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ABSTRACT

This paper considers the needs and operations of the "interaction sciences," areas of study that attempt to investigate the relationship of basic fields of knowledge to specific environments, in contrast to the "knowledge sciences." The differences in goals, facilitating environments, and provisions for service are discussed. The knowledge sciences are seen as essentially increasing the basic systems of knowledge in a laboratory setting, while the interaction sciences increase the conceptual systems by providing a field for interaction of the knowledge fields and the environmental circumstances where there is constant interaction with the environment. The problems faced by researchers in the two "science" areas and the major role of interaction sciences in higher education are also presented. These include: (1) the development of tools that can be adopted by the more basic sciences for their own use in furthering research; and (2) focusing on problems that need research for a more complete evolution of the basic sciences. The paper concludes with a discussion of the problems that need solution before an effective environment for educational research can be realized. (AF)

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The Role of the Interaction Sciences in Higher Education

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One of the most significant movements in the field of higher education in the twentieth century has been the rapid growth and development of the interaction sciences. These areas of study lie in fields that attempt to investigate the relationship of basic fields of knowledge to specific environments. Such fields as medicine, engineering, agriculture and education, originally viewed as strictly service fields, have become an important part of a scholarly environment of the university as a new type of science.

The place of the interaction sciences in the university setting has not been secure, however, because the university itself is unaccustomed to the particular mode of operation necessary for the full development of these new sciences. This is particularly important due to the marked difference in how these fields operate and the effective operations found in the more traditional arts and sciences. This difference has caused many problems, among which has been a continual status problem in the university setting.

It is the purpose of this article to present the needs and operations of the interaction sciences as contrasted with the knowledge sciences so that a more thorough understanding of their role and needs in the higher education environment can be appreciated.

Table 1 gives a summary of the major differences between the goals and operations of the knowledge and interaction sciences. Examples of the knowledge sciences would be such fields as biology, sociology, political science, chemistry, etc. The goals of the scientist are primarily to increase the basic systems of knowledge in these content fields. The discovery of knowledge, per se, is the primary focus of their attention and their major goals are the development of theories or systems that can more adequately explain and predict phenomena in their given area.

In order to accomplish these goals, certain kinds of favorable environments have been established in institutions of higher education over a period of years. As Table 1 indicates, special laboratories are established where the observations of the scientist can be done under maximum conditions of control. The scientist's laboratory, in many respects, serves a similar but not an equivalent role that the library serves for the humanities. The scientist should have available to him contacts with like-minded and trained professionals who can provide the necessary intellectual cross-fertilization and stimulation. Other substantial needs for the scientist are the opportunities for quietness and reflection in seclusion. The development of theoretical propositions and the very difficult abstract thinking that these require need an environment of unhurried calm in a setting where distractions are reduced to a minimum.

Several organized attempts have been made to create such an environment such as the Institute for Advanced Study at Princeton and the Center for Advanced Study in the Behavioral Sciences in Palo Alto, California. This model has been

Table 1

Differences between Knowledge and Interaction Sciences

	Knowledge Sciences	Interaction Sciences
Examples	Biology, Psychology, Chemistry, Physics, Sociology, Political Science, etc.	Medicine, Engineering, Education, Agriculture
Goals	Increase the basic systems of knowledge in a content field.	Increase conceptual systems describing, explaining and predicting interaction of knowledge fields to certain environmental circumstances. Concerned with the sequence of actions.
Facilitating Environment	Special laboratories where observations can be controlled. Libraries for the dissemination of knowledge. Quiet and reflection in seclusion. Contacts mainly with like-minded and trained professionals for intellectual cross-fertilization stimulation.	Special conditions through which to observe interactions (i.e. a hospital attached to medical school, or a laboratory school attached to a college of education, or an agricultural field station.) Much contact with environments relevant to study (i.e. patients, bridges, pupils, farmers). Periodic seclusion necessary for organization of interaction systems.
Provisions for Service	Little or none. Contacts outside the profession interfere with thought and are to be avoided.	Almost always a part of the interaction science, sometimes as a price to be paid for observing the interaction, and sometimes because it is the service dimension (i.e. the treatment of the patient) that needs studying and analysis.

generally accepted by colleges and universities, and the most effective of them in advancing the sciences have provided a similar kind of environment and division of time.

As suggested in Table 1, the interaction sciences involve rather different sets of goals and need a different kind of environment in which to reach them. In the first place, their goal is to increase the conceptual systems regarding the interaction of the knowledge fields and the environmental circumstances. Therefore, they are not so much interested in the biochemistry of cortisone or other steroids as they are the influence of the cortisone with the human environment of the patient and what this implies for the science of medicine. The engineer's interest in materials' strengths generally has a specific application in mind in terms of construction of a road or a bridge, etc. The educational researcher who is interested in learning usually has a specific environment such as the elementary classroom, tutoring, or a special group of students such as mentally retarded children, in mind as an important part of his research goals.

Therefore, instead of the laboratory so valued by the knowledge sciences, another kind of special environment is needed to allow the interaction sciences to study and to observe the interactions (that is, a hospital attached to a medical school, or agricultural field station, or a laboratory school attached to a college of education). The interaction scientist, instead of retreating to the quiet and seclusion of academia is much involved in those contacts with the environment that are relevant to his study. He may be observed to be deeply involved with patients, farmers, pupils, etc.

Another rather distinct difference between the two sets of sciences has to do with their attitude toward provisions for service. The service contributions of the knowledge sciences are usually restricted to the teaching of college

classes. Contacts with the general public or contacts outside their own professional domain interfere with the basic goals of the knowledge sciences and are to be avoided.

In strong contrast to this situation, the interaction scientist is almost always involved in some kind of service activity. If he is not giving some service himself, he is studying the efficacy of the service. The service being provided represents the attempts to apply basic knowledge to particular environmental problems. Sometimes he is involved in service as the price that has to be paid for being allowed to observe interaction. It is very difficult for persons schooled in the background of arts, humanities and sciences to separate this type of research from service. Many persons may not even view this activity as a legitimate function of an institution of higher learning.

Role of Interaction Sciences in Higher Education

Both the knowledge sciences and interaction sciences have their own unique problems, and these further help to differentiate the two major areas. The problems that are faced by the persons in the knowledge sciences are often caused by the misperception of their role by the general public. The general public, impressed by the many societal problems that need attention, continually approach the knowledge sciences with questions which perhaps should be more properly directed to the interaction sciences. For example, a child psychologist who has spent most of his career studying cognitive growth may be asked, at a P.T.A. meeting that he has been induced to address, how a child can be made to stop sucking his thumb.

The political scientist who has spent his career studying the development of power structures in African governments may be pressed for a political decision which more properly belongs to the politician who is the interaction

man between knowledge of political systems and the interaction of the systems with the current environment. Unfortunately for us, there is no observable interaction science relating the knowledge of politics to the political life, so the practitioner or politician is forced to rely too heavily on his own intuitive judgment with very little research or investigation as to the efficacy of his operation.

Another major problem faced by the knowledge sciences involves a variation on the above, namely that society wishes certain problems to be solved and puts pressure on the knowledge sciences to involve themselves in solving applied problems. There remains in the public mind a general lack of understanding in the importance of knowledge for knowledge's sake or to grasp the proposition that, in the long run, the pursuit of knowledge for knowledge's sake will enable a society to deal more effectively with future problems than would an intensive concern with present day problems that are not related to larger conceptual schemes. So the basic problem of the knowledge scientist is that he is constantly being enticed out of his isolated environment in which he works best to try and deal with problems that he would rather avoid.

The problems of the interaction scientist are somewhat different. They run the very real risk of being engulfed with service demands. The physician who wishes to study the relationship of drug therapy to the mental health of the patient may be overwhelmed with patients demanding his immediate services and be unable to organize the observational environment necessary for his research. Similarly, the educational research person may feel strong demands to place some bits of knowledge into operation in the educational system, and this interferes with further investigations and research.

A substantial problem facing the interaction scientist in the higher education environment is a very noticeable tendency to try to emulate the more prestigious (in the university sense) knowledge sciences. Thus, one can always find an engineer who proudly announces that he is really a physicist and likes to do more basic research or the educational researcher whose primary identification is as a psychologist, or the person doing medical research in medical school whose primary identification is really with biochemistry. One serious trouble with trying to emulate these knowledge sciences is that the facilitating environment for the knowledge sciences is fatally incorrect for the interaction sciences. Unless the interaction scientist involves himself with his environment, he is not really advancing the cause of his particular field, although he may be contributing to the knowledge sciences. If promotions are based upon the ability to take on the protective coloration of the more basic knowledge science, then the necessary work of developing the interaction sciences will not go on.

Another major problem of the interaction sciences is that they do depend upon the knowledge available in the more established sciences. Their role is to study the effectiveness of the bridge that is built between the basic field and the relevant environments. If the basic field has little to offer, the foundations on that side of the bridge weak and inadequate, one runs the risk of developing a form of alchemy or the medical quack or the educational expert whose basis for operation lies in his own memory of his past education.

There are two good reasons for using the term interaction sciences rather than applied sciences. In the first place, the term applied sciences gives the impression that the primary emphasis is on service, and this is not necessarily the case. Second, there is the further inference that is often drawn that the interaction sciences are in a parasitic relationship with the knowledge sciences,

drawing their own worth from them but giving nothing in return. It should be pointed out, however, that the interaction sciences, when operating effectively, contribute substantially to the knowledge sciences as well as receiving from them.

One of the major functions of an interaction science is to develop tools which become adopted by the more basic sciences for their own use in furthering research. Some examples of these can be seen in the area of educational research where the development of measures of intellectual ability that had their basis in attempts to evaluate educational potential and achievement. Such tests as the Rorschach Ink Blots devised to determine the mental health of patients, have been used as research tools to study more thoroughly the personality dynamics of the adult human. Tools such as the electroencephalograph, used to identify pathology in the central nervous system, can be employed for more basic research into mental processes and general cortical behavior. In many respects, the interaction sciences provide tools which become useful to the knowledge sciences.

Another major contribution of the interaction sciences is their ability to focus on problems that need to be researched for a more complete evolution of the basic science. The problems of the interaction sciences in studying the developing language in culturally disadvantaged children or in deaf children have encouraged a more thorough investigation of the development of linguistic systems in all persons. The research on the impact of steroids upon such problems as arthritis and asthma has encouraged further research into the basic nature of the hormone system in human beings, and so it goes. So the contributions move in both directions between these two major science areas.

The Needs of Educational Research

How does one obtain a productive educational research environment? More specifically, what adjustments need to be made in existing facilities of the university to meet the problem? The first step often taken represents a minimum adaptation of the existing facilities. This would be to encourage faculty members who have shown an interest in educational research to pursue their interest by helping them attain outside grants or giving them a light instructional load. Such a move which sometimes may be productive in the field of chemistry or psychology, for example, falls very short of the requirements in the area of educational research. In one case we are dealing with the basic knowledge science, and in another case, we are dealing with the interaction science with different needs and different physical requirements.

At one time, I remember talking with a dean of a graduate school (not Duke and not Illinois) who discussed the great virtues of teaching a full schedule and then going into the laboratory at night or on weekends to conduct his research. Such an approach may be possible in chemistry, although many chemists would disagree, but it is completely inapplicable for interaction sciences. The administrator, in this case, revealed his own lack of understanding of the basic differences of the two sets of sciences.

Table 2 summarizes the various needs and problems that have to be overcome to provide an effective environment for educational research. One of the most prominent of the problems is the continual demand for service. There are never enough teachers and there are many teachers who need additional training. A person identified as being in the educational research field becomes a target immediately for much pressure to fill some of these service needs. If service requirements are allowed to take precedence, the potential for educational research becomes extremely limited.

Table 2

Developing Environment for Educational Research

Problem	University Adjustment
Service Demands	Institutionalize research time through joint appointment or released time. Organizations designed specifically for research and development activities such as ESI at Harvard, or EIP at Duke, or Bureau of Educational Research at Illinois, are examples of such organizations.
Continued Contact with Basic Knowledge Fields	If such an organization is developed as above, interdisciplinary teams can be formed which allow for cross-fertilization of ideas between basic and interaction sciences.
Relationship with Environment	Contacts with public schools and other units necessary to provide the environments for study. Eventually an educational unit under control of the research and development team seems highly desirable.
University Status	Status must be earned and research production will prove its worth or lack of worth. Universities can help by understanding the basic differences between the two sets of sciences and maximizing the environment for the differing research needs.

One of the more common university adjustments is to institutionalize a certain amount of faculty time that is committed to research. This is done by deliberately limiting the teaching load of professors who are engaged in research. Even more effective has been the establishment of organizations that are as specifically committed to educational research and development activities. Examples of these would be such operations as the Educational Services Institute

at Harvard, the Education Improvement Program at Duke, the Bureau of Child Study at Kansas and the Bureau of Educational Research at Illinois. There are many other examples, and these all serve the general purpose of providing for a community of research people, all of whom are interested in investigations and can contribute to each other's thinking. At the same time, the organization protects them from inordinate demands of service.

Paradoxically, many universities have found that the establishment of research centers or institutes also tends to improve their service program by attracting first quality people who would like to divide their time in research and teaching.

Another problem is how to keep those persons involved in interaction sciences in contact with the basic knowledge fields from which they must draw many of their important concepts. Thus, a person in educational research should have some means for continually bridging the gap between education and psychology or education and sociology or other areas upon which they must draw for conceptualization and theoretical positions. If such an organization, institute or center is developed as noted above, then it becomes easier to develop and attract an interdisciplinary team that can be formed from persons from many different areas which allows for the continual cross-fertilization of ideas between basic and interaction sciences. In this interdisciplinary team, for example, can be included psychologists and sociologists as well as educational research persons who can work together in attacking basic educational research issues.

Another very substantial need that is required for educational research is a clear avenue to the environments in which observations must take place. This demands, as a minimum, extensive contacts with the public schools or other environmental units necessary for systematic study. Eventually, most

universities find it necessary to establish an educational service unit under the control of its own research and development team. Otherwise, many interesting innovations and research techniques that might seem highly applicable and worth investigating may not be approved or permitted in a public school setting.

Another important aspect of relationships with environments is for the educational researcher to have continued contact with newly developing Research and Development Centers and Regional Education Laboratories which, in turn, provide opportunities to use their environmental resources for important research investigations.

The final problem that always exists with educational research persons and all persons involved in interaction research involves their lower status in the university environment. Although outside support sometimes seems more available for the interaction sciences, status within academia clearly goes to the knowledge sciences. Still, it is useless for the educational researcher to apply for some kind of status which, in the end, must be earned. It will be the research production of such a team as noted above which will eventually prove its worth or lack of worth. The role of the university here is not to supply an artificial award of status but rather, understanding the basic differences between the two sets of sciences, to provide the necessary environment in which the educational research team would have an opportunity to prove its usefulness and productivity.