Gerhard L. Salinger

Many industrial arts, technology education, and now technology and engineering education leaders have made their mark on our profession. Their legacy is something that members of the profession enjoy and have a responsibility to continue and build upon.

This is the nineteenth in a series of articles entitled "The Legacy Project." The Legacy Project focuses on the lives and actions of leaders who have forged our profession into what it is today. Members of the profession owe a debt of gratitude to these leaders. One simple way to demonstrate that gratitude is to recognize these leaders and some of their accomplishments. The focus in this issue will be on Dr. Gerhard Salinger.

by Gerhard L. Salinger
and Johnny J Moye, DTE

I...realized that technology educators could make strong contributions to science education by providing real-world contexts for learning science.

Dr. Gerhard L. Salinger

Place of Birth: Berlin, Germany, August 25, 1934

Married to: Evelyn since June 21, 1958
Children: David, Peter, Andrew, four grandchildren

Degrees:

- B.S. Yale University (Physics)
- M.S. University of Illinois (Physics)
- Ph.D. University of Illinois (Physics)

Occupational History:

- Univercidade de Sao Paulo, Visiting Scientist
- Rensselaer Polytechnic Institute, Assistant, Associate, Full Professor of Physics, Chair of the Department (11 years)
- National Science Foundation, Program Officer in the Division of Research on Learning in Formal and Informal Settings (and predecessors), Co-Lead Program Officer of the Advanced Technological Education program.

Technology education funding through the National Science Foundation (NSF) was practically nonexistent until you started your career there. Why were you interested in developing the profession through various projects, and what did you do to start the long relationship that followed?

I came to the NSF in 1989, after having been a faculty member in the Physics Department of Rensselaer Polytechnic Institute for 25 years. I was asked to be a program officer in the Division that funded projects in K-12 STEM education. My main experience with K-12 education came through my three sons, serving on school committees and serving on a school board for five years. The then head of the Directorate for Science and Engineering Education suggested to me that NSF needs to do more for the average student. I called my middle son who had just graduated from SUNY Oswego in technology education and asked him about the organization that supported technology education nationally. I was put in touch with ITEA and met its then Executive Director, Kendall Starkweather, who quickly sent several leading technology educators to see me, and I met many more at the first ITEA conference I attended in Indianapolis. These men (they were all men then) educated me about technology education.

As I pointed out, my background was physics and not science education, although I had an interest in physics education at the college level as well. At Rensselaer—primarily an engineering school—I became acquainted with engineering. I wondered how students came to know that they wanted to study engineering—leave alone what kind of engineering. As I was learning about science education, I realized that the pedagogies that science educators were striving for were being used by technology educators—project based, teacher facilitation, etc. Thus the discussion with technology educators became of interest. It was also pointed out to me that even in high school science courses, mathematics became a gatekeeper. Technology education, with its emphasis on outcomes, might also be a way to engage more students in the study of science while also learning technological concepts and practices. The technology educators seized the opportunity and began to write proposals to develop instructional materials that engaged students in the study of technologies that also illustrated scientific principles.

You helped provide experiences for a whole series of technology educators through the NSF rotators program. Who were those professionals, and what was the objective of having them work at NSF? What kinds of projects and experiences did they work on?

Although NSF had funded a few technology projects in the past, there was little understanding of technology education at NSF in the 1990s. I asked Kendall Starkweather to review some proposals to help educate the reviewers about technology education and to expose technology educators to the new ways of teaching science. An opportunity arose to bring a technology educator to NSF on a trial basis to learn how technology education would fit into the programs in the Division of Instructional Materials, Research and Informal Education. On the advice of technology educators, Collen Hill, an enthusiastic young technology educator from California State University at Long Beach, was hired in a temporary position. The Division became convinced that the development of instructional materials and professional development in technology education should be part of the education of all students.

At the time STEM could be written as St_ M. Nationally renowned science educators such as Jim Rutherford, Rodger Bybee, and George Nelson also became interested. With the leadership of program officers with deep knowledge of technology education like Franzie Loepp, Ted Lewis, Rodney Custer, Dan Householder, Marie Hoepfl, and Karen Zuga, the T became large and engineering concepts began to be part of the program (STeM). At the NSF, they were Program officers, providing advice to proposers, constructing review panels, and making the case for funding proposals or not. They participated in writing Program Solicitations and setting policies and procedures. They also made contacts in other Divisions of the Education Directorate and in other Directorates such as Engineering and also began to serve on panels at the National Academies of Science and Engineering—providing input on technology education into their studies.

Next Generation Science Standards (published in 2013) emphasized engineering education in the service of science education, and the Division of Research on Learning moved more toward educational research in science, mathematics, and engineering. Thus, it became more difficult to find technology educators with these interests and skills and who would come to the NSF for two years. How to teach science through design is an important issue. The present direction for grants seems to be to provide professional development on engineering design for science teachers rather than also providing professional development in science and mathematics for technology educators. In my opinion, the technology and engineering educators associations (ITEEA and ASEE) should be encouraging technology and engineering educators and researchers to apply to become program officers in programs in the Directorate of Education and Human Resources at NSF. Their understanding of the teaching of technology and engineering concepts and practices in K-12 would benefit the programs, and their exposure to research and implementation efforts across the nation would be very helpful in establishing a career path.

In 2004 the NSF Centers for Teaching and Learning program funded the Center for Engineering and Technology Education—a partnership of five universities, five technology teacher education programs, and 15 school districts. The purpose was to provide graduate education for technology educators that emphasized introducing more engineering concepts and educational research into the education of aspiring technology and engineering educators. In addition, for several years, young investigators in the 21st Century Leaders program of ITEEA and FTEE were brought to the NSF. NSF program officers provided information and answered their questions. The idea was to make them aware of NSF programs and how to address their research and development interests within existing programs.

How did NSF determine the funding directions during your Program Officer years? Were they effective? Why?

Programmatic directions at NSF are developed in two ways. Program officers present ideas in Division meetings. Some of these ideas stem from conversations with prospective proposers who have ideas that do not fit into present programs. Others may come from review panels or from the program officers themselves. The Assistant Director and Division Directors may also present ideas for changes in program direction. After some discussion, these ideas become part of a Program Solicitation developed by program officers and reviewed by NSF administration.

In the early 1990s, Congress requested that NSF fund STEM technician education at two-year colleges and preparation for that in secondary schools. Because of my interest in technology education, I was asked to develop and co-lead the program with Dr. Elizabeth Teles, a former two-year college mathematics instructor. The Advanced Technological Education (ATE) program built a community of STEM technician educators at both the community college and secondary education level in a variety of disciplines, from agriculture and biotechnology to information technology to manufacturing to photonics, etc. ATE supports professional development for teachers in technical subjects and encourages relationships between community colleges and high school Career and Technical Education programs. Students with backgrounds in technological subjects are encouraged to continue their education at the community college level. The technology educator program officers participated in developing solicitations, encouraged proposals, reviewed proposals, and recommended awards.

You were the NSF Project Leader and a primary supporter for the Technology for All Americans Project that went on to create the* Standards for Technological Literacy *content standards, with supportive standards related to professional development, programs, and assessments. Did the project accomplish what you originally envisioned? How did the results position our profession both in and outside of our subject area?

I came to NSF at the time of development of educational standards. The NCTM Standards were written, and the AAAS Project 2061 project, which included technology education, was in full swing. The Science Standards, in which it was not clear that technology would be included, were just being developed. The technology educators requested funding to develop *Standards for Technological Literacy*. First they developed *Technology for All Americans: A Rationale and Structure for the Study of Technology*. Based on this work, ITEA was granted a project to develop *Standards for Technological Literacy* and *Advancing Excellence in Technological Literacy*. As the Standards were being developed, the National Academy of Engineering (NAE) was approached to review them. NAE made several important suggestions, and William Wolf, then President of NAE, wrote a forward to the Standards. In this process, I reminded the project leadership that the Standards were about Technology Education and not technology educators. There are many places in the STEM curriculum that could include the study of technological concepts and practices.

The Standards had a very positive influence on technology education in that they provided a coherent model of the content and practices to be learned. Before the Standards, students engaged in technological projects, but there was no underlying framework for what was to be learned. The Standards gave direction to technology educators in colleges and in schools. More interest developed in developing the ideas of design, trade-offs, and societal needs in teaching. The National Academy of Engineering, under the leadership of program officer Greg Pearson, developed several other documents that influenced the support of the NAE for the study of technology and of engineering K-12. A definite move toward engineering education ensued. Designs became based more on scientific and mathematics principals rather than on cut and try. Now *Next Generation Science Standards* embody engineering concepts and practices. The ideas of technology education are at the table.

What were some of the most important decisions that you made while working with NSF STEM educational programs, and what were some of the unrealized expectations?

Perhaps the most important decision was made for me by placing me in the NSF Division that funded K-12 education rather than in the Undergraduate Division in which I had much more experience. I had to learn about K-12 science education and realized that technology educators could make strong contributions to science education by providing real-world contexts for learning science. I thought that student experience with technology and engineering education in K-12 might also inform students about the career opportunities in engineering. I am concerned that the emphasis on K-12 technology and engineering education is waning at a time when K-12 schools embrace more of the ideas.

A second decision made for me was being asked to co-lead the Advanced Technological Education Program. This program has built a large community that is improving education of technicians at two-year colleges. The ATE program is strengthening Career and Technology programs in high schools by providing a path to well-paying, rewarding careers. It has provided the basis for other federal programs for community colleges.

What leadership characteristics made you successful in promoting technology and engineering education, given the advent of STEM education and the inclusion of engineering education at the pre-university level?

I was fortunate to have Division Directors who encouraged experimentation based on plausible ideas, and I exploited the opportunity. I had a more extensive background in the content of physics and engineering than my colleagues and could make a convincing case. I enjoyed working with creative people who wanted to try new approaches. Having left my own physics research program to develop a strong physics department, I learned that the pride of enabling can be a good alternative to the pride of doing. I am proud of the work that I was able to enable.

Thank you Dr. Salinger for your service to the technology and engineering profession and for sharing some of the highlights of your career.

The Legacy Project has now interviewed 19 very influential leaders. It is beneficial for current (and future) leaders to read about the issues that existed and how they were addressed "back in the day." In a few months the next interview will appear in this journal. If you have a suggestion of a leader to recognize, contact johnnyjmoye@gmail.com with that person's name and contact information.

Gerhard L. Salinger, Ph.D., *served as a visiting scientist at the Universidad de São Paulo, Physics Professor and Department Chair at Rensselaer Polytechnic Institute, and National Science Foundation Program Officer.*

Johnny J Moye, DTE *serves as ITEEA Senior Fellow. He is a retired U.S. Navy Master Chief Petty Officer, a former high school technology teacher, and a retired school division CTE Supervisor. Johnny can be reached at johnnyjmoye@gmail.com.*