Mary P. Dolciani Award

The Mary P. Dolciani Award recognizes a pure or applied mathematician who is making a distinguished contribution to the mathematical education of K–16 students in the United States or Canada. The award is named for Mary P. Dolciani Halloran (1923–1985), a gifted mathematician, educator, and author, who devoted her life to developing excellence in mathematics education. A leading author in the field of mathematical textbooks at the college and secondary school levels, she published under her professional name Dr. Mary P. Dolciani. This award is made possible by a gift from the Mary P. Dolciani Halloran Foundation.

Roger Howe
Texas A&M University

Roger Howe earned a BA in mathematics from Harvard College in 1966 and three years later a PhD from the University of California, Berkeley. For more than 50 years, Howe has made important contributions to mathematics and to mathematics education, at the State University of New York at Stony Brook, Yale University, and Texas A&M University. He has also held visiting positions at 21 universities and research institutes.

In recognition of his many achievements, Howe has been named a Guggenheim Fellow, a Fellow of the Japan Society for the Advancement of Science, a Fellow of the American Mathematical Society, and an Elected Member of the National Academy of Science, the American Association of Arts and Sciences, and the Connecticut Academy of Science and Engineering. He has also received the Lester R. Ford Award from the MAA and the AMS Award for Distinguished Public Service.

As a research mathematician, Roger Howe has made fundamental contributions to representation theory, a field with deep connections to harmonic analysis, number theory, automorphic forms, and mathematical physics. Among his contributions is the introduction of the notion of "reductive dual pair" which is also called the "Howe pair."

Howe's Mary P. Dolciani nomination summaries his contributions to mathematics education as follows: "Roger Howe's work in mathematics education combines his broad knowledge and deep insight in mathematics with his substantial and collaborative engagement with all aspects of the education enterprise —classroom practice, teacher education, curriculum and standards, assessment, education research, and international comparisons—and at all levels, K–16. This work has been expressed in two modes: active membership in many influential policy and advisory groups, both national and international; and through a series of profound essays on the mathematical nature of early mathematics learning."

In the early 1990s, Howe began thinking seriously about the mathematics education of younger students. His insights caused him to revise his own undergraduate instruction, making it more interactive and more supportive of student mathematical agency. In 1997, he received the Yale College Dylan Hixon '88 Prize for Teaching Excellence in the Natural Sciences. The award presentation included the statement:

> If mathematics is a language, you certainly speak it beautifully. Fortunately, for those who are not themselves native speakers, you have demonstrated a gift for making fundamental concepts in the structure of mathematics become familiar and intelligible.

Howe's interest in undergraduate mathematics teaching also led to his 2007 geometry textbook with William Barker (Bowdoin College): "Continuous symmetry: From Euclid to Klein."

Howe's initial involvement with K–12 mathematics education was through policy and committee work. He was a member of the NRC Mathematical Sciences Education Board (1995–98); chair in 1998 of the AMS Consultative Committee to the NCTM mathematics standards revision; member of the Steering Committee for The Mathematical Education of Teachers report (1998–2001); member of the NRC Study

Committee that wrote Adding it Up (1999–2000) and member of the RAND Mathematics Study Panel that wrote Mathematical Proficiency for All Students (2000–03). In 2000 he began the first of two three-year terms on the AMS Committee on Education, serving as chair from 2000–04. At the same time, he served as Undergraduate Program Coordinator for the Park City Mathematics Institute (2000–08) and served on four College Board panels, committees, and commissions between 2002 and 2012.

Stemming from this involvement, Howe wrote a review of the book Knowing and Teaching Elementary Mathematics by Liping Ma, which highlighted the large differential in mathematical understanding between the elementary teaching corps in the US and China. This was published in *NOTICES of the AMS* (September 1999), and was reproduced in the *Journal for Research in Mathematics Education of the NCTM* (November 1999). Recently, he wrote a revisitation of the book, including a summary review of the US policy response, for the *AMS NOTICES* (June/July 2020). This has been republished in *The Best Mathematics Writing of 2020*, produced by Princeton University Press.

Later, Howe served on the U.S. National Commission on Mathematics Instruction (2006–15) and the Executive Committee of the International Commission on Mathematics Instruction (ICMI). His work with the ICMI led to the first ICMI Study on primary mathematics in Macao, China, and the publication, *Proceeding of ICMI STUDY 23: primary mathematics study on whole number*. Other service roles include serving on over 10 advisory boards, expert panels, and planning boards including the MSRI Education Advisory Committee. Other influential publications to which Roger Howe has significantly contributed are *Focus in High School Mathematics: Reasoning and Sense-Making* (NCTM, 2009); and *The Teacher Development Continuum in the United States and China* (National Academies Press, 2010). The latter is the proceedings of a workshop in China that Howe conceived and helped implement while a member of the USNCIM.

Roger Howe also began to teach teachers mathematics including serving as a seminar leader at the Yale New Haven Teachers Institute for ten summers between 2004 and 2019, an instructor at the University of Chicago's Project SESAME twice, and an instructor at the UCLA Summer Institute for Elementary Teachers in 2016.

In addition to his many service contributions and his involvement in writing influential publications to guide mathematics education in the U.S., Howe has contributed deep and nuanced understandings of the mathematical foundations of early school mathematics, with a special focus on place value. His thoughts about the amazing power of place value notation are found in an editorial he wrote in 2011 for the *ICMI News* titled "The greatest calamity in the history of science". The title references a comment of Gauss that Howe is fond of quoting: "The greatest calamity in the history of science was the failure of Archimedes to invent positional notation." Among Howe's many other insightful essays, are: "The three pillars of first grade mathematics", on the taxonomy of early computational tasks, the design of corresponding word problems, and connecting counting number with measurement number, along with using the addition facts to also begin the study of base ten structure; "From arithmetic to algebra", which represents algebra organically as generalized arithmetic; and "The Most Important Thing for Your Child to Learn about Arithmetic," which argues for a specific ingredient in learning arithmetic with understanding.

In 2015, a conference was held at Texas A&M in honor of Roger Howe. The event led to a book, *Mathematics Matters in Education: Essays in Honor of Roger E. Howe*. He has also served as co-editor, with Yeping Li (Texas A&M), W. James Lewis (U Nebraska, Lincoln) and James Madden (LSU), of proceedings of several workshops on mathematics education convened since 2016 at Texas A&M. Since 2016, Roger Howe has served on the faculty of Texas A&M because it presented him with an opportunity to extend his work in mathematics education.

For his distinguished career as both a research mathematician and one of our most influential mathematicians devoted to improving the teaching and learning of mathematics in the United States, Roger Howe is an outstanding selection for the 2022 Mary P. Dolciani Award.

Response

I am deeply grateful to MAA for selecting me for its Dolciani Award. I have had great respect for the work of previous Dolciani awardees, and am humbled to be joining them. It gives great satisfaction that some of what I have tried to do about math education, in several arenas over several decades, has been found worthy of recognition.

My thinking about mathematics education has been influenced by many people from several communities. I should mention especially Richard Askey, Chih-Han Sah and Hung-Hsi Wu, who started the MathEd discussion group, in operation since 1995. Its participants include several dozen of the US mathematicians most committed to mathematics education, including several Dolciani Awardees, as well as selected mathematics educators, teachers and mathematicians from Canada and the UK. Deborah Ball's pursuit of the idea of mathematical knowledge for teaching has had significant impact on my thinking. I am also grateful to Yeping Li for bringing me to Texas A&M, to work directly on improving the mathematical training of their elementary education majors.

On a personal level, concern for mathematics education helped me focus on improving my own teaching. This made teaching a much more rewarding activity for me, and led to ongoing relationships with students over many years. It also made possible my participation in the Yale Teachers Institute, and fruitful interactions with its highly dedicated K–12 teacher Fellows.

In thinking about mathematics education in the US, I have tried to hear the silences in our curriculum —important ideas that do not get explicit attention—that may lead to student failure to master key topics. This issue has motivated much of my writing about mathematics education. In order to achieve the main goal, of significantly improving mathematics education in the U.S., teachers will have to be given the opportunity to understand these gaps and to learn how to fill them.

Biographical Sketch

For over 40 years, from 1974 to 2016, Roger Howe taught and did research in the Mathematics Department at Yale University. His mathematical research investigates symmetry and its applications. He has held visiting positions at many universities and research institutes in the US, Europe and Asia. He is a member of the American Academy of Arts and Sciences and the National Academy of Sciences. In 2016, Dr. Howe accepted the Curtis D. Robert Professorship in the Department of Teaching, Learning and Culture at Texas A&M University. There he is leading a team of mathematicians and mathematics educators in a project to produce more effective preparation in mathematics for elementary teachers. More informally, Dr. Howe has devoted substantial time to issues of mathematics education for three decades. At Yale, he has led numerous seminars on topics in mathematics for the Yale Teachers Institute.

He served on a multitude of committees, including those for several of the major reports on US math education. He served as a member and as chair of the Committee on Education of the American Mathematical Society, and on the Steering Committee of the Park City/IAS Mathematics Institute. In that role, he helped to organize a series of meetings devoted to increasing the contribution of mathematicians to mathematics education, especially to refining understanding of the mathematical issues in K–12 mathematics curricula, including the meeting of mathematicians, mathematics teachers and school administrators that led to the creation of the Common Core State Standards for Mathematics. He served on the US National Commission on Mathematics Instruction from 2006–2016, and as a member of the Executive Committee of the International Commission on Mathematics Instruction from 2010–2016. In 2006, he received the Award for Distinguished Public Service from the American Mathematical Society.