Vale Norman Lederman (1952-2021)

Norman Lederman, an internationally known and respected science educator, died after a short illness on February 2021 in Rhode Island, USA. Norm and Judy, his wife and research partner of many years, had recently relocated from Chicago to enjoy retirement years with their family and Norm's stepchildren. Pleasingly Judy was at his side when he passed away. There is no best way to go, but that is a good way.

Norm well embodied in his 47-year career the oft-sought goal of bridging the worlds of science teachers, science teacher educators, and academic researchers.

HPS&ST Involvement

Over the past 30 years Norm was engaged with the HPS&ST research community. In 1992 the journal *Science & Education: Contributions from HPS* was founded and from the earliest years, Norm was a valued Editorial Committee member and reviewer. In the same year Norm published an article that comprehensively reviewed the research literature on teaching NOS.

Lederman, N.G.: 1992, 'Students' and Teachers' Conceptions of the Nature of Science: A Review of the Research', *Journal of Research in Science Teaching* 29(4), 331-359.

It was published in a *JRST* thematic issue jointly edited by Rodger Bybee, James Ellis and myself. It deservedly became one of the most cited articles published in the journal.

In 1995 I invited Norm to respond to a substantial article on **'The Nature of Scientific Thought'** by the Australian philosopher Wallis Suchting who had been one of my philosophy teachers at University of Sydney. Norm's thoughtful response was:

Lederman, N.G.: 1995, 'Suchting and the Nature of Scientific Thought: Are we Anchoring Curricula in Quicksand?', *Science & Education* 4(4), 371-377.

In the article he concluded:

> There is little doubt that many will wish to quibble with Suchting's philosophical analysis and ultimate conclusions. However, his analysis does raise serious questions regarding our current approach …. to science instruction and curriculum. Failure to carefully consider the concerns raised by his analysis of scientific thinking may result in science curricula and approach to science instruction that clearly misrepresents the scientific enterprise.

Norm contributed to the 1995 IHPST Minneapolis conference and his paper was subsequently published:

Lederman, N. G. (1999). **Teachers' understanding of the nature of science and classroom practice: Factors that facilitate or impede the relationship**. *Journal of Research in Science Teaching*, 36(8), 916-929.

With a number of his colleagues and students he contributed to the IHPST 1999 Lake Como conference.

Abd-El-Khalick, F., & Lederman, N. (1999, September). *Success of the attempts to improve science teachers' conceptions of nature of science: A review of the literature.*

Lederman, N., Bell, R., & Abd-El-Khalick, F. (1999, September). *Developing and acting upon one's conceptions of the nature of science.*

In 2012 he was a plenary speaker at the IHPST regional conferences in Seoul; and he participated in other IHPST international and regional conferences.

As is documented below, Norm put 'Nature of Science' or NOS on the international science education curriculum, teaching and research agenda. He was a welcomed lecturer and teacher in countless countries. Norm and co-workers elaborated and defended a seven-point characterization of NOS. They maintained that the list was framed in accord with three principles: accessibility to school students; wide enough consensus among historians and philosophers; and being useful for citizens to know. There are nearly 40,000 citations of Norm's authored and co-authored NOS publications.

There were, of course, critiques of minor and major parts of his research programme; but these debates were healthy, clarifying and advanced the main field. For instance, the 12 contributions to Myint Swe Khine's anthology ***Advances in Nature of Science Research*** (Springer 2012) include critical pieces. One of these is my own chapter that has a section titled 'The Devil is in the Detail: The Need for Philosophical Articulation'. The matter of philosophical sophistication in NOS debate was a topic that Norm and myself discussed in numerous convivial meetings in many lands, usually over a beer, or for Norm a whiskey. The anthology also contains elaborations by Norm, Judy and other well-known NOS researchers, including two of his earliest students Renee' Schwartz and Randy Bell.

Career

Shortly after earning his B.S. and M.S. degrees in biology from Bradley University (1971) and New York University (1973), respectively, Norm taught biology for a decade to high school and community college students in Illinois and New York, as well as college students at Syracuse University. During those years, he earned an M.S. in secondary education from Bradley (1977) and Ph.D. in science education from Syracuse University (1983), studying under Dr. Marvin Druger. Norm held assistant professor positions in science education and teacher education at Syracuse University, State University of New York–Albany, and Oregon State University (OSU). In 2001, he chaired OSU's Department of Mathematics and Science Education, and left that year to establish and chair the Illinois Institute of Technology's (IIT) new Mathematics and Science Education Department.

In 2011, Norm was named an IIT Distinguished Professor. By the time of his retirement in 2020, his IIT department had become a local, national, and international force in discipline-based mathematics and science education. Along the way, Norm was a Visiting Research

Professor at National Changhua University of Education, Taiwan; Fulbright Scholar at the University of Pretoria, South Africa; Honorary Professor at the Hong Kong Institute of Education; Guest Professor at Beijing Normal University, China; and Distinguished Foreign Expert at the State Administration of Foreign Affairs, China. At the time of his death, Norm was a "virtual" visiting professor at the University of Science and Technology of China.

Research and Publications

Norm was an intellectual force and prolific researcher. He studied preservice and inservice science teachers' knowledge structures of subject matter and pedagogy, pedagogical content knowledge, and teachers' concerns and beliefs. Norm is best known for his research on teaching and learning about nature of science (NOS), a robust domain of research in science education that is inextricably linked with his name. Norm's 1992 review of the research literature on NOS published in the *Journal of Research in Science Teaching* (JRST) continues to be one of the top five most cited papers in our field. This paper has shaped research on NOS in science education for the past 30 years.

Over his distinguished career, Norm published more than 200 articles in professional refereed journals and 46 book chapters. He authored or edited 11 books, including an elementary science teaching methods textbook. Norm co-edited with Sandra Abell the *Handbook of Research on Science Education: Volume I* (2007) and *Volume II* (2014), and was editing *Volume III* of the handbook, with Dana Zeidler and Judy Lederman, at the time of his passing. Norm has given more than 1000 presentations, invited talks, and keynote addresses at regional, national and international professional conferences and meetings, as well as universities around the globe.

His work has been heavily cited with 38,000+ citations on Google Scholar (h-index = 70; i10-index = 153) and 6,400+ citations on the Web of Science® (h-index = 33; i-10 index = 45).

Editorship

Norm's research leadership extended to shaping the field through extensive engagement in the editorship of professional journals. He served as co-editor of the *School Science and Mathematics Journal*, and *Journal of Science Teacher Education* (JSTE), as well as associate editor for *JRST*, *JSTE,* and *International Journal of Science Education*, among many other journals. Norm served on the editorial boards of some 15 science education journals across the globe.

Teaching and Supervision

Norm taught and mentored hundreds upon hundreds of science students, preservice and in-service science teachers, and graduate students in science education in the United States and across the globe. He was major professor to 51 doctoral students, mentoring them into successful careers of their own. These included: Fouad Abd-El-Khalick, Valarie Akerson, Selena Bartels, Randy Bell, Huey-Por Chang, Julie Gess-Newsome, Shiang-Yao Liu, Tisha Morrell, Judy Morrison, Gary Holliday and Renee' Schwartz. Norm was an exceptional mentor and treated his doctoral students as family; in turn he was considered as family by all.

For his work, Norm received the Illinois Outstanding Biology Teacher Award from the National Association of Biology Teachers (1979), as well as the Presidential Citation for Distinguished Service (1986) and Outstanding Mentor Award (1998) from the Association for the Education of Teachers in Science (AETS).

Recognition

Additionally, Norm provided significant service and leadership to major national and international organizations across science teaching, science teacher education, and science education research. He was elected president of AETS (1994), member of the board of directors (1994–1998) and director of teacher education (1996–1998) of the National Science Teachers Association (NSTA), and NARST executive board of directors (1997–2000) and then NARST president (2002). He also served as the North American representative to the International Council of Associations for Science Education (2004–2010). For this extensive service and leadership, NSTA recognized Norm in 2017 with the Distinguished Service to Science Education Award.

For his scholarship, Norm was elected Fellow of the American Association for the Advancement of Science (2009) and American Education Research Association (2010). He was recognized with an honorary doctorate from the University of Stockholm, Sweden (2008). In 2011 NARST honored him with the Distinguished Contributions to Science Education through Research Award for his outstanding and continuing contributions, notable leadership, and substantial impact in the area of science education.

Norm will be sorely missed by Judy, his family, and so many close friends around the world. But his special contributions in making HPS&ST research engaging and interesting for science teachers will surely live on.

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