The cultural location of teachers' mathematical knowledge: another hidden[1] variable in research on mathematical knowledge for teaching?

Paul Andrews

Putting aside the almost obsessional interest shown over the course of the last decade by many governments in the outcomes of large scale tests of mathematical achievement like TIMSS, its repeats, PISA and its repeats, much recent comparative mathematics education research has focused on explicating the national mathematics *script*, premised on a belief that teachers in one country behave in ways that identify them more closely with compatriots than teachers elsewhere (Schmidt et al. 1996) because:

> "teaching and learning are cultural activities (which)... often have a routineness about them that ensures a degree of consistency and predictability. Lessons are the daily routine of teaching and learning and are often organized in a certain way that is commonly accepted in each culture" (Kawanaka 1999, 91).

This sense of routine predictability has been variously described as the *traditions of classroom mathematics* (Cobb et al. 1992), the *cultural script* (Stigler and Hiebert 1999), *lesson signatures* (Hiebert et al. 2003) or the *characteristic pedagogical flow* of a lesson (Schmidt et al. 1996). The latter embodies the pedagogical strategies which, through repeated enactment, are typical of a country's lessons, which appear routine and beneath the consciousness of most teachers (Cogan and Schmidt 1999). Explanations for such patterns draw on beliefs that cultures "shape the classroom processes and teaching practices within countries, as well as how students, parents and teachers perceive them" (Knipping 2003, 282), to the extent that many of the processes of teaching are so "deep in the background of the schooling process ... so taken-for-granted… as to be beneath mention" (Hufton and Elliott 2000, 117). Importantly, "studying teaching practices different from one's own can reveal taken-for-granted and hidden aspects of teaching" (Hiebert et al, 2003) and many studies have unveiled unnoticed but culturally-located teaching practices characteristic of the systems under scrutiny (Stigler et al, 2000; Wilson et al, 2001). In particular, "comparing teaching and learning processes in different countries promises to help us to become more aware of our own implicit assumptions concerning the learning of mathematics" (Knipping, 2003, p. 283).

In many respects, one might reasonably expect variation in the ways in which mathematics is conceptualised and presented in countries of substantial cultural difference. Indeed, and prompted by ongoing concerns about the mathematical underachievement of US students, much recent research has examined aspects of mathematics education in the US and a number of high-achieving Pacific Rim countries (An et al, 2004; Becker et al, 1999; Cai, 2004, 2005; Cai and Lester, 2005; Cai and Wang, 2006; Jacobs et al, 1997; Ma, 1999; Lew, 1999; Lin, 1988; Lin and Tsao, 1999; Stigler and Perry, 1990; Stigler et al, 1996; Whitman and Lai, 1990; Yeping and Ginsburg, 2006) and confirmed considerable variation in the ways in which mathematics is presented in those countries which Tweed and Lehman (2002) have described as the culturally east and culturally west and which draw on Confucian and Socratic didactic traditions respectively.

Even within Europe, with the majority of its countries sharing a Judeo-Christian cultural heritage, there is growing evidence indicating that mathematics education traditions vary substantially from one country to another. For example, Robertson (2001) describes well the problems encountered when tasks previously set for use by French students were adapted for use by Scots students and vice-versa. She noted in respect of their accessibility to Scots

[1] As colleagues will know, this is an allusion to the 2002 book, *beliefs: a hidden variable in mathematics education*, edited by Gilah Leder, Erkki Pehkonen and Günter Törner

students, many French items were either unfamiliarly formal in their presentation of mathematics or presented in such particular French contexts as to make translation difficult (Robertson, 2001). Other studies of this cultural near-neighbour, form have included, for example, comparisons of various aspects of mathematics education in England and France (Jennings and Dunne, 1996), England and Holland (Beishuizen, and Anghileri, 1998; Beishuizen et al, 2002), England and Germany (Kaiser, 1999), England and Switzerland (Prais, 1997), England and Hungary (Andrews and Hatch, 2000, Andrews, 2007b; Graham et al. 1999), Belgium (Flanders) and Holland (Torbeyns et al, 2002), England and Russia (Wilson et al, 2001), England, France and Germany (Kaiser et al, 2006; Haggarty and Pepin, 2002; Pepin and Haggarty, 2001). All, in their differing ways, have highlighted substantial differences in how mathematics is construed by participants and presented by teachers to their students.

Such differences are probably unsurprising when considered against research highlighting deep-seated cultural differences across such countries. For example, without even considering the former Soviet countries, Hofstede (1986) identified substantial cross national variation among European countries across his four dimensions of cultural difference – individualism, power distance, uncertainty avoidance and masculinity. Of Cumming's (1999; 2003) six core countries, four are European and his analyses of the socio-political development of universal primary education in England, France, Germany and Russia offer much not only by way of highlighting but also explaining substantial differences in systemic expectations and practices underlying educational developments throughout the nineteenth and early twentieth centuries. Sharpe (1997) highlights the influence of the Protestant and Catholic churches on the development of education in England and France. Osborn (2004) describes how societal emphases on the individual, community and nation respectively underpin educational expectations in England, Denmark and France, while Kaiser and her colleagues (2006) explain how differences in the philosophical underpinnings of the English, French and German education systems influence the presentation of school mathematics. Thus, it would seem logical to accept that cultural differences, no matter how small, impact in expected and unexpected ways on teachers' professional conduct and so even culturally near neighbours appear to conceptualise and present mathematics differently from each other.

Inevitably, there are sceptics. LeTendre et al. (2001), drawing on an international self-report survey, concluded that mathematics teachers' core teaching practices and beliefs showed little cross-national variation. However, and this seems a significant methodological conundrum, studies advocating similarity seem either to aggregate scores on several variables in ways that mask underlying differences, as with Anderson (1987) and Van de Grift (2007), or examine variables of such inclusiveness that similarity is inevitable, as in the case of LeTendre et al. (2001).

It seems to me that any educational system's expectations of the educational process, the nature of curriculum mathematics, the manner of its delivery, the means by which teachers are prepared for their professional activity, the expectations of all participants and so on, are consequences of cultural differences that set one country's mathematics education traditions apart from those of even its closest neighbour. I can see no reason why mathematical knowledge in teaching should be construed as outside this framework. Thus, by way of an appeal, I would like to see further research on mathematical knowledge in teaching acknowledge more explicitly than it has thus far the cultural location of all matters educational.