Guest Editorial…

Searching for an Understanding of Mathematics Teachers: A Personal Trajectory

Paola Sztajn

Ten years ago, I arrived at the Indianapolis airport to begin my doctoral studies in the United States. I brought in my bag a few books and a list of questions about mathematics teaching, teachers, and their education. I now have many more books. I also have some answers. However, quite a few of my original questions still persist. Actually, many of the questions I came to answer have changed and evolved. On top of those, I have managed to add quite a few more to my 1991 list. In these ten years, I have learned that my interrogations are not always simple; that is, they do not have the causal or linear answer I was looking for when I first got here.

As I started my studies in mathematics education, I had one very broad question that was at the top of my list: why do teachers do what they do, the way they do it, when they do it, while teaching children mathematics? For me, teachers' actions, including some of my own, were a puzzle. On a broad scope, I was interested in teacher education. However, I believed that to better organize pre-service and in-service courses for teachers, one needed to understand teachers and their practices. Ten years ago, I was naïve enough to think I would answer my major question and go on to work on teacher education! Today, I realize this particular inquiry is still what moves me towards research. Although I do not feel much closer to an answer than I was before, I have come to better understand the entanglement and range of my question. Probably most important, I have grappled with the complexities of teaching and the difficulties of researching it.

In my attempt to understand teachers, I started formal work in the field of mathematics education studying teachers' beliefs. In the late 80s, I remember how excited I was when I first read mathematics education papers that discussed this issue (e.g. Ernest, 1989; Thompson, 1984). For me, it was fascinating to have an argument which allowed me to say that teachers' mathematical knowledge was not enough to "explain" their mathematics teaching. There was something more to teachers' practice; there was something about the way teachers saw mathematics that related to what they chose to do in their classrooms.

Studying the relation between beliefs and practice, I realized these were neither linear nor causal relations; there were other issues to be considered. In particular, I started to ponder whether one could only truly understand teachers from a network perspective. That is, one cannot separate beliefs or sets of beliefs, and should never separate beliefs and practices. Rather, it is necessary to understand teachers well enough to see how all these multi-layered pieces fit together from the teachers' perspectives.

For example, consider the following (very exaggerated) situation: Teacher A believes mathematics should be taught through problem solving. However, Teacher A also believes (or knows?) that her principal does not think that way. She also believes (or knows?) that she needs her job. Thus, she teaches in a more traditional way. In this case, although there is a discrepancy between beliefs and practice, this difference makes total sense from Teacher A's perspective. If we only ask the teacher what her beliefs are and observe her practice, we might fail to see these other issues and understand the connections Teacher A is making. Therefore, to fully account for Teacher A's mathematics teaching, it is not enough to ask her what her beliefs about mathematics and its teaching and learning processes are. It is necessary to understand Teacher A from a broader perspective.

Moving in this direction, I started talking about teachers' ideologies. At that time, Ernest (1991) was a refreshing theoretical framework to consider. The goal was to regard other beliefs teachers had, not directly related to mathematics education, which nonetheless influenced their mathematics classrooms. These beliefs could help us integrate beliefs and practice. From the ideology perspective, I looked at teachers' beliefs about education, about children, and about society. I wrestled with issues of students' needs and equity.

Still, I felt I did not have a good framework for understanding teachers and their mathematics teaching. An important issue was missing: teachers' knowledge. How does one talk about mathematics teaching without talking about mathematical knowledge? In the second half of the 90s, I was surprised to see myself coming

Paola Sztajn is an Assistant Professor of Mathematics Education at the University of Georgia. Her research interests are elementary teacher education, beliefs and knowledge. Currently, she is working on a research project entitled "Knowledge development in mathematics teaching: Learning from experienced elementary teachers."

back to my starting point. The content knowledge I had run away from became a missing term in my equation.

Fortunately, the discussion on teachers' knowledge had moved a long way, and the issue of pedagogical content knowledge (Schulman, 1986) made it easier for me to bring mathematics back to my interest on teachers and teaching (e.g., Ball, 1991). With mathematical content knowledge came many other features of teachers' knowledge that I had not previously considered: knowledge about students and their learning, about pedagogical materials; knowledge about schools and their culture, about curricular debates. In my search for an understanding of teachers and their mathematics instruction, all these different types of knowledge had to be integrated with all the different beliefs I had been studying.

The relation between beliefs and knowledge is a delicate one. Although Grouws (1992) included separate chapters for these two issues in the *Handbook of Research on Mathematics Teaching and Learning*, Fennema and Franke (1992) opened their chapter saying "we believe it is impossible to separate beliefs and knowledge" (p. 147). Thompson (1992) addressed the distinctions between beliefs and knowledge (pp. 129-130) arguing that beliefs are disputable, knowledge is not; beliefs are independent of their validity while knowledge must satisfy a truth condition. Knowledge also involves evidence—although "it should be noted that the evidence against which a claim to knowing is evaluated may change over time as old theories are replaced by new ones"(p. 130).

An important point was noted by Thompson when she claimed that "teachers treat their beliefs as knowledge" (p.129). At first, I did not pay attention to this sentence in her text. After all, I knew the difference between beliefs and knowledge—I thought. Today, this simple sentence seems to be a fundamental one. If teachers treat beliefs as knowledge, it might be that to understand teachers from the teachers' perspectives we have to bring beliefs and knowledge together. It might be that the separation between beliefs and knowledge that is appropriate from an epistemological standpoint, or that seems appropriate as an analytical tool, has become counterproductive in the study of teachers and their mathematics teaching.

I have come to think that we have to integrate the studies on beliefs and knowledge to move forward. Thus, currently, I have started to consider using an epistemology of professional practice defined as the "study of the *set* of 'knowledges' *really* utilized by professionals in their everyday working space to carry out *all* their tasks" (Tardif, 1999, p.15). Coming from a sociological analysis of professionals and their knowledge, this definition has the words *set, really* and *all* highlighted (in the original) to further qualify its fundamental assumptions. This far-reaching idea of knowledge includes content knowledge, aptitude, attitude, and know-how, for example. This epistemology considers knowledge and beliefs from the same standpoint. The goal of such an epistemology is not only to reveal all types of knowledge teachers use, but also to understand the ways in which they are integrated in the achievement of professional tasks.

It is still too early to know where this approach will take me—and probably in ten years, if invited, I will write another editorial for *The Mathematics Educator* about how my previous perspectives were not sufficient in my search to better understand mathematics teachers. However, I believe this approach will give me many insights about mathematics teaching—and I am looking forward to further discussing it with my peers.

Again, I face the challenge of trying to consider a network approach in which one attempts to study teachers from a perspective in which practice, knowledge, beliefs, personal histories, etc, have to come together into an organized set of relations. Today, mathematics education research, for the most part, still seems to be approaching teachers from a fragmented perspective (both when studying knowledge or when studying beliefs). This might be the reason why some of the studies in the field do not seem to be taking the community forward in its understanding of teachers and teaching. I am convinced we need to look at teachers from an ever-growing, more holistic perspective.

As I come to focus on my personal trajectory in search of an understanding of teachers, I can see my own pattern: I always move towards broader frameworks, further integration, and networks of ideas. As I come to understand one aspect of teachers, I try to integrate it with other ones within a wider scope. Thus, I seem to be moving away from the study of the parts to the study of the whole. It may be that our focus on the parts has taken us away from a comprehension of the whole. And it may be that only the study of the "whole" will allow us to understand mathematics teaching with all its complexity. For, as I learned, when discrete agencies interact, in synergism, the total effect is greater than the sum of individual effects (Mish, 1991). Or, as Professor John Le Blanc told me, the whole > $\sum$ parts.

See page 14 for references.

References

Cooney, T. J. (1992). *A survey of secondary teachers' evaluation practices in Georgia* (A study supported by the Eisenhower Program for the Improvement of Mathematics and Science Education). Athens: University of Georgia, Mathematics Education.

Cooney, T. J., Badger, E., & Wilson, M. R. (1993). Assessment, understanding mathematics, and distinguishing visions from mirages. In N. L. Webb & A. F. Coxford (Eds.), *Assessment in the mathematics classroom* (pp. 239-247). Reston, VA: National Council of Teachers of Mathematics.

Cooney, T., Ice, N., & Sanchez, W. (1999). Lärares arbete med ny utvärdering. [Interpreting teachers' movement toward reform in mathematics assessment] *Nämnaren tidskrift för matematikundervisning 26*, 13-18.

Goodlad, J. I. (1984). *A place called school: Prospects for the future.* New York: McGraw-Hill.

Hancock, C. L. (1995). Enhancing mathematics learning with open-ended questions. *Mathematics Teacher, 88,* 496-499.

Kulm, G. (1993). *A theory of classroom assessment and teacher practice in mathematics.* Washington, DC: Department of Education. (ERIC Document Reproduction Service No. ED 358 129)

Kulm, G. (1994). *Mathematics assessment: What works in the classroom.* San Francisco: Jossey-Bass.

Lambdin, D. V., Kehle, P. E., & Preston, R. V. (Eds.). (1996). *Emphasis on assessment: Readings from NCTM's school-based journals.* Reston, VA: National Council of Teachers of Mathematics.

Mathematical Sciences Education Board. (1989). *Everybody counts: A report to the nation on the future of mathematics education.* Washington, DC: National Academy Press.

Mathematical Sciences Education Board. (1993). *Measuring what counts: A conceptual guide for mathematics assessment.* Washington, DC: National Academy Press.

Moon, J., & Schulman, L. (1995). *Finding the connections: Linking assessment, instruction, and curriculum in elementary mathematics.* Portsmouth, NH: Heinemann.

National Council of Teachers of Mathematics. (1989). *Curriculum and evaluation standards for school mathematics.* Reston, VA: Author.

National Council of Teachers of Mathematics. (1991). *Professional standards for teaching mathematics.* Reston, VA: Author.

National Council of Teachers of Mathematics. (1995). *Assessment standards for school mathematics.* Reston, VA: Author.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics.* Reston, VA: Author.

Senk, S. L., Beckman, C. E., & Thompson, D. R. (1997). Assessment and grading in high school mathematics classrooms. *Journal of Research in Mathematics Education*, 28, 187-215.

Stenmark, J. K. (Ed.). (1991). *Mathematics assessment: Myths, models, good questions, and practical suggestions.* Reston, VA: National Council of Teachers of Mathematics.

Webb, N. L., & Coxford, A. F. (Eds.). (1993). *Assessment in the mathematics classroom.* Reston, VA: National Council of Teachers of Mathematics.

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Continued from page 3…

References

Ball, D. L. (1991). Research on teaching mathematics: Making subject-matter knowledge part of the equation. In J. Brophy (Ed.), *Advances in research on teaching: Teacher's knowledge of subject matter as it relates to their teaching practice* (Vol. 2, pp. 1-48). Greenwich, CT: JAI Press.

Ernest, P. (1989). The knowledge, beliefs and attitudes of the mathematics teacher: A model. *Journal of Education for Teaching, 15,* 13-33.

Ernest, P. (1991). *The philosophy of mathematics education*. London: The Falmer Press.

Fennema, E., & Franke, M. L. (1992). Teachers' knowledge and its impact. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 147-164). New York: Macmillan.

Grouws, D. A. (Ed.). (1992). *Handbook of research on mathematics teaching and learning*. New York: Macmillan.

Mish, F. C. (Ed.). (1991). *Webster's ninth new collegiate dictionary*. Springfield, MA: Merriam-Webster Inc.

Schulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*(2), 4-14.

Tardif, M. (1999). *Saberes profissionais dos professores e conhecimentos universitarios (Teachers' professional knowledge and university-based knowledge)*. Rio de Janeiro: Pontificia Universidade Catolica.

Thompson, A. (1984). The relationship of teachers' conceptions of mathematics and mathematics teaching to instructional practice. *Educational Studies in Mathematics, 15*, 105-127.

Thompson, A. G. (1992). Teachers' beliefs and conceptions: A synthesis of the research. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 127-146). New York: Macmillan.