes related to the interaction of belief and practice that separated the six teachers into two equal groups. The results show that autonomy depends on one's perception, therefore challenging the sufficiency of the construct as a characteristic of a good mathematics teacher.

Key Words: mediators; mediated teachers; teacher autonomy

Introduction

Possibly as a reaction to the introduction of the National Curriculum in the late 1980s, the term *teacher autonomy* now occupies a position of importance in the professional literature of English teacher education (Alexander, 2009). In the particular context of mathematics teaching the introduction of the National Numeracy Strategy (1999), whereby the non-statutory guidance became, de facto, a script against which teachers were evaluated by the inspectorate, further reduced teachers' sense of professionalism. Indeed, across the board, different government initiatives were seen to erode teachers' professionalism, policy and practice (Jones et al., 2008), reflecting research that where teachers feel controlled they become teachers who control their students (Pelletier et al., 2002). From such circumstances grew a movement to equip newly qualified teachers in becoming confident and reflective teachers (Pollard, 2008). Such teachers have been encouraged to reflect upon what they do and how they engage with the constraints and affordances different contexts demand of them. Moreover, where teachers are supported at 'various levels within the social context' they are working, they acquire not only an advanced knowledge of their professional field, but also a particular confidence and sense of autonomy (Dierking and Fox, 2012: 141). Such autonomy, where teachers feel able to make decisions that are not driven by external forces, leads to teachers loosening their control of student learning (Warfield et al., 2005). However, the nature of autonomy, despite its regularity of use, remains elusive. In this paper, I present findings from a multiple case study of primary mathematics teachers' beliefs and practice that offered considerable insights into how notions of autonomy play out in their respective classrooms.

The nature of teacher autonomy

In the rhetoric of mathematics teacher education practice and policy the *autonomous teacher* is not an unfamiliar topic, and yet there has been relatively little research on the nature and manifestation of this much promoted quality (e.g. Yackel & Cobb, 1996; Warfield et al., 2005: Watson and De GEest, 2010). In coming to a definition, I have examined literature from a range of research fields. For example, Littlewood (1996), writing in the context of language education, defines an autonomous person as

one "who has an independent capacity to make and carry out choices which govern his or her actions", a capacity dependent on two main components, "ability and willingness" (p. 428). From the perspective of mathematics education, Ernest (1989) argued that an autonomous mathematics teacher would have an awareness of having adopted specific views on and assumptions about the nature of mathematics and its teaching and learning; the ability to justify these views and assumptions; an awareness of the existence of viable alternatives; and a context-sensitivity concerned with reconciling and integrating classroom practices with beliefs and to reconcile conflicting beliefs about themselves. Such views, concerning the level of a teacher's awareness of his or her beliefs in relation to practice, resonate with the notion of the reflective professional highlighted above. In related vein, Ernest's context-related observation that "teachers in the same school are often observed to adopt similar classroom practices" (1989: 3), has found affirmation in recent research highlighting the influence of the social context of learners on teachers' classroom decision-making (Skott, 2009). The limited literature seems to suggest that an autonomous teacher is one who has the knowledge and dispositions to make independent professional decisions in ways that acknowledge but can mediate contextual factors.

Significantly, the extent to and ways in which professionals negotiate constraints seem to be a key element of autonomy (Hargreaves, 1996). For example, different educational systems impose different curricular expectations with respect to what is permitted deviation from expected norms (Goodson, 2003). Indeed different notions of professionalism have been framed according to their proponents', whether state, municipality or school, ambitions (Hargreaves, 1996). Thus, autonomy appears very much the concept its definers wish it to be. In a related vein, teachers who are able to navigate their professional contexts and act autonomously experience less stress than teachers who are not, particularly with regard to control over what is taught (Pearson and Moomaw, 2005).

Interestingly, throughout the literature teacher autonomy is assumed to be a precursor to learner autonomy (Gavrilyuk et al., 2013). Indeed, teachers who do not view students as autonomous learners do not see the need to focus on students' thinking in their instruction (Pelletier et al., 2002). Moreover, affective factors such as attitude, feelings, rationality, responsibility for actions and values have all been shown to be significant (Pennycook, 1997). Thus, autonomy appears to be a multi-faceted construct linked to teachers' awareness of and ability to negotiate the constraints within which they work. Moreover, the more competent they are in this regard the more effective and less stressed they are likely to be. That is, professional fulfilment seems dependent on the extent to which one is autonomous.

Methodology

As indicated above, this paper draws on a multiple case study examination of the beliefs and practice of six primary teachers. All teachers, drawn from the same locality, were purposively selected as leaders of the subject in their school and considered locally to be ambassadors of mathematics learning and teaching. They were similarly qualified; each teacher had studied 'A' level mathematics before specialising in mathematics in his or her training and each had achieved a 2.1 degree or above. Some had become, or were applying to become, leading mathematics or advanced skills teachers.

Data, focussed on teachers' management of whole class interaction (WCI), they were subjected to a constant comparison analysis (Strauss and Corbin, 1998),

collected by means of interviews to tease out individual teacher's backgrounds, their beliefs and attitudes towards the subject and the teaching of the subject; video-recordings of random mathematics lessons, (between three and six lessons per teacher) and stimulated recall interviews (SRIs) following each lesson to elicit the teacher's rationale for various elements of observed practice. These elements are reported below in the three themes that emerged from the data.

Results & Analysis

As the data were analysed it became apparent that a number of dichotomies were emerging. For example, during their initial interviews all six teachers discussed how they had enjoyed learning mathematics at both primary and secondary school, and described several good teachers and what made them memorable. However, the role played by their families in the construction of their memories of early mathematics differed. One group of three teachers, which I label group 1, comprising Caz, Ellie and Louise, spoke of being members of families in which an enjoyment of doing mathematical problems for their own sake was valued. A second group of three teachers, which I label group 2, comprising Sarah, Gary and Fiona, mentioned no such memories but talked only of satisfaction gleaned from pages of correct answers in their workbooks at school. This group valued the rightness and wrongness of mathematics, in contrast to the other. Essentially the initial interviews revealed, within some shared experiences, two distinct groups of strongly-held beliefs about and attitudes towards mathematics.

The lesson observations yielded three distinct themes, which were also later found to dichotomise the six teachers. These three themes concerned teachers' *mathematical intentions,* or their learning aims or goals; their *pedagogical approaches* or the teaching strategies they adopted during the whole class phases of their lessons; and the *classroom norms*, or the repeated patterns of classroom behaviour, they encouraged. In the following, I discuss these three themes, and my interpretation of them, supported by insights from the stimulated recall interviews (SRIs).

Teachers' mathematical intentions

Analyses yielded five characteristic mathematical intentions (MI) as evidenced by either teachers' observed lessons or their SRIs. All five, which are well known in both research and curriculum literature (Askew et al., 1997), were considered by all teachers to be important in ensuring their children's learning of mathematics. Significantly, the manifestations of these five intentions dichotomised the six teachers in exactly the same way as the initial interviews. Details of the two groups' perspectives on mathematical intent can be seen in table 1, highlighting the extent to which all six teachers used the same professional language but frequently meant very different things in practice.

Group 1: MI	Group 2: MI
Prior knowledge is constantly activated through reference to known knowledge throughout lesson	**Prior knowledge** is activated at the start of every lesson to recall previous activity
Connections are made explicitly through opportunities to discuss and explore ideas	**Connections** are made implicitly with little development of ideas
Vocabulary is emphasised with children and high expectations of its use thereafter	**Vocabulary** is emphasised through Q & A episodes, low expectations of use elsewhere

Mathematical Reasoning derives from opportunities to think and play with ideas individually and collectively.	**Mathematical Reasoning** draws on learned facts memorised from games and tricks.
Mathematical tasks provide opportunities for learning how to be a mathematician; playing with and discussing ideas	**Mathematical tasks** are demonstrated by the teacher so that children will know how to do same.

Table 1: A summary of the two groups' mathematical intent

As table 1 indicates, one group of teachers provides opportunities for their children to think and explore ideas with others and to make connections. This group also provides opportunities for children to use their vocabulary in appropriate ways, and emphasises enquiry, argumentation and justification. Despite a similar professional vocabulary, the second group of teachers present only closed and very limited opportunities for their students to engage with mathematics. Finally, and quite unexpectedly, through observations and later discussion, the dichotomisation highlights an interesting perspective on, perhaps unwittingly, who works the hardest during the WCI phases of lessons, the children or the teacher.

Teachers' pedagogical approaches

The observations revealed that teachers' practices did not always match the beliefs espoused during their initial interviews. They all espoused to provide opportunities to discussion, for example, but what individual teachers understood discussion to mean could be quite different. The analyses revealed seven key behaviours characteristic of teachers' pedagogical approaches (PA), which also split the six teachers into the same two groups as before. Table 2 summarises these differing characteristics.

Group 1: PA	Group 2: PA
Discussion: Provided opportunities for all children to engage in **authentic discussion** (Reynolds & Mujis, 1999).	**Discussion**: A **non-authentic discussion** with alternative views neither sought nor reconciled.
Questions: Teachers provided children time to think about their answers before being expected to answer.	**Question:** Little time given for thinking. Often questions were asked to which the children already knew the answers.
Explaining: Teachers spoke of and enacted modelling as a collective Q & A strategy, while demonstration meant 'telling'.	**Explaining:** Teachers repeatedly explained through demonstration/telling. They saw modelling also as showing/telling best practice; children watch and learn the best way.
Resources: All resources were espoused and enacted as scaffolds for relational learning.	**Resources:** Although espoused as scaffold, resources were used in rote ways to support instrumental learning.
Practising: Seen as part of an approach to develop speed and agility.	**Practising:** Perceived as the most important aspect of mathematical learning.
Encouragement of enjoyment: Playing with numbers and shapes was seen as an integral element of mathematical exploration	**Encouragement of enjoyment:** Teachers focused on extrinsic social pleasures rather than intrinsic mathematical pleasures. Keeping children entertained seemed the dominant theme
Expectation and **differentiation.** Teachers emphasised high expectations irrespective of school context. Differentiation was discreet and flexible.	**Expectation** and **differentiation.** Teachers had low expectations fro some groups. Differentiation was explicit, typically in inflexible groupings.

Table 2: Pedagogical Approaches espoused by project teachers

My interpretation of the details of table 2, allied to the mathematical intentions of the two groups of teachers, is that the dichotomies allude to important insights with respect to professional autonomy, particularly as the vocabulary used by both groups

is the same. In particular, the teachers in group 1 emphasise a *relational* perspective on mathematical learning in comparison to teachers in group 2 who emphasise an *instrumental* perspective. These perspectives, which were observed in their teaching were not as apparent in their espousals. Although the same vocabulary is used to describe approaches to mathematics teaching each group assigns different meanings.

These elements are not new and reinforce previous work concerning the relationships between: beliefs and practice (Thompson, 1984; Beswick, 2005); classroom discourse (Myhill et al., 2005); and the making explicit of connections (Askew et al., 1997). Pedagogically, the data appear to dichotomise according to Skemp's (1976) relational versus instrumental approaches to learning and teaching. Where group one discursively extends children's knowledge and understanding, group two focuses on tightly controlled routine skills.

Classroom norms

Finally the classroom norms, or the repeated patterns of classroom behaviour, fell into three categories summarised in table 3. The same two groupings emerged from the data, with the norms typifying group 1 teachers falling into what Yackel and Cobb (1996) call socio-mathematical norms. Those of group 2 teachers appeared more social than mathematical.

Classroom Norms		
	Group 1: *Sociomathematical norms*	Group 2: *Social norms*
Structural classroom norms	Quick pace to improve mental agility Flexible lesson structure	Quick pace to improve lesson & amount of material covered. Nonflexible *(do as instructed)* lesson structure
Cognitive class norms	Awareness of learning theories Affordance & constraints of thinking time	Awareness of rhetorical learning experience Superficial time offered to children to think
Attitudinal classroom norms	Enjoyment of mathematics: *through enjoyable, challenging/interesting tasks, games, the recall of knowledge facts and relationships between numbers and shapes.* Achievement (*understanding).* High expectations of all children.	Enjoyment of mathematics lessons: *children enjoy mathematics through laughing together* Achievement (*accomplishment*) of content covered. Low expectations of children from low-socio-economic families

Table 3: Classroom norms recorded

The details of table 3 provide further case study evidence of distinct groups of teachers of mathematics as defined by their espoused and enacted beliefs. This is in accordance with previous case studies, e.g. Twisleton (2002) and Palmér (2012). that have also shown the extent to which a child's opportunity to learn mathematics is determined by what teachers believe and do. Askew et al. (1997) also found different groups of teachers: discovery-, transmission- and connectionist-oriented teachers, with the latter group being designated as *effective*. Characteristics of these three elements can be seen within the two groups reported here. However, while it is not the place here to suggest that group 1 teachers are better than group 2, it is clear that they offer qualitatively different learning experiences for their children, confirming that teachers incorporate assumptions about the nature of mathematics, based on their early experiences as a learner, into a personal philosophy of mathematics with clear classroom consequences (Jennings and Greenberg, 2009).

Discussion

When viewed against typical perspectives on teacher effectiveness, both groups initially seemed indistinguishable. For example, all had good subject knowledge qualifications, which evidence suggests is a characteristic of teacher quality (Rowland and Ruthven, 2011). But the data above seem to suggest that the quality of subject knowledge alone is no predictor of teacher belief or practice. At the espoused level, all teachers exploited the same mathematical pedagogical vocabulary. For example they explicitly mentioned the use of mathematical vocabulary, children's prior knowledge, connections made and rich tasks used, which evidence suggests are crucial to effective mathematical teaching (Petrou and Goulding, 2011). But the data above suggest that the interview articulation of professional vocabulary is not evidence of its use in practice. When general pedagogical approaches to teaching and learning were discussed, all teachers were again in agreement, as in, for example, the use of discussion, questioning, differentiation and choice of resources are thought to be facilitators of learning (Alexander, 2009; Moyer, 2001). But the data above suggest different interpretations. Finally, all teachers esposed high expectations in relation to pupils' achievement and engagement in mathematics, another characteristic of good teaching (McKown and Weinstein, 2008). But the data revealed very different manifestations of such expectations in practice.

All teachers talked in ways that would find approval in the literature as being autonomous teachers, just as others construed them locally. However, Lawson (2004) cautioned us that 'the appeal of teacher autonomy… must be tempered by the recognition that it has the ability to both liberate and deceive' (p. 3). The dichotomisation of these six teachers presents a problematic picture. On the one hand, we see the teachers of group one whose espoused beliefs resonate closely to their practice and expectations of effective teaching found in the literature. On the other hand, we see the teachers of group 2 whose beliefs are not only incommensurate with their practice, but also unlikely to provide children with meaningful learning opportunities. In other words, it could be argued that teachers of group 1 are autonomous, whilst those of group 2 are not. In the following I revisit notions of autonomy in relation to these two groups by introducing the concept of mediation.

Theorisation and Conclusions

I construe the teachers of group 1 as mediators in that they seem able to analyse the contexts in which they work and then act in ways that remain consistent with their core beliefs. For example, they warrant their practice against critical reflections on their own personal and professional learning, frequently drawn from research readings, professional development and classroom-based experiments. They have secure subject and pedagogical content knowledge that allows them to mediate imposed initiatives with confidence and authority. They do not implement permanent changes without first trialling and evaluating them. Flexibility was seen to be a consistent attribute, where individuals' daily progress was analysed and dealt with accordingly. For example, none of these teachers saw low socio-economic factors as barriers to learning, only high expectations were observed.

I construe the teachers of group 2 as mediated in that they seem unable, and unaware, to analyse the contexts in which they work and act in ways that remain consistent with their core beliefs. For example, their approach to mathematics teaching and learning draws more on their core beliefs derived from their own early

experiences of learning rather than their training or professional-development. They espoused discussion but actioned only teacher question and answer episodes. Classroom norms exhibited a focus on having fun, but this was through social enjoyment rather than in the mathematics. Mediated teachers relied upon their senior manager to inform them of new initiatives, implying a dependent behaviour and a low-level professional identity. They discussed the demands of increasing paperwork and accountability, but offered few strategies that would help them manage these demands. Mediated teachers had low expectations of pupils from low socio-economic backgrounds, consistently presenting low level learning opportunities.

In sum, although increasing paperwork and accountability were viewed as continuing workplace frustrations for all teachers, clear strategies for handling these were articulated by the mediators only, indicating a high level of professional resilience. They operated at a high level of self-awareness, a component of a strong professional identity, having an ability to recognise and reconcile conflicting beliefs about themselves, their role and their environment. Whereas mediated teachers operated at minimal levels of self-awareness, demonstrating weak professional identities. Where constraints were seen as starting points for structuring their approaches, whereas mediators viewed these as barriers to be negotiated in their teaching of mathematics. Therefore, the notion of autonomy is insufficient to characterise a good teacher of mathematics.

References

Alexander, R. (2009) *Children, their World, their Education: final report and recommendations of the Cambridge Primary Review*. London: Routledge.

Askew, M., Brown, M., Rhodes, V., Wiliam, D. & Johnson, D. (1997) Effective Teachers of Numeracy in Primary Schools: Teachers' Beliefs, Practices and Pupils' Learning BERA. *Annual Conference* (University of York).

Beswick, K. (2005) The Beliefs/Practice Connection in Broadly Defined Contexts. *Mathematics Education Research Journal*, 17(2), 39-68.

Dierking, R.C. & Fox. R.F. (2012) "Changing the Way I Teach" Building Teacher Knowledge, Confidence, and Autonomy**.** *Journal of Teacher Education*, 64(2), 129-144.

Ernest, P. (1989) The Impact of Beliefs on the Teaching of Mathematics, In Ernest, P. (Ed.) *Mathematics Teaching: The State of the Art*, London: Falmer Press.

Gavrilyuk, O.A., Lebedeya, T.P. & Karelina. N.A. (2013) Developing University Teacher Autonomy: New Strategies for Teaching English Grammar. *Education*, 3(3), 207-213.

Goodson, I.F. (2003) *Professional knowledge, professional lives: Studies in education and change* Maidenhead: Open University Press.

Hargreaves, D.H. (1996) Teaching as a research-based profession: Possibilities and prospects. In Hammersley, M. (2007). *Educational Research and Evidenced based Practice*. London: OU (Sage) publishers.

Jennings, P.A. & Greenberg, M.T. (2009) The Prosocial Classroom: Teacher Social and Emotional Competence in Relation to Student Classroom Outcomes. *Review of Educational Research*, 79(1), 491-525.

Jones, E., Pickard, A. & Stronach, I. (2008) *Primary Schools: the professional environment (Primary Review Research Survey 6/2)*, Cambridge: University.

Lawson, A. (2004) Teacher autonomy: Power or control? *Education 3-13*, 32(3) 3-18

Littlewood, W. (1996) Autonomy: an anatomy and a framework. *System*, 24(4) 427-435.

McKown, C. & Weinstein, R.S. (2008) Teacher expectations, classroom context and the achievement gap. *Journal of School Psychology*, 46, 235-261.

Moyer, P. (2001) Are we having fun yet? How teachers use manipulatives to teach mathematics. *Education Studies in Mathematics*, 47(2), 175–197.

Myhill, D. & Warren, P. (2005) Scaffolds or straitjackets? Critical moments in classroom discourse, *Educational Review*, 57(1).
Palmér, H. (2012) (In)consistent? The mathematics teaching of a novice primary school teacher. *Nordic Studies in Mathematics Education*, 17(3-4), 141–157.
Pearson, L.C. & Moomaw, W. (2006) Continuing Validation of the Teaching Autonomy Scale, *The Journal of Educational Research*, 100(1), 44-51.
Pelletier, L.G., Séguin-Lévesque, C. & Legault, L. (2002) Pressure from above and pressure from below as determinants of teachers' motivation and teaching behaviors. *Journal of Educational Psychology*, 94, 186–196 .
Pennycock, A. (1997) Cultural alternatives and autonomy. In Benson, P. & Voller, P. *Autonomy and Independence in Language Learning*. London: Longman.
Petrou, M. & Goulding, M. (2011) Conceptualising teachers' mathematical knowledge in teaching. In Rowland, T. & Ruthven, K. (Eds.) *Mathematical knowledge in teaching*, London: Springer.
Pollard. A. (2008) Reflective teaching. London: Continuum
Reynolds, D. & Muijs, D. (1999) The effective teaching of mathematics: A review of research. *School Leadership & Management*, 19(3), 273-288.
Rowland. T. & Ruthven, K. (2011) *Mathematical Knowledge in Teaching*. London: Springer.
Skemp, R. (1976) Relational understanding and instrumental understanding. *Mathematics Teaching*, 77, 20–26.
Skott, J. (2009) Contextualising the notion of belief enactment. *Journal of Mathematics Teacher Education*, 12(1), 27-46.
Strauss, A.L. & Corbin, J. (1998) Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory. Newbury Park, CA: Sage.
Thompson, A.G. (1984) The Relationship of Teachers' Conceptions of Mathematics and Mathematics Teaching to Instructional Practice. *Educational Studies in Mathematics,* 5, 105-127.
Twiselton. S. (2002) Beyond the curriculum - learning to teach primary literacy. *British Educational Research Association. Conference Proceedings*. University of Exeter.
Warfield, J., Wood, T. & Lehman, J.D. (2005) Autonomy, beliefs and the learning of elementary mathematics teachers, Teaching and Teacher Education, 21, 439-456.
Watson, A. & De Geest. E. (2010) Secondary mathematics departments making autonomous change. In Joubert, M & Andrews, P. (Eds.) *Proceedings of the British Congress for Mathematics Education* April 2010, 232-238.
Yackel, E. & Cobb, P. (1996) 'Sociomathematical norms, argumentation, and autonomy in mathematics', *Journal for Research in Mathematics Education* 27, 458–477.