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ICMI Newsletter

A Newsletter from the ICMI-International Commission on Mathematical Instruction

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Contents

The 2017 Hans Freudenthal Award for outstanding contributions of an individual's theoretically well-conceived and highly coherent research programme for Terezinha Nunes

Credit: University of Oxford

The Freudenthal Award, with which ICMI honors innovative, consistent, highly influential and still ongoing programs of research in mathematics education, is being awarded in 2017 to Professor Terezinha Nunes, University of Oxford, UK, for her outstanding contribution to our understanding of mathematical thinking, its origins and development.

For more than 35 years now Terezinha Nunes has been researching children's mathematical learning, as it takes place in formal and informal settings. The results of her numerous, exemplarily designed studies combine into an insightful, consistent, and comprehensive story of the emergence and evolution of mathematical thinking. This constantly developing account has been inspiring the work of mathematics education researchers and informing mathematics teachers' practices all over the world. It has had a major impact on both *what* we know about children's learning of mathematics and on *how* we know and think about it.

Terezinha Nunes' research has been immensely innovative and influential from its earliest stages. In one of her first studies, she documented the mathematical skills of young Brazilian street vendors who, although almost unschooled and incapable of executing paper-and-pencil arithmetic tasks, proved impressively proficient in complex money transactions. Understandings gained through this research have echoed throughout the mathematics education literature ever since the project's completion, for almost three decades now. It was one of those studies that, in the last quarter of the 20th century, revolutionized our thinking about learning—about its nature, origins and development. Conducted with David Carraher and Analucia Schliemann and summarized in their seminal book *Street Mathematics* (1993), this research made a decisive contribution to what is now known as the "situative turn" in the learning sciences at large, and in mathematics education in particular. Terezinha Nunes' contribution to this conceptual revolution has been evidenced, among others, by the widespread use of the term *street mathematics* and by the large number of cross-situational and cross-cultural studies on mathematics learning inspired by her work.

Terezinha Nunes' later research on the development of mathematical thinking, conducted in Brazil and the UK, spans multiple mathematical topics, from additive and multiplicative reasoning to fractions, variables, randomness and probability. She has studied children's logical reasoning and its role in the learning of mathematics, as well as problem solving and the way mathematics is being used in science. A special place in her work has been reserved for research on the mathematics learning of deaf children and for developing and testing innovative intervention programs based on insights thus gained. In parallel to the work of scrutinizing different types of mathematical thinking and their development, Terezinha Nunes has also systematically constructed a big picture of this development. As research findings have accumulated, she has been adjusting and refining her syntheses. Different versions of these cumulative, integrative accounts have been disseminated, among others, through her 2000 ICME plenary address, her 1996 book written with Peter Bryant *Children Doing Mathematics,* and the 2016 ICME monograph *Teaching and Learning about Numbers in Primary School*, which she co-authored with colleagues.

While forging her stories on children's thinking about numbers, Terezinha Nunes has been transforming her own thinking as a researcher. She has come a long way from being a traditionally trained clinical psychologist, whose research was firmly grounded in Piaget's ideas about human development, to being inspired by cultural psychology and the work of Vygotsky and his followers to at least the same extent. Hers is a special type of synthesis between cognitivist and sociocultural approaches. Today, she speaks about "mathematics learning as the socialization of the mind" and claims the utmost importance of cultural shaping. At the same time, she asserts the existence of cross-cultural invariants in children's mathematical thinking. If these two tenets may sometimes appear incompatible, she argues, it is only because different cultures build on the common elements to produce forms of mathematical competences diverse enough to make the cross-cultural invariants almost invisible. Another basic tenet of her work is that children's quantitative reasoning may and should be developed independently of, and possibly prior to, their numerical skills. These and many other of her research-generated insights on mathematics learning were novel to the mathematics education community when first announced. Careful to notice phenomena that have escaped the attention of investigators wedded to the "deficit model" of research, she portrayed children's mathematics in unprecedented detail and depth.

Terezinha Nunes' tendency for bridging apparent opposites and bringing the separate together finds its expression also in her attempts to improve the practice of teaching mathematics. Not a typical dweller of the ivory tower of academia, she has always made sure that her work finds its way to those for whom it was meant in the first place – educators, parents, and anybody interested in promoting children's learning. She has been consistently translating her research-generated insights into innovative pedagogies.

Trained as a psychologist, Terezinha Nunes began investigating children's mathematical thinking because of her professional interest in human development. Her studies soon began to attract the attention of mathematics education researchers, leading to her membership in the International Committee of PME (1986-1990; in 1989-1990 she served as Vice-President of PME) and on editorial boards of major mathematics education journals, *Educational Studies in Mathematics* (1989-1995) and *For the learning of mathematics* (2000-2004). Since then, she has been one of the most widely recognized members of the community of research in mathematics education. This, however, was not her only professional membership. An interdisciplinary thinker, who has been investigating children's evolving reading and writing skills in parallel to her work on mathematical thinking, Terezinha has enjoyed a prominent status also among developmental and cultural psychologists. Her insights about numeracy and about literacy constantly informed and enriched each other and combined together into a major advancement in our understanding of human development and learning in general.

Terezinha Nunes began her studies in psychology in her native Brazil and earned her masters and PhD degrees at City University of New York (1975, 1976, respectively). She began her academic career in Brazil at the Federal University of Minas Gerais and the University of Pernambuco. Later, she moved to the United Kingdom, where she taught at the Institute of Education, University of London, Oxford Brookes University and, since 2005, at the University of Oxford. She is now Professor Emerita at the University of Oxford and a Fellow of Harris Manchester College, Oxford. Throughout her career, she has completed tens, if not hundreds of studies, most of which were conducted in Brazil and in the UK. An exceptionally prolific writer, she has authored or co-authored more than a dozen books and almost two hundred journal papers, book chapters and encyclopedia entries in English and Portuguese. An ardent team player and highly appreciated teacher, Terezinha Nunes has been an inspiration to her colleagues and to her many students.

As an outstanding researcher driven by an insatiable passion for knowing, one who has made a paramount contribution to mathematics education and is likely to continue adding substantial insights for years to come, Terezinha Nunes is an eminently deserving recipient of the Hans Freudenthal Award for 2017.

The 2017 Felix Klein Award for life-time achievement in mathematics education research for Deborah Loewenberg Ball

Credit: University of Michigan

The Felix Klein Award, with which ICMI honors the most meritorious scholars within the mathematics education community, is given in 2017 to Deborah Loewenberg Ball, the William H. Payne Collegiate Professor in Education and an Arthur F. Thurnau Professor in the University of Michigan, Ann Arbor, MI, US. The Felix Klein Award 2017 is awarded to Professor Ball in recognition of her outstanding contributions and her leadership role in deepening our understanding of the complexities of teaching mathematics and in improving the practice of teaching and of teacher education.

These achievements are grounded in Deborah Ball's firm belief that research and practice of teaching are co-constitutive and must always be developed in tandem. Early in her life, Deborah Ball, at that time an exceptionally talented elementary school mathematics teacher, set out to investigate what was involved in the work of teaching children mathematics "for understanding." Her intention was to uncover the work in order to support the learning of teaching practice. Ever since then, her ambition has been to contribute in a substantial way to the project of improving ways in which mathematics teachers support their students' learning. This goal gave rise to two lines of work, both of them combining research with development in the domain of teacher education. The first strand, in which the research element came first, has been generating studies revolving around the question of what mathematical knowledge is required for teaching learners. In the second line of work, related to the practice of education in a more immediate way, the development of innovative teacher preparation programs has been combined with research, through which Deborah Ball has been trying to gain a better grasp of the moment-to-moment dilemmas with which teachers grapple in the classroom.

The first of these pursuits gave rise to the theory of MKT, Mathematical Knowledge for Teaching, the kind of knowledge that requires competence in both everyday and academic mathematical discourses, but is identical to neither. In her multiple studies, Deborah Ball and her colleagues have been able to identify many unique features of MKT, and then to corroborate the conjecture about a correlation between teachers' competence in this special brand of mathematics and the achievements of their students. With the support of a group of mathematicians, the theory has been translated into an instrument for measuring teachers' knowledge of mathematics for teaching. The MKT project proved highly influential, as evidenced by the widespread use of the term MKT and by the great popularity of Deborah Ball's publications on the topic. Her 2008 paper "Content knowledge for teaching: What makes it special?" co-authored with Mark Hoover and Geoffrey Phelps Thames, which appeared in the *Journal of Teacher Education,* is one example of such a widely read article.

The second, newer strand of Deborah Ball's work is centered in TeachingWorks, a national organization she established at the University of Michigan to help in improving teachers' preparation and to define "a professional threshold for entry to teaching." The mission of the institute is to identify "high-leverage" teaching practices, that is, those recurring elements of teacher's classroom activities that are central to what Deborah Ball terms "the work of teaching." It is also part of the mission to work in partnerships with others to improve the preparation of teachers. To this end, Deborah Ball has been carrying in-depth analyzes of the ways in which mathematics teachers juggle their multiple classroom tasks, such as interpreting the learner's often idiosyncratic ways of thinking, gradually transforming the children's special understandings into more canonical ones, sustaining equitable learning dialogue and taking care of the emotional well-being of the students. This line of Deborah Ball's research, while relatively new, seems to be an attempt to close the circle that opened with the early reflection on her intuitive efforts, as a teacher, to identify and to bridge the gap between her own mathematics and the mathematics of her students. Indeed, this current research project harks back to Deborah Ball's early publications, such as her now classical 1993 article "With an eye on mathematical horizon: Dilemmas of teaching elementary school mathematics", in which the memorable case of "Sean numbers" helped the author to highlight challenges of classroom teaching.

Deborah Ball has played multiple leadership roles, and not only within community of mathematics education but also within that of education at large, and not only within United States, but internationally. In all these arenas, hers was a systematic effort to build bridges. Her years-long work on bringing together research and practice of mathematics education is just one example of these attempts. Another expresses itself in her striving for a fruitful collaboration between the communities of mathematicians and of mathematics educators. In this later undertaking, she has been acting on her strong belief that certain differences of opinions on mathematics and on teaching that arise occasionally between these two communities, far from being an obstacle, are likely to help in creating a synergetic partnership.

Deborah Ball's achievements as a researcher and a leader have been recognized nationally and internationally. This recognition is signaled, among others, by the unprecedented frequency with which her publications are cited by other authors, by her great popularity as a speaker, by her multiple roles within ICMI and by her membership of numerous policy-making or advisory committees, such as the National Science Board, appointed by President Barack Obama. Whereas her work is firmly grounded in mathematics education, the recognition of its outcomes goes well beyond the community of mathematics education. This is evidenced by Deborah Ball's prestigious membership in the National Academy of Education and by her current roles as the President of the American Educational Research Association and as a member of the American Academy of Arts and Sciences.

Deborah Ball has been an elementary classroom teacher before and during her studies at Michigan State University, which she completed in 1988 with a PhD in mathematics education. Upon graduation, she joined Michigan State University, and in 1996 she was recruited to the University of Michigan to develop the mathematics education group.

She has been teaching at the University of Michigan ever since then and also spent over a decade serving as Dean of the School of Education there.

With more than thirty years of outstanding achievements in mathematics education research and development, Deborah Ball is a most distinguished member of mathematics education community and a highly deserving recipient of 2017 Felix Klein Award.

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