

Preface

In 1989, I was the assistant dean at Thayer School of Engineering at Dartmouth College in Hanover, New Hampshire. In consultation and collaboration with the dean and several faculty members, I invited a dozen mathematics and science teachers from New Hampshire, Massachusetts, and Vermont, to sit down with us for a couple of days to consider to what extent Thayer School might offer a program of value for teachers. Self-interest was in part the motivation. Thayer School wanted to develop better relations with teachers so that they might have an appreciation of Dartmouth's undergraduate engineering program and might then encourage their top students to consider applying to Dartmouth to study engineering.

From this set of discussions arose the plan for what came to be called "Engineering Concepts for the High School Classroom," a summer workshop first offered in 1990. The workshop was designed to introduce high school science and mathematics teachers to a creative problem-solving framework based on techniques used by engineers at work. This framework had been developed through an unusual but highly successful undergraduate engineering course taught at Dartmouth since the early 1960s, and developed as a means of introducing students to the practice of engineering. Teachers were quite interested in learning more about methods for approaching open-ended problems with their students and felt ENGS 21* might offer a useful model.

From the beginning, we explained to participating teachers that the workshop's success would depend on them. We could provide information about engineering and engineering problem solving, but we were not experts in pedagogical theory or technique and knew little about K-12 education. We would need to work as partners to create value from the endeavor. This approach has worked well, and what is now called the Dartmouth Project for Teaching Engineering Problem Solving truly is a partnership between Thayer School—its faculty, staff, and leadership—and a growing number of teachers involved with the program.

Teachers have been enthusiastic about the workshop. Many who had attended different professional development workshops and clinics over the years told us that "Engineering Concepts" was unique in both its content and usefulness. They urged me to find ways not only of continuing to offer it in future years, but to expand its initial goals and impact; over the last seven years they have worked with me to provide guidance for doing so. Through the partnership with teachers and the inspiration they have given me, I have learned a great deal more about education and effective teaching and learning, and expanded not only my interests and understanding, but also my circle of colleagues and friends. Teachers in the U.S. today are under-recognized and under-supported for their considerable knowledge, energy, and effective strategies for the many challenges facing them, but those participating in our workshops are among the most dedicated, thoughtful, and open-minded professionals I have met.

A major factor in our partnership's success has been Professor John Collier's generous, open-minded approach in sharing the techniques which have worked well for him in teaching, in research and development, and in life. A master teacher with obvious respect for his students as colleagues, John has also taught us that an important "spec" for problem solving, for teaching and learning, and in fact for all endeavors, is fun. A second important factor has been the Thayer staff who have worked in supporting the workshop and its

*"Introduction to Engineering," known in its early years as ES 21, is now ENGS 21, or "ENGINES 21."

participants and who are listed in the Acknowledgments. Year after year, teachers have commented on the dedication, service, and support provided by Thayer staff members whose goal has been quality in performance, and who achieve it. This endeavor also owes a great deal to Charles Hutchinson, ninth dean of Thayer School, who has supported the project and my work at every turn, frequently with his own highly effective personal energy, time, and dedication, because he thought it was the right thing to do.

Prior to the development of the Engineering Concepts for the High School Classroom workshop, the problem-solving framework which served both introductory and capstone engineering courses at Thayer School had largely been an oral tradition, passed along from one professor to another as they taught the courses. Some of the participants in the first workshop in 1990 returned as “TAs” in 1991 and began to document the framework in what they called “A Paper Partner.” The following year, the next group of TAs expanded and revised the paper partner, and we began to develop the documentation into a much larger resource manual for workshop participants. Some of that early documentation appears, somewhat modified, in this book.

As the years have gone by, the workshop has not been able to accommodate the increasing numbers of teachers interested in learning about engineering problem solving. Approximately three-quarters of the 185 teachers who participated in the workshop between 1990 and 1996 have gone on to implement the methods in their teaching, many with impressive results, a few of which are documented here. This book was developed as one means of reaching out to teachers who could not attend the workshop to provide the information, and in some part, the inspiration, for them to use problem solving in their teaching. It may also prove useful to the many other people—school administrators, school board members, policy makers, parents, and other taxpayers and donors—who care deeply and work hard to support teachers in their mission of educating the children of our nation, the future of our society.

I am particularly grateful to the John Brown Cook Foundation for providing the financial means to develop this book, and to Ellen Frye, who undertook the project of writing it with experience, skill, devotion, and a critical eye for detail and improvement. Marian Miner Cook, Greg Cook, Cia Cook, and Leo McKenna of the Cook Foundation understood the need and had faith in our vision and approach.

Carol B. Muller
Executive Director
Dartmouth Project for Teaching Engineering Problem Solving