Issues for Planners

The State of Graduate Education. BRUCE L. R. SMITH, Ed. Brookings Institution, Washington, DC, 1985. x, 193 pp., illus. Paper, $9.95. Brookings Dialogues on Public Policy. From a conference, Washington, DC, Nov. 1984.

The sciences and engineering are the primary focus of attention in this review of American graduate education, but the range of topics and the depth in which they are discussed make the book relevant to academic planning as a whole. Although the data for some sections are as recent as 1984, tabulations in other sections are less current. Fortunately or not, the major directions of events have not been altered, a fact that only adds urgency to the points being made.

A succinct presentation on the minority presence in higher education discusses two strategies for reducing the underrepresentation of women and minorities: early intervention in the undergraduate years to introduce such students to research and a faculty-student mentoring program intended to ensure intensive, closely monitored involvement in research, both activities reinforcing the students' urge toward and capacity for graduate study.

An assessment of the status of graduate education in engineering challenges all concerned. The inability to attract and retain first-rank faculty, the inability to obtain, or maintain, equipment and facilities for state-of-the-art instruction and research, and the inability to attract the best of the U.S. undergraduates in engineering into full-time graduate study must ultimately lead to a massive deterioration of university engineering efforts and a consequent abdication of responsibility to industry. It is suggested that weakness in current engineering curricula, faculty overload, and inadequacy of research facilities have been hidden from current employers owing to the high quality of today's engineering undergraduates.

Compensatory efforts to maintain enrollments in engineering schools account for the large number of foreign undergraduates who are deficient in familiarity with necessary equipment and mastery of the English language. The movement of foreign students into graduate work and ultimately onto the engineering faculties will make for difficulties in the schools' relations with government contracting and granting agencies as pressure to restrict the transfer of information overseas becomes more apparent within the government.

Where the support structure for first-rank experimental research, in the form of assistants, paraprofessionals, and money for supplies and expenses is lacking, engineering schools will not even attempt to develop in-house facilities that are needed for experimental (as opposed to analytical) research, with the result that responsibility for this engineering activity will be transferred out of the university. Entirely new arrangements for acceptable graduate education in engineering may have to be made.

The computer revolution and its dimensions are being recognized generally throughout higher education. The very survival of educational institutions may depend upon the skill and aggressiveness with which they accommodate to the revolution, that is, on how the computer is employed in the service of teaching, research, and information management. The universities will have to decide the role their continuing education units shall play for them if changes in the location and methods of education mean that the institutions become less campus-oriented.

The chapter on the problem of capital facilities will be of interest to all who participate in decisions to recruit outstanding faculty members into science and engineering departments. The cost of such a recruitment ranges between $200,000 and $800,000 to cover new equipment and preparation of the space to house the new staff member.

In the consideration of broader philosophical issues and choices facing the academic planner for graduate education that concludes the volume it is suggested that some degree of contingency planning should be attempted to prepare for "likely contingencies not included in the mainstream of academic projections on which . . . policies are [typically] based." A set of "surprises" are enumerated that "seem to be in the realm of reasonable probability." Planning in advance for countermeasures and political strategies to be adopted should these contingencies arise would be a novel approach and potentially very wise.

This is a volume that should command a readership extending beyond academia into industry, government, and the philanthropic agencies of the nation.

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Number of doctoral degrees in science and engineering per 100 bachelors' degrees awarded six years earlier.

Year of doctorate	All fields	Engineering	Mathematics and computer science	Social and psychological sciences	Life sciences	Psychological and social sciences
1970	11.9	9.7	6.5	25.0	14.9	9.1
1975	7.8	7.2	4.1	16.7	10.3	5.8
1980	5.9	5.7	3.6	14.8	8.0	4.0
1983	6.5	6.7	4.8	15.2	7.1	4.8

Reprinted from R. G. Snyder, "Some indicators of the condition of graduate education in the sciences," in *The State of Graduate Education*. Sources: National Science Board, *Science Indicators, 1982* (Government Printing Office, Washington, DC, 1983; National Research Council, *Summary Report, 1983: Survey of Doctorate Recipients from United States Universities* (National Academy Press, Washington, DC, 1983).

Science Teaching Surveyed

Science Education in Global Perspective. Lessons from Five Countries. MARGRETE SIEBERT KLEIN and F. JAMES RUTHERFORD, Eds. Published for the American Association for the Advancement of Science by Westview, Boulder, CO, 1986. xxii, 231 pp., illus. Paper, $22. AAAS Selected Symposium 100. From a symposium, Washington, DC, Jan. 1982.

In the past several years, science educators in the United States and other countries have become increasingly interested in going beyond the confines of national borders to seek ideas, share information, and discuss common problems. Cross-national science education conferences are increasing in number and variety. More and more students, professors, consultants, and researchers in science education travel from their home countries to others. Papers published in science education research journals originate from many different countries and give increasing credence to a view of science education as an international enterprise. Thus the publication of *Science Education in Global Perspective* is timely.

The book provides a vivid conspectus of the context for science learning in five Asian and European countries, which are economic or ideological competitors of the United States on the world scene. Readers will not find accounts of science education in countries from all parts of the globe in this book, as they might expect by interpreting the word "global" in the title to mean worldwide. The book also does not deal with tertiary education in the sciences. What the five authors of the book's major chapters do provide are rich descriptions of the conditions of both elementary and secondary

school science education in Japan (by Kay Michael Troost), the People's Republic of China (by Paul DeHart Hurd), East and West Germany (by Margrete Siebert Klein), and the Soviet Union (by Charles P. McFadden and Izaak Wirszup).

The information presented for the five countries is remarkably uniform, a testimonial to the editors' organizational skill and the authors' persistence in ferreting out comparable data on which some generalizations could be based. The presentation for each country includes a description of the general organization of the school system, a discussion of the philosophy underlying the teaching of science, descriptions of the science time and subject requirements at various grade levels in the elementary and secondary schools, samples of the subject-matter content of science courses, and a discussion of the examination system. Also presented is valuable information about the country's science teachers, including their status and compensation, requirements they must meet for initial certification to teach, and their opportunities for in-service education. Well-chosen, informative tables and figures complement the text throughout. The data from the several countries are collated and analyzed by F. James Rutherford in the concluding chapter, a trenchant highlight of the book. The lessons Rutherford derives from studying the five countries include the specifications of the components of a national commitment to science education. He recommends nine specific actions that must be taken by local schools and the federal government if the verbal commitment already made to science education is to be implemented in the United States.

We can only be pleased that this pioneering comparative study was undertaken. Nevertheless, the study whets our appetite for further information. Though it yields much information about the context for science learning in the various school systems, little is said about outcomes. What is the achievement level in science after the students in these countries complete their courses? after they have graduated from secondary schools? How thorough is their understanding of key science concepts and theories, and how well do they understand scientific inquiry? Which misconceptions about the natural world do students cling to even after years of science instruction? How adept are they in solving new science problems and in applying science knowledge and principles in their daily lives? Do they understand the interplay of science, technology, and society? And so forth. Put another way, how successful are the school systems in these countries in attaining the goals they have set for their own science education programs or goals for which a consensus is emerging among science educators internationally?

To make balanced judgments about the worth of various countries' science education programs we also need knowledge about the transactions that mediate between the contextual factors and the outcomes. For instance, we need information about the instructional methods and procedures teachers use, the social interactions in the science classroom and laboratory, the interactions of students with materials of the natural world, the availability and use of computers as aids to science teaching, the nature of procedures for assessing and evaluating students, and the design, manner, and styles of science textbooks and other instructional media. It is from such knowledge that we can hope to deepen our understanding of the dynamics of science teaching and learning. It is here also that knowledge about the practices leading to differential outcomes may be the most useful.

This book's timely recommendations are of importance to American policy makers, lawmakers, and educators, but the editors and authors of *Science Education in Global Perspective* also make a valued contribution to our understanding of science education internationally. The book gives us much information and lets us see what studies are still needed if we want to understand science education in these and other countries.

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Traditions and Reforms

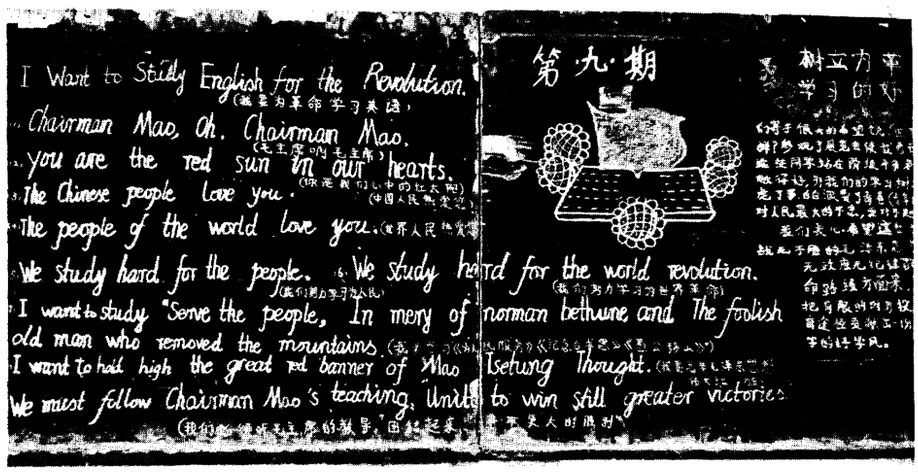
The Schooling of China. Tradition and Modernity in Chinese Education. JOHN CLEVERLEY. Allen and Unwin, Winchester, MA, 1985. viii, 319 pp., illus. $27.95; paper, $13.95.

With approximately 182 million full-time students, China has three-quarters as many people in school as the United States has citizens. There are more teachers in China (over nine million) than there are people living in New York. Yet China also counts over 200 million illiterates among its people.

These facts alone are impressive enough to make the topic of John Cleverley's book worth examining. What makes his work even more intriguing is the breadth with which he treats his subject. Cleverley, like the Chinese, views education historically and in its economic, political, and social context. The result is an overview of education that in its scope is as ambitious as the leaders in the People's Republic have been in their efforts to transform schools.

The Chinese education system traces its lineage further than most American descendants of John Dewey can comprehend. Forms of schooling were in evidence over 3000 years ago; the roots of a systematic philosophy go back 2500 years to Confucius. These original models have left a powerful imprint on modern Chinese educational practice and debate, particularly with respect to the importance of examinations, the centrality of moral education, and the recurring dominance of an elitist approach to schooling. Cleverley, like many of China's own critics, points out the strength of these continuities and their influence on attempts to change.

Details of China's repeated efforts to alter these persistent educational patterns are as



"An English lesson on the blackboard, Zhengzhou Middle School, 1972." [From *The Schooling of China*]