PREFACE

Historically the Education Research and Methods Division (ERM) of the American Society for Engineering Education (ASEE) has provided leadership in research and innovation in teaching engineering. Five or so years ago the Division began to review its role and to look to the future. This book arose out of these discussions.

As part of my contribution to the debate, as a result of discussions with the group, I produced a paper on the need for instructional leadership in engineering education. It was used as a background paper for a seminar organized by the ERM Division at the Kansas City Frontiers in Education Conference (AD 2000), and it was published in the conference proceedings.

When I revised and extended this paper I replaced the term instructional leader with that of curriculum leader. This extended version of the paper was used as a background report for the Forum on Engineering Education Leadership that resulted from the Kansas City seminar.

Dick Culver, in his introduction to the Forum, used Astin's recently published definition of leadership to focus on the purposes of the Forum. He summarized it as follows:

"Leadership involves fostering change, implies intentionality, is inherently value-based, is by definition a group process, and thus depends on collaboration."

Or, to put it in the way of the New Shorter Oxford Dictionary (1993) it is the ability "to lead or influence." Culver took the view that this necessarily involved change, thus by definition a leader is a change agent.

Culver argued that while there was a substantial body of research that supported the need for new approaches to teaching in higher education, this knowledge remained the preserve of educational researchers and a few dedicated teachers. The first objective of this book is to make the knowledge accumulated from research and innovation in the curriculum and instruction in engineering education more generally available.

He quoted from John T. Bruer's The Minds Journey. From Novice to Expert to support his case. "Teaching methods based on research in cognitive science are the educational equivalents of polio vaccine and penicillin. Yet few outside the educational research community are aware of these breakthroughs or understand the research that makes them possible."

This is the case worldwide, irrespective of the drive in some countries to evaluate university teaching. If evaluations are done by peers, then it is the case of the ignorant (I do not mean to depreciate) leading the ignorant, and such assessments are often carried out within a very limited notion of what constitutes good or effective teaching.

Teachers in higher education are accountable, if only to their profession. If they believe they are an expert profession, then they have obligation not only to ensure that beginning teachers have an adequate training but to be aware of the pedagogical knowledge that is available to inform the curriculum process.

But there is another argument. It stems from the fact that teachers in higher education value research in their own subjects. It is, therefore, surprising that the notion that teaching and learning should be informed by research has not pervaded the teaching profession in higher education. Patricia Cross has argued that teaching will not become a respectable activity until teachers treat their classrooms as laboratories for research.2

To encourage the development of this idea, Tom Angelo and Patricia Cross worked with teachers to develop and evaluate 50 techniques of classroom assessment. They are intended to help "individual college teachers obtain useful feedback on what, how much and how well their students are learning. Faculty can then use this information to refocus their teaching to help students make their learning more efficient and more effective."3

Another approach is to learn through more formal research into one's classroom practices, and even more generally into other dimensions of the curriculum process. Among others, Patricia Cross and Mimi Steadman as well as this writer have illustrated how this can be done.4 There are several examples of such research in recent publications of the Proceedings of the ASEE Annual Conferences and the Proceedings of the Frontiers in Education conferences. Some provide major contributions to educational knowledge. While the first objective of this study is to provide an illustrative review of research and development in engineering education since 1960; the second objective is with the examples given to encourage the practice of classroom assessment and research.

Classroom assessment and classroom research require different levels of expertise. In the case of classroom assessment, teachers need not be necessarily exposed to a formal course of training since learning about learning is accomplished through the implementation of classroom assessment techniques. It is a level 1 of teaching expertise.

Classroom research requires more knowledge before one can begin. This might be related to a specialist topic (e.g., cooperative learning, student ratings), or it may be of a more general kind (e.g. the redesign of a curriculum). In either case the teacher(s) may require help from educational specialists, and there are examples of such collaboration in the recent literature of engineering education. These teachers acquire a level 2 of expertise and leadership. The third

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objective is therefore to promote the idea of curriculum leadership. That is the idea that in departments and schools there will be persons who can be consulted about classroom assessment and research and are acknowledged as such.

Leading implies following. To the extent that we set ourselves goals, and to the extent that we set about obtaining those goals, we both lead and follow. In this sense, every individual is a leader, even at the level 1 of teaching expertise. Because this is the case, each individual has within him or herself the attributes of leadership. What distinguishes one person from another as a leader is the use to which they put the attributes of leadership in the varying situations in which they find themselves. To acknowledge the findings of educational research and not to do anything about them is a neglect of professional responsibility. It is also a denial of the professional’s responsibility to lead. Transformational leadership is required to create an environment in which teaching is valued as much as research.

Those faculty members who, in an ethos that values research above teaching, spend time on classroom assessment strategies are leading themselves, and by example, others. If they try to persuade others that such activities are worthwhile and lead to better practice, they are leading in the traditional understanding of leadership. The same is true of classroom research, the second level of expertise.

More generally, part of the role of the professional teacher is to lead beginning teachers into the pedagogy of higher education. In Ralph Tyler’s words, they have the goal of “helping practitioners who want to improve the curriculum of the schools (engineering departments) in which they work.”

There will be those who have acquired the capability to do this at the first level of expertise. There will be others who can do it at the second level of expertise. Those who take on these leadership roles can help create a climate of cultural change from the bottom up. By themselves such activities cannot be expected to maintain cultural change since they are often due to the initiatives of individuals. In any event, those individuals also need support from the top, and this means that those at the top will have to have an understanding of the professional pedagogy. While they may wish to act as curriculum leaders themselves, given the scope of the knowledge required, there would seem to be the need to recognize a faculty, school, or departmental position of curriculum leader whose promotion prospects are not diminished because of the task. This is a third level of curriculum leadership. A fourth level of leadership is involved in the external politics that determine the program.

Philip Jackson’s summary of Joseph Schwab’s view of the role of the curriculum specialist is as good a description of the role of a curriculum leader in any context as there is. It read as follows,

- Skillful use of the rhetoric of persuasion (which includes knowing how to elicit participation in small group settings and person to person encounters). (The first stage of curriculum leadership).
- Experience in deliberation (and causing people to deliberate at greater levels than they have before).
- Ability to read learned journals and the habit of doing so.
- Ability to guide colleagues to the use of the journals, and to encourage them to believe that their classrooms are laboratories for valid research.
- Knowledge of curricular practices (their design and improvement).
- Knowledge of the behavioral sciences which contribute to the guidance of educational policy and practice (e.g., branches of psychology and sociology).
- Knowledge of the humanities which contribute to the guidance of educational policy and practice (e.g., philosophy).
- “nodding”, and sometimes detailed acquaintance with some of the academic fields from which other engineering subjects are drawn.

There are difficulties with this list as with all lists. My comments are shown in italics. The first item would pre-suppose that the person is a propagandist for a particular model, but the real need is that all professional teachers should have defensible theories of learning, and sociology for it is in these domains of knowledge where the aims of education reside. This implies that professional teachers and curriculum leaders in particular should have a training that is at least in scope similar to a good quality course of training provided for graduates who wish to teach in high school.

Discussion of the idea of training university teachers is no longer anathema. In the United Kingdom the Government wishes to make the training of new teachers in higher education compulsory. Thus, an Institute for Teaching and Learning (ILT) has been established by legislation and university teachers are encouraged to become members. Some universities require all newly appointed teachers to take certificate courses accredited by the Institute for Teaching and Learning.

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7 Culver has suggested that the level 0 person be called a lecturer, the level 1 a practitioner, the level 2 a researcher and level 3 a leader.
8 Ibid P. W. Jackson (1992)
9 The ILT has been subsumed into a Higher Education Academy.
Cropley, writing from an Australian perspective, considered "that, unless the requirements for faculty to have a formal teaching qualification become mandated, improvements in the quality of teaching and learning at universities will remain elusive and fractured. If universities wish to be competitive in the future and if they seek to have a reputation for quality, then the compulsory accreditation of teaching in higher education, both generally, and in education specifically, is a proactive step that is unequivocal about the commitment to that change." Governance of this kind could have a profound influence on the how, what, and why of accreditation.

Prior to that, both in Australia and the United Kingdom there had been a considerable amount of training, generally in the form of short courses, and a substantial amount of research had created a basic pedagogy of higher education. There have also been substantive contributions to this research effort in Canada and the United States. As in the rest of the world many short courses are on offer in North America, and many of these are provided for the induction of new teachers. Some courses are provided that offer credits. One or two universities are providing mentoring programs.

Within engineering some 20 or so centers for engineering education and professional development have been created at universities in the United States. Several are of long standing. They are engaged in major research and faculty development. Some offer courses with credits for persons in doctoral programs who are graduate teaching assistants. The National Academy of Engineering has now established a Center for the Advancement of Scholarship on Engineering Education. It seeks to "enhance faculty awareness of challenges, opportunities, and standards for the conduct, evaluation and communication of research on engineering education. Reduce barriers to faculty engagement in such research, and speed the transition of research results."

Worldwide, since the early 1960s, there has been an increasing flow of papers in the engineering education journals and conferences. They number around 10,000 since 1964. There are at least 1500 articles that a tutor of students in a post-graduate education course would consider provide a framework for the discussion of pedagogical principles. The first purpose of this book is to examine that collection of papers from the perspective of the curriculum process. The second purpose is to have in mind the need for professional teachers, especially those who would lead the curriculum, to acquire defensible theories of learning, philosophy, sociology, and history as they apply to the process of curriculum improvement and evaluation.

Dr. Sandra Courter of the University of Wisconsin-Madison agreed to ask the students in two of her courses for TA’s on Teaching and Learning in Engineering to evaluate the 14 chapters that had been written by asking them to critique them and give short papers about them in class. Some major changes were made as a result of these seminars.

Encouraged by these 20 or so TA’s, and taking into account their advice as well as that of the aforementioned and other colleagues, I continue with the task. My purpose is to provide a resource for engineering educators working at each of these levels of expertise. It is based on the wide range of knowledge available in the literature of engineering education. I draw attention to its limitations, and where appropriate I point out relevant work in other fields of knowledge. It is comparable with the level of knowledge required by graduate trainees for teaching in high schools. While the language of the book may be challenging at times, and on occasion all too brief, it is hoped that the organization of this material within a single text will provide a substantial resource for those who wish to lead. This means that the more challenging chapters, so the TA’s told us, come in the first part. Since the text is intended as a resource reader, each chapter is relatively self contained, and may be read independently of the others.

Doubtless some will argue that I should have included articles that are not included and excluded some that are. I shall have achieved my purpose if it is agreed that I have given the flavor of a field and the debates within it, together with sufficient information to guide further reading. For this reason I have tried to draw out examples issues from the authors themselves.

The report was concluded during a period when it was evident that an explosion in the number of reports on the evaluation of on-line learning in all its many forms had begun. On-line learning is opening up many possibilities for inter-university collaboration in an international framework. But, the first reports suggest that the same principles of learning that were established from traditional contexts for learning will apply. They also suggest that it is possible to establish effective communities of learning in the on-line context.

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12 Ibid.
13 For example the Engineering Learning Center at the University of Madison-Wisconsin where some of the evaluation of this text was done.
For convenience the text is divided into four main parts. The first is about aims and objectives and their screening. It is about the curriculum process and how the foundation subjects of education (History, Philosophy, Psychology, and Sociology) are used to determine the aims and objectives of the curriculum and the internal structure that integrates assessment, content, teaching, and learning. Part II is about the curriculum per se, and it considers content organization, trends, and change. Chapter 7 is about change and the problems of changing the curriculum. This is followed by a chapter (8) on interdisciplinary and integrated study and a chapter on project and problem based models of the curriculum. Part III focuses on problem solving, creativity, and design. For convenience, in spite of some overlap between them, each of these concepts is dealt with in a separate chapter. Part IV focuses on teaching, assessment, and evaluation. Following on from the chapter on design in the previous section, this part begins with a chapter (13) on the lecture, cooperative learning, and teamwork. This is followed by a discussion of other approaches to teaching including case studies, PSI, laboratory work, and electronic assisted learning, a term that is meant to be all embracing (Chapter 14). Various definitions of the meaning of assessment are given, and the value of the traditional distinction between assessment and design is highlighted (Chapter 15). Chapter 17 draws together the lessons learnt from research, development, and experience for attrition and retention. The study concludes with a brief epilogue on the future of engineering education.

It is not expected that readers will approach this text linearly. Even though it contains its own logic each chapter may be treated as free standing, although inevitably there will be relationships with material in other chapters, some of which have been cross-referenced. This approach means that some overlaps are unavoidable.

Many of the activities and innovations referred to in this text are due to individuals apparently working on their own. Because nothing further has been reported about them, it is not known if they have continued with or stopped the innovation. For this reason the past tense is used throughout the text. In addition to the opening summaries, italics have been used for quotations.

John Heywood

Dublin, Ireland
August 2005