Interest in educational research is constantly increasing. With this increased interest it is becoming quite important for science educators to re-examine their responsibility in this area. In the following article, Drs. Scandura and Nelson present cogent arguments for the inclusion of research specialists in departments of science and mathematics education.

The Emerging Research Role of the Subject Matter Educator

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The traditional role of the professor of subject matter education has been to integrate, interpret, and disseminate relevant knowledge for practitioners. Teacher training and the in-service education of teachers have been his major responsibilities. Graduate school professors also educate those professional personnel who train teachers. The preparation of texts, writing for professional journals, and activity in local, state, and national organizations compete for the remainder of his time.

The thesis of this paper is that the subject matter educator is equally responsible for conducting research—a responsibility which has been badly neglected. In view of the large number of questions being raised in this revolutionary era of curriculum modernization, of improvements in educational research methodology, and of the growth of knowledge in the behavioral sciences, continuance of this neglect is unwarranted. Further, the availability of federal funds makes some of the practical problems that have existed in the past no longer relevant. In addition, the pressures on college and university educators to produce large numbers of teachers will lessen in the foreseeable future as the teacher ranks become filled. Research might well occupy the relinquished time; a quality emphasis demands progressive clinical innovations coupled with strong research programs.

From its inception, postdoctoral research in education has been left largely to educational psychologists and research methodologists. As for subject matter education, some of these specialists are conducting relevant research and most provide a valuable consulting function—but, they cannot do the job alone. Providing assistance with the psychological, design, and statistical phases of an investigation are but a poor substitute for thorough familiarity with the discipline (i.e., mathematics and science education, social studies education, and the like) to be understood.

In sum, this historical division between educational researchers and teacher educators has resulted in neither group having been properly equipped to conduct significant curricular and instructional research in the subject matter areas. Mathematics and science have undergone far reaching changes during the twentieth century; school mathematics and science, in particular, find themselves reorganizing after a ten-year revolution. The social sciences are also growing at an exponential rate; the social studies, in the schools, are on the verge of radical change. As a result of such growth and curricular change, certain persisting developmental and methodological problems have been reborn to be sure, but many new problems also have emerged. Those educators traditionally charged with research typically
do not have the backgrounds necessary to ask the appropriate questions, let alone answer them. On the other hand, recent technological advances in research methodology and relevant research findings in the behavioral sciences are unknown to most teacher educators and subject matter specialists. They normally have not been equipped to conduct modern behavioral research.

As a partial solution, interdisciplinary teams, often supported by government funds, have developed in many parts of the country. Typically, these teams have consisted of scholars in one of the subject matter fields, behavioral scientists, and public school teachers. Less frequently, there is a professor of education. In any case, the educator, although often present and sometimes consulted as a matter of courtesy, is not making or even involved in many of the important decisions.

Armed generally with first-rate people and the knowledge, methodologies, and tools that are now available, the team approach has often resulted in work far superior to that done previously. Yet, there are misgivings. Many highly competent educators feel that, in some cases, suggestions have been made which are not feasible, not desirable, or both. Thus, mathematicians or scientists design a curriculum that is well suited to the development of research mathematicians or research scientists without asking whether or not this is a good thing to do. And, some psychologists, without really appreciating the problems of education, attempt to apply laboratory findings to educational problems almost indiscriminately. In other cases, the academicians are exhorting the same things that educators have been saying for years. But now, someone is paying attention.

One major difficulty in a separate discipline approach to educational research is poor communication. The educator and psychologist often fail to understand the mathematician and scientist and so are unable to criticize them intelligently. Similarly, the mathematician and scientist do not really appreciate all that the psychologist tells them; after all, “that stuff based on rats has little to do with real thinking.” As for the educator, “he doesn’t have much of importance to say anyway.”

Lack of adequate communication is perhaps one of the major reasons that interdisciplin ary teams often lead to the development of new disciplines. There is a real need for subject matter educators, with a good background in both subject matter and at least one of the behavioral sciences, who are research oriented. How, for example, can a person ask and hope to answer basic questions relating to the problems and processes of teaching, learning, and creation in the subject fields without solid understanding of the subject, psychology, research methodology, and the educational process? The background necessary for this sort of endeavor is not acquired in any of the traditional doctoral programs in the separate disciplines or in education. In the past, professors of subject matter education have been selected largely on the basis of past scholarship in one of the disciplines or on their performance as classroom teachers or administrators. The importance of such backgrounds cannot be doubted. Yet, the fact remains that the educational process rests on the behavioral sciences, and knowledge of subject matter alone is not sufficient for the researcher in subject matter education. Neither is teaching or administrative skill sufficient. Having been involved primarily with practice and little with theory and supporting research, the master professor-teacher typically is ill-equipped to conduct research. More important, lacking familiarity with behavioral research, both the academic scholar and the former school professional often rely on time-worn statements like “rote learning is useless” and “understanding is the goal of all good instruction.” Such statements simply do not indicate the extent of present knowledge.

Lest there be some misunderstanding, we wish to emphasize that we do not feel that
all subject matter educators should conduct scientific research. The conscientious clinical educator, in most cases, has too much to do already. The people we describe should have an appreciation of clinical problems, to be sure, but they also must be specifically trained to do research. There may be some (few) people who can conduct significant research while maintaining an active clinical role, but for the vast majority, to try is to achieve mediocrity in both. Ideally, faculty roles should be defined more clearly, as in the medical schools, to allow clinical specialists and researchers to work separately, but in close proximity, the researchers keeping the clinicians in touch with the latest developments and the clinicians making the researchers aware of practical problems and clinical findings in need of clarification.

To be maximally effective, the training of subject matter education researchers must begin on entrance to the graduate schools, must be based on new, specially devised graduate programs, and must be under the supervision of qualified researchers. We feel that such training cannot continue to be solely an individual happenstance occurrence. Appropriate research experiences must be provided during the graduate years, as is done in the academic disciplines. The dissertation must become the product of research experiences, not an introduction; it should "make a substantial contribution to understanding" rather than merely pay lip service to this ideal and be relegated to nonsignificant obscurity on some library shelf. The course work should provide opportunities for comprehensive understanding of the subject field and a behavioral science, thorough familiarity with research procedures and the literature relating to a significant area of research, and grounding in the foundations of education.

An interdisciplinary approach would seem essential to train the sort of person we have described. It also is our opinion that graduate training in "hyphen" education must be clearly separated from the in-service education of teachers. We point this out only because of the unfortunate confusion that has all too frequently occurred in the more traditional clinical programs. In addition, we feel that the time of both students and staff would be best spent if fewer, but more demanding courses were required for graduate degrees in education. The most advanced training might consist of graduate seminars devoted to research and to interdisciplinary study.

The admission of bright young persons to graduate study in education, sound interdisciplinary courses of study, and research programs directed toward the improvement of subject matter education are the least that can be provided for a society struggling with educational problems. Extending educational leadership will require bold and imaginative schools of education with competent research personnel and adequate facilities. To continue to ignore (or minimize) research in subject matter education is to chance that in the near future there may no longer be such a function for educators to ignore.
It is obvious that a curriculum reform cannot be effective without the enthusiasm of the teachers who are presenting it. The author of this investigation analyzes certain characteristics of a selected group of biology teachers in relation to their reactions to the BSCS Biology Program.

Biology Teachers and Their Attitudes concerning BSCS

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Two of the major goals identified by the scientists and teachers who are responsible for the new science curriculum programs are: (1) the development of curricular materials and science programs that are consistent with current scientific knowledge; (2) the development of curricular materials and science programs which provide the student with an understanding of the process of science.1,2

The second of these goals is directly related to the recognition made by the Biological Sciences Curriculum Study2 (BSCS) regarding the role of the teacher in the learning situation:

The BSCS fully recognizes that merely providing new curricular materials, however good they may be, will not necessarily result in improved biology teaching in the secondary schools. It may facilitate improved teaching, but the teacher remains the key.

The teaching techniques suggested in the new curricular materials for high school science are in some cases quite different from the conventional approach to teaching science courses. How then, does the classroom teacher view these suggestions for modifications and changes in teaching techniques? Currently, science teachers are receiving special training in the new science curricular materials in summer institutes, in-service institutes, and academic year institutes, as well as the casual exposure offered by science conferences and articles appearing in periodicals. The assumption seems to be that this special training is sufficient to enhance, if not guarantee, a favorable attitude toward the use of the materials and techniques suggested. Little information exists to enable a suitable evaluation of this assumption. The new science curricula are devised so that suggested techniques of teaching are essential to the success of the program, and since some science teachers have demonstrated a reluctance to accept these techniques, it would seem that inquiry into the reasons for teacher reactions to these curriculum programs constitutes an area in which there is a need for research.

The information gained from such a study could be used by those who design curriculum programs as well as by those persons anticipating revisions and modifications of existing programs. The results should also provide implications for those who plan programs of teacher training in the uses of these curricular materials.

As additional information becomes available through these kinds of research efforts, those developing new curricular materials will have guidelines which will enable them to plan a science curriculum that will be consistent with current scientific knowledge, and, that can be used effectively by a majority of the secondary classroom science teachers.

Statement of the Problem

This study was designed to permit the author to investigate the reactions of a selected group of science teachers to the BSCS Biology Program and relate these re-