DOCUMENT RESUME

ED 243 779 SO 015 626

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TITLE Knowledge Systems and the Role of Knowledge Synthesis in Linkages for Knowledge Use.
INSTITUTION Pittsburgh Univ., Pa. Learning Research and Development Center.
SPONS AGENCY National Inst. of Education (ED), Washington, DC.
PUB DATE 84
NOTE 37p.; For related documents, see SO 015 627-628.
PUB TYPE Information Analyses (070)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Developed Nations; Developing Nations; Educational Research; *Information Dissemination; Information Needs; *Information Utilization; *Linking Agents; *Research and Development; Research Utilization; Social Science Research; Technical Assistance
IDENTIFIERS *Knowledge Linkers; Knowledge Utilization

ABSTRACT

The relationship between the social structure of knowledge systems and knowledge syntheses is explored in order to define the social and cultural requirements for effective linkage. Following an introduction (section 1), analysis is divided into 5 additional sections. Section 2 discusses tools for conceptualizing knowledge systems, including social knowledge systems in simple and complex societies, major functions performed by knowledge-related activities (knowledge production, organization and structuring of knowledge, distribution of knowledge, and storage of knowledge), and the social construction of reality. Section 3 considers linkages between national knowledge systems through international channels. The quantitative increases in students from less developed nations, increasing numbers of scientific and professional organizations, and the growth of international development assistance have all aided the globalization of interaction and transfer of knowledge. Section 4 outlines four types of linkages: those between research and use within an institutional domain, those from research to use across institutions, those between a central use-oriented region and a peripheral research-oriented region, and those between central research-oriented regions and peripheral use-oriented regions. The diversity of linkage challenges and the roles of different kinds of knowledge syntheses are examined. Sections 5 and 6 assert that certain types of linkages--linkages that cross institutional domains--call predominantly for certain types of knowledge syntheses. (LP)

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1984

The research reported herein was supported by the Learning Research and Development Center, supported in part as a research and development center by funds from the National Institute of Education (NIE), Department of Education. The opinions expressed do not necessarily reflect the position or policy of NIE and no official endorsement should be inferred.

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September 1982

1. THE PURPOSE OF THIS PAPER

The effective use of knowledge for the improvement of practice and policy requires that major gaps between institutions, organizations, and indeed cultures be bridged in order for knowledge to be brought to bear on a practical problem. Such efforts to establish linkages between different social frameworks of knowledge are complex undertakings in what Jurgen Habermas calls "communicative action" (Habermas, 1981). The understanding of linkages between research institutes and practice-oriented organizations such as school systems, municipal administrations, or firms, just to mention a few examples, is rather more complex than the idea that linkages are simply channels through which validated knowledge flows.

A linkage in the social system of knowledge (an idea which we will introduce in some detail later) establishes a pattern of communicative action bridging cultural and social gaps between otherwise separate communities--and in the context of global interdependencies

between different civilizations. As knowledge is communicated, it must first be transformed in various ways to fit into the structures of the working knowledge of the recipient community, and then it must be validated and revalidated (Holzner and Marx, 1979; Rich, 1979; Cernada, 1982). Knowledge syntheses are one especially important type of such validation.

This paper explores the relationship between the social structure of knowledge systems, which set the context for the communicative action of linkage agents, and knowledge syntheses in order to define the social and cultural requirements for effective linkage with a special focus on knowledge syntheses. By "synthesis" we mean, of course, the act as well as the result of putting together components or parts to form a larger whole. The focus on synthesis directs our attention to the manner in which knowledge structures of very diverse natures, such as theories as well as manuals, hang together (Holzner, forthcoming).

2. CONCEPTUAL TOOLS

2.1. The Idea of the Social Knowledge System

Knowledge related activities are differentially distributed in society and often occur in highly specialized social frameworks, such as universities, libraries, parliamentary research offices, factories, and so on. As the economist Fritz Machlup (1962, 1963, 1969) has shown in his path-breaking book The Production and Distribution of Knowledge in the United States, it is fruitful to view a society from the point of view of the structured distribution of knowledge related activities. Machlup, of course, did this from an economist's point of view and he

continues to work towards a new, comprehensive economics of knowledge.

We take the sociological perspective and define the social system of knowledge as the aspect of social systems that comes into view when one focuses particularly on the socially structured distribution of knowledge related activities. In a sense it could be said that the knowledge system represents above all a society's collective learning capacity. Societies like individuals live in reality which is often harsh and dangerous, but they can only come to terms with their realities through what they learn about them, i.e., with the manner in which they socially construct what is taken to be real. Thus, socially structured knowledge systems are a society's core resources for the construction of new culture, as well as the maintenance of culture, determining in a major way the adequacy of a society's learning capacity. The social structure of knowledge systems is in very complex ways related to the kind of knowledge that is created, but it is also in complex ways related to a society's moral culture and indeed sense of identity (Robertson and Holzner, 1980).

The diffuse, that is non-specialized, knowledge systems of simple societies have long since been replaced in the advanced industrial countries by highly specialized, formally institutionalized structures that often become the object of deliberate policy. In these complex modern knowledge systems, the scientific community and the science-based professions rather obviously constitute the core of the system, but they by no means exhaust it (Mendelsohn, Weingart and Whitley, 1977; Krohn, Layton, and Weingart, 1978; Knorr, Krohn, Whitley, 1980; Elias, Martins and Whitley, 1982; Mendelsohn and Elkana, 1981;

Agassi, 1981). Complex linkages to various worlds of practice in technology, medicine, education, policy, and so on need to be included as well.

In order to provide an appropriate context for the analysis of specific linkages, we need to specify in somewhat greater detail the structure of knowledge systems, which we do by outlining guidelines that one might use in describing them.

2.2. Mapping the Social Knowledge System

Modern, highly specialized societal knowledge systems are complex structures indeed. We need three distinct but intersecting sets of categories for their adequate description. The first such set deals with the types of knowledge functions, the second with institutional domains and frameworks for knowledge, and the third with the distinction between center and periphery. Using these three types of categories enables us to identify particular regions within the socially structured knowledge system which may variously be linked with one another. Thus, types of linkage arrangements will necessarily differ depending on their location in the knowledge system and the particular regions they connect to each other. This, in turn, should provide in each case somewhat different demands for knowledge syntheses.

The major functions performed by knowledge related activity can be described under five headings:

(1) Knowledge production, for example in scientific research and scholarship--but we do include here rather broadly conceived production of any form of new knowledge;

(2) Organizing and structuring knowledge, by which we mean all those efforts that result in the more or less organized assemblage of knowledge as for example in textbooks, encyclopedias, curricula; i.e., in knowledge syntheses in the broadest sense of the term and of many different kinds;

(3) Distribution of knowledge, through journals, other forms of publication, consultations, linkage agents, instruction, and so on;

(4) Storage of knowledge, in archives, libraries, and in the memory of persons and collectivities; and

(5) Finally, there is the use of knowledge which may, in interactive feedback relation connect with the production of new knowledge, or else be the incorporation of knowledge in otherwise not primarily cognitive activities, such as in knowing how to build a house; or knowing how to teach reading effectively --that is, the incorporation of knowledge in practice as well as policy (Holzner and Marx, 1979; Rich, 1981).

It is not difficult to see that these five knowledge related functions are being served by quite distinct sets of institutions and communities (Caplan, 1979). They are also interrelated in many ways, one of which rests on the circumstance that certain core institutions, like the university, serve multiple knowledge functions simultaneously. However, there are well known and major differences between the culture of researchers who produce new knowledge, the various practitioner cultures, and the cultures of those that make it their primary responsibility to disseminate knowledge, as journalists do; or that devote them-

selves to knowledge storage or to the structuring of bodies of knowledge. But, useful as this classification is, it must be supplemented.

Major institutional domains or fields, such as medicine, agriculture, the major industrial sectors, domains of policy debate, may evolve into specialized knowledge systems of their own with all five knowledge functions being discharged by specialized agencies. Certainly, this is the case in the major science based professions, such as engineering or medicine (Freidson, 1970). We have institutions of medical or engineering research, a specialized textbook industry, specialized channels for the distribution of knowledge, specialized libraries and other knowledge storage provisions, and very specialized modes for the use of knowledge. Similar circumstances prevail in the profession of science based agriculture. However, these specialized domains of specific knowledge systems are linked in many ways with the society-wide system at large and all of them are specifically anchored in the academies and universities.

Finally, the distinction between center and periphery reminds us of the fact that the systems are not only differentiated, but also ordered along a dimension of higher and lower degrees of prestige, influence, and in some instances formal authority (Shils, 1975). The center of the knowledge system itself may be variously linked with the center of political power. The nature of these relationships is of the utmost importance, especially with regard to the autonomy of knowledge as well as the availability of resources for knowledge related work. However, there are degrees of centrality and peripherality both with regard to the knowledge functions and the sectors. For example, there is little question

that in the United States today medical research is more central than educational research. Further, most user communities occupy peripheral status in the knowledge system, albeit they may occupy a highly central position in the political system.

2.3. The Social Construction of Reality

It is an empirical fact that what people know, as well as the qualitative nature of their knowledge, is very different in different historical epochs, in the different walks of life of one and the same society at one time, and in different societies. What is taken to be real can be shown to be the result of a complex social process which we call the social construction of reality (Holzner, 1969; rev. ed., 1972; Berger and Luckmann, 1967).

Sociologists have throughout the history of their discipline focused on the nature of meaningful social action, that is on the way and manner in which actors define and interpret a situation with which they are trying to come to terms.

This undeniable circumstance of the variability of what is taken to be knowledge in society continues to raise the difficult problem of relativism. Is the sociologist simply to say that the object of study, when we investigate knowledge in society, is merely whatever is taken as knowledge by whomever we study? In some sense this must be the case because ours is an empirical discipline and it is an important objective of the sociology of knowledge to discover the manifold forms of knowledge in human societies, their social origins and consequences.

However, there is a universal distinction across all societies between knowledge and other forms of meanings. Knowledge is generally taken to be some kind of validated belief on the basis of which a prudent person can take risky action. This reflection focuses our attention no longer primarily on the in-itself-intriguing task of describing the manifold and colorfully different forms of knowledge, but on the socially structured process of assessing knowledge claims to ascertain their validity.*

Throughout history there has been a process, in recent times vastly accelerated, that one can describe as the quest for valid knowledge. Such validity at times was established on the basis of traditional authority, or religious revelation, or the dictates of conscience, or rationally guided empirical inquiry, or formal mathematical calculation. These various forms of knowledge validation, of course, do not exhaust the types of validity assessments in social use. It is, however, clear that not all such modes of validation of knowledge claims are of equal merit. Indeed, we are living in the context of a historical process striving for ever more "adequate" validity assessments.

This problematic becomes entirely unavoidable if one approaches the study of knowledge use and of knowledge systems from the point of view of improving their effectiveness and adequacy. This means that the processes of the social construction of reality need to be critically examined with a focus on the qualitative nature of the tests that are applied to knowledge claims of various kinds.

*Please note that this argument differs considerably from the position taken by Burkart Holzner (1969) as well as Peter Berger and Thomas Luckmann (1967).

2.4. Strategic Foci in the Analysis of Knowledge Systems

If one approaches the task of describing knowledge systems from the point of view of having information relevant to their potential improvement, it becomes necessary to reflect on what might be the strategic foci that deserve special attention. The idea of the relative effectiveness of a knowledge system emerges directly from our foregoing analysis of the quest for valid knowledge and it involves two major criteria: the quality of knowledge being produced, and the quality of knowledge in use to serve social needs. The first criterion, of course, points beyond social standards to the state of science and scholarship itself. The second criterion, however, directs our attention to the effects of knowledge for the quality of action in a society.

The conceptual analysis of what the comparative sociology of science has discovered indicates that there are indeed three critical clusters of factors which require close attention. The first cluster deals with the question of the degree, scope, and quality of research autonomy within the scientific and scholarly community. Such autonomy is never absolute and it is very differently structured in different societies. There are good reasons to believe, on the basis of existing evidence, that both scope and quality of autonomy have a great deal to do with the effectiveness of the knowledge system. The second cluster of factors deals with the nature and quality of the critical assessment and scrutiny of knowledge claims. Such knowledge claims are of at least two varieties: claims as to what state of affairs has been discovered, and claims as to expertise. The former are, within the sciences, assessed by for example replication of experiments,

or more broadly empirical and rational critique. However, we do know that standards of such critique diverge widely and that knowledge claims are often assessed on the basis of political, ideological or religious grounds. The critical assessment of expertise is equally vital and has a lot to do with the quality of training, examinations, and certifications. Finally, there is the matter of the linkages between the knowledge producing domain of the knowledge system, the other components of that system, and society at large especially through use. Indeed, the quality of these linkage institutions, organization, roles, and channels does require special attention.

It does seem that the current state of knowledge in the comparative study of knowledge systems would allow for the difficult but feasible undertaking of construction of a theory of knowledge system effectiveness--even though this task yet remains undone.

2.5. Strategic Foci in the Description of Regions in the Knowledge System

When we investigate particular regions in a knowledge system, for example characteristics of a user community and a research community linked by deliberate efforts at improving the use of research in action, we do need a number of different conceptual tools. Among the most important is the concept "frame of reference." A frame of of reference is the structure of assumptions and implicit or explicit dispositions toward decision rules in inquiry which would provide the framework for the construction of meanings. We often find in the professions and certainly in the academic disciplines that a great deal of effort is expended in attempts to standardize the cognitive

reference frames of professionals. Graduate and professional schools are very serious about teaching the particular perspective for which the future professional will be responsible. Thus, a frame of reference can indeed be considered a perspective that focuses attention, but it also provides boundaries for what is to be taken as the field of relevant information (Holzner, Fisher and Marx, 1977; Weiss and Bucavalis, 1980, 1982; Holzner, Mitroff and Fisher, 1976. [Note the somewhat different use made of the term "frame" in Marc DeMey (1982).]

Often frames of reference are not thought about by those who employ them. Rather they are taken for granted as the obvious way of viewing the world. Yet, frames of reference strongly structure cognitive activities.

Among the aspects of frames of reference of the greatest significance we must single out truth tests. We mean by that those occasions in which the cognitive activity is focused on accepting or rejecting a knowledge claim. In describing a region of the knowledge system, it is of extreme importance to become aware of the grounds on the basis of which knowledge claims are sifted as relevant or irrelevant, adequate or inadequate, cogent or not. Such truth tests limit what a person may be persuaded to accept. It is quite obvious, and yet still very important, that the truth tests in social currency among, say, Indonesian peasants are very different from those that have currency among research scientists. If, however, one wishes to link these two communities, it becomes a matter of considerable importance to discover empirically how truth claims are assessed and how the gap, if any, might be bridged through linkage.

Well structured frames of reference are necessarily embedded not only in an encompassing culture, but also in a complex social organization and authority structure. The professions are very good examples of this institutionalization of frames of reference, which in turn links them to the construction and availability of knowledge resources. Knowledge resources not only include knowledge that is stored somehow but also the knowledge accessing skills of communities, organizations, or individuals. Specialized frames of reference demand specialized knowledge resources, which in turn require a considerable investment of time in mastering the skills required to access them. These complexes, once established, are not readily amenable to easy change precisely because of the enormous investment of effort and time they represent.

The final concept we need to at least touch upon is the notion of "situated rationality." Actors usually attempt to proceed rationally within their frames of reference, albeit they are tied into a situation which poses for them certain more or less inescapable predicaments. They approach the situation on the basis of a host of assumptions, many of which are not likely to be subjected to highly reflected inquiry. This in turn is not necessarily non-rational behavior--scrutinizing one's frame of reference requires effort and time which may not be available. So it may come about that the leader of an organization may resist learning about apparently relevant data, because his situated rationality directs his attention to issues of organizational harmony or survival (Rich, 1979:23). We must keep in mind that linkages connect differently structured regions within their knowledge system. The nature of these different regions to be bridged will have much to do with the nature

both of the linkage and of the knowledge syntheses occurring within it.

3. THE EMERGENCE OF A GLOBAL KNOWLEDGE SYSTEM: LINKAGES AS INTER-CIVILIZATIONAL ENCOUNTERS

All of this has become much more complex when we look at the linkages between national knowledge systems through international channels. It is the case that in the post-war period the advanced industrial societies of the West, and increasingly of Japan and to some extent the USSR, have seen the emergence of the knowledge intensive society. These societies are characterized by an enormously increased reliance on science and technology, and by increases in communications, and the growth of the knowledge based professions. Much has been written about this phenomenon which has been variously labeled as the emergence of the "knowledgeable society," or the "post-industrial society," or the "knowledge based society."

More recently we see the development of a knowledge intensive global system (Cohen, 1982). The quantitative increase in the number of students from less developed countries studying in the universities of the advanced countries has little parallel in history. The globalization of interactions and transfers of knowledge is further aided through the increasing number of scientific and professional societies as well as the various efforts at development assistance through international or national organizations.

Linkages in the global knowledge system need to be thought of as intercivilizational encounters (Nelson, 1981). We have pointed out above that each societal knowledge system is embedded in complex

ways in its society and comprehensive culture. Transactions among scientists or professionals from different civilizations necessarily occur in the context of often turbulent, even though sometimes deceptively simple, intercivilizational encounters.

4. TYPES OF OF LINKAGES

All linkages connect regions in the knowledge system or, across cultural or civilizational boundaries, regions in different knowledge systems with each other. On the basis of the categories we suggested for the mapping of knowledge systems, one can devise a rather coarse-grained typology which, however, may be of some help in identifying different kinds of linkage problems. The complete matrix resulting from the intersect of the three kinds of categories we have used for the characterization of knowledge systems, namely knowledge functions, institutional domains, and center/periphery distinctions, would generate a typology of regions and linkages far too complex to handle in this paper. However, we will select from this complete matrix certain linkages that appear particularly important. These are: (1) the linkage from research to use within an institutional domain and its counterpart, the linkage from use to research within such a domain; (2) the linkage between research and use across different institutional domains; (3) linkage from a use oriented region at the political center to a relatively peripheral source of research knowledge; (4) linkage from a relatively central research region to a relatively peripheral use region.

4.1 Linkages Between Research and Use Within an Institutional Domain

These linkages have reached the highest degree of development in the modern professional complexes such as medicine, engineering, and agriculture. Each of these can be considered a social framework for knowledge and knowledge use.

Recently the model of science-based professionalism has been extended in the United States especially to other institutional domains as well. These include areas that have a relatively soft knowledge base, such as education and mental health. However, because linkage problems have become particularly visible and have received particular attention in these fields, we present a number of examples from them.

Linkages within a single domain suffer particularly from both structural and frame of reference related barriers which are, simulatenously, quite real and frequently masked and time consuming to comprehend. That is, there may often be a working assumption that those producing knowledge and those using knowledge share a common reality. In fact, this is rarely the case. Not unlike the assumption that Americans will immediately understand British culture, or vice versa, because of a purportedly shared language, the notion that, e.g., school teachers and educational researchers inhabit the same conceptual and organizational world is now understood to be entirely fallacious.

To expand on this example it is possible to delineate the frame of reference employed by classroom teachers as craft-oriented, experientially-based and possessing, as a core ingredient, truth tests of a highly pragmatic nature (Miles, 1981; Huberman, 1982; Holzner and Salmon-Cox, 1982; Miehls and Meehan, 1982; Lortie, 1975). Further,

teachers' organizational environments are schools--sometimes referred to as "loosely-coupled" organizations (Cohen and March, 1974; Weick, 1976) --in which the individual teacher has high autonomy vis-à-vis students and low authority vis-à-vis the organizations as a whole. The teacher works in isolation from other adults and engages in performances largely unevaluated, even unobserved, by peers.

Among those who produce the knowledge to be used by teachers, educationals researchers engage in a form of science. In fact, the professional organization to which they belong has undergone deliberate restructuring within the past two decades in order that the pursuit of educational research be even more science-like--and perceived as such by others--than it has been previously (Persell, 1972; Salmon-Cox, 1977). Researchers are professionally socialized through extensive higher education and adhere to truth tests which emphasize formal notions of reliability and validity. Frequently they work colleagually and always their work--as embodied in journals, books, formal presentations--is publicly scrutinized.

Providing linkages between these two communities within the same domain requires a delicate transformation of knowledge. In the 1960s' surge of knowledge production for education, the necessity for this transformation was not always obvious (Holzner and Salmon-Cox, 1977). By the 70s, the need to bridge what was already being labeled the "gap between knowledge production and use" was more clear and both individual roles and organizations--collections of social actors--were developed to engage in linkage activities (Salmon-Cox, 1980; Havelock, 1973). In a

recent overview of the research on the use of "external agents," Louis (1981) provides in extensive detail the evidence so far amassed regarding the effective use of individuals who link these two parts of the knowledge system in education.

4.2. Linkages from Research to Use Across Institutional Domains and Vice-Versa

Here we are dealing with linkage channels that are far less established than those within the highly developed professions. Examples are linkages between basic research and public policy, such as those provided by the United States Academy of Science committees or panels reviewing the state of knowledge that has a bearing on the practical issue. Other examples are linkages between universities and business, for example by providing counsel or training for international programs, or for jointly undertaking developmental ventures. In these kinds of linkage situations the problem of cultural gaps and divergencies between frames of reference becomes particularly visible. Hence, such intersector linkages often require knowledge transformations that mesh with the truth tests and frames of reference of both communities.

An interesting example in education is the history of, and current commotion about, the role of computers in education. Several large companies, thinking there were substantial profits to be made in fairly short order, invested heavily in the mid-sixties and early seventies in development efforts to promote computer assisted instruction. In retrospect it is easy to see the errors: hardware costs remained fairly high, longer than then imagined; most significantly, software/courseware ingenuity was lacking. Industrial expertise could and did bring about

sophistications in machinery. But without a critical mass of people knowledgeable about educational need and instructional strategy--to say nothing of the expertise necessary for integrating computers into the ecology of the school--CAI attempts never reached the dreamed-for goals.

Currently the proliferation of micro-processors to schools (and homes and offices and elsewhere), again spurred by industrial profit-seeking, reposes a challenge to developers. Some feel that accumulated experience now makes possible what was elusive before (Lesgold, 1981). However, linkage problems caused by crossing domains are probably going to be far more severe than was the case previously, as the current movement is taking place within a highly politicized context. Congress and the administration, in a mood not dissimilar to that in the immediate post-Sputnik era, are moving in directions that will vastly increase access to computers within schools. Yet it is still unclear, even unknown, what the role of these computers will be and how best to employ them in effective ways.

4.3 Linkages Between a Relatively Central Use-Oriented Region and a Relatively Peripheral Research-Oriented Region

This type of linkage is of particular interest in the context of bringing knowledge to bear on policy. Almost invariably the policy maker occupies a position of greater centrality in the authority system than the researcher. A particularly instructive example can be found in the interaction between the United States Congress and the National Institute of Education in congressional efforts to evaluate the efficacy of the Title I programs.

In this interaction, itself detailed by both Leviton (1982) and Singh (1982), what was crucial was the provision of information tailored

specifically to user need. As the Singh account makes clear, previous interactions between researchers and the Congress might best be characterized as miscommunication. In the case of the studies commissioned through the National Institute of Education, to aid Congress in the formulation of regulations for the implementation of Title I programs, researchers were forced to face: time deadlines; information packaging constraints, i. e., information provision that was useful and clear; and the realization of congressional interest. This last is important because it meant that policy researchers could not claim disinterest of the client as an explanation for non-use of information. Congress made its need clear and specified guidelines for researchers to follow.

Both Singh and Leviton outline a "success" story and one which each claim laid the groundwork for future collaborations. Singh, also, points to one caveat, namely the provision of this particular kind of information--precise, timely and in response to specific questions--serves this need well but does not supplant all other information needs, e.g., Congress and agencies, over long time periods, also need information addressed to long-range program planning and redirection.

4.4 Linkages Between Relatively Central Research Regions to Relatively Peripheral Use Regions

This type of linkage represents the standard image of a diffusion of knowledge. Examples abound, for example in the agricultural extension service, in the RDx network of the National Institute of Education for the improvement of schools, and in the efforts of international development oriented organizations. However, such linkages are by no means unproblematic because the need to bridge

cultural gaps is compounded by the problem and dynamic of center periphery relationships. What appears in the relatively central location as well grounded knowledge may be perceived at the relatively peripheral use region as the capricious exercise of imposed authority.

Within the literature on planned change in education, concerns about these problems coalesced in a body of research on "the degree of implentation" of innovations. (For a brief overview, see Leinhardt, 1980. Also, Hall and Loucks, 1977; Fullan and Pomfret, 1977; and Berman and McLaughlin, 1978). The focus here stems from the concern that evaluation of the effectiveness of any particular new program or practice is meaningless without information about whether or not, and to what degree, the program or practice is being used in the schools.

Sieber (1981) points out that it is now well understood that implementation of an innovation is a distinctly different phase of the change process from the adoption of the innovation. In his overview on incentives and disincentives for "knowledge utilization in public education," he discusses what is known about both externally and internally rooted rewards for, and hindrances to change. A major explanation of low implementation rates is that the source of the knowledge to be used is distant; is insensitive to the incentives/disincentives issues as these are experienced by the intended users; is often apparently arrogant, especially with regard to the degree of adaptability that will be tolerated during the implementation process.

Another example within education is the past twenty year history of some aspects of evaluation research. (The field, as a whole, is disparate, with several major trends. Only one shall be described

here.) In the 60s, when institutionalized educational R&D first got underway, particular emphasis was placed on product development. Concomitantly there was growth in the area of product evaluation: was reading or math or science program A more effective than program B?

Here we have the center/periphery relationship in an exaggerated form. School district X not only receives a product to implement, from some source, but then from an equally or even more remote source comes a judgement on the efficacy of the innovation. It was the case that these judgements were frequently inconclusive, owing largely to the inability to compare conclusively across implementation sites, or to compare results of the work of different evaluators because of conceptual and procedural differences in research design.

> [A] reason for the state of confusion about educational change is ultimately most fundamental . . . The very inconsistency of research findings over the last decade may reflect educational reality, not simply inadequate methodology. Empirical studies have exposed how complex educational change is, and have consistently challenged the possibility of simple, comparable generalizations (Berman, 1981: 255).

Berman adds another factor here, namely, the complexity of the processes under scrutiny.

Some evaluators then moved away from product/process comparison to attempt the constructions of causal models to explain the elusive processes they had uncovered (Cooley and Lohnes, 1976; Cooley, 1978; Cooley and Leinhardt, 1978; Leinhardt, 1978). During this period there was little direct interaction between researchers at the center and users at the periphery. Yet, conceptually, one might say that the

researchers were in fact attempting to understand process at the periphery in such a way that future work would put both groups on a more equal footing.

Interestingly, Cooley's most recent work is a collaborative series of efforts with a school district (Cooley, 1982). The form this interaction has taken is based on his current conception of how best to improve education. It is a conception which changes the center/periphery relationship to a center/center one, and its format is one guaranteeing that researchers are concentrating on user needs, as it is a user-driven system.

This typology of linkages does illustrate some of the diversity of linkage challenges. It also shows that very different kinds of knowledge syntheses are likely to play a role. For example, the interactive linkage of research and use within an institutional domain is likely to provide, over time, for well integrated stocks of working knowledge more or less at all levels of the specialized system. That is, the communication of new research findings to physicians becomes a specialized professional task, and the manner of synthesizing knowledge becomes well routinized. Much more difficult is the linkage between research and use across institutional boundaries. The investigative panels of the National Academy of Science do construct knowledge syntheses around policy issues, but the very task of problem definition is a complex and onerous one. Further, much of the information

contained in the newly constructed knowledge synthesis may be lost in the policy process itself, where very different formats of synthesizing knowledge have currency (such as the executive summary).

The examples we gave for the relationship between relatively central use regions and relatively peripheral research regions place the emphasis--in the successful cases particularly--on interaction with the focus on analysis, with the final knowledge synthesis created in the use region. The complex and very different change that may connect relatively central research with relatively peripheral use regions creates a variety of demands for knowledge syntheses, but beyond knowledge syntheses one must here speak of knowledge transformations. The structure of the knowledge that becomes incorporated in the practices prevailing in the use region needs to be transformed so as to fit into the truth tests and surrounding knowledge structures of that region itself.

We now turn to an examination of the different forms of synthesis.

5. TYPES OF KNOWLEDGE SYNTHESES

In this section of our paper we are drawing especially heavily from two papers which form a part of the NIE-sponsored project on knowledge synthesis, namely Burkart Holzner's paper "Social Processes and Knowledge Synthesis," (forthcoming) and the paper "Types of Synthesis and Their Criteria"(1980a) by Kenneth Strike and George Posner. We will place the typology into a broader context by first examining synthetic and analytical cultural styles. We will then turn to modes of synthesis by style of inquiry and finally utilize the typology provided by Strike and Posner by level of synthesis.

Knowledge synthesis, of course, is the combining of knowledge parts to form a new knoweldge structure or whole. It is an integrating cognitive activity.

Some cultural styles have been characterized as relying more on synthesis than on analysis. It is generally believed that western civilization is characterized by a decline of synthesis and an increased reliance on analysis. The sociologist Pitirim Sorokin distinguished between sensate cultures, those that rely on sense data and are analytic and individualistic, and their opposites, which he called ideational cultures in which thinking is synthetic. Sorokin was convinced that sensate civilization would exhaust itself and that new faith structures would arise (Sorokin, 1937-41).

To some the current concern with knowledge syntheses might appear as a turn within Western culture from the analytical to the synthetic. However, this is not so. The synthetic reasoning in Sorokin's ideational civilization rests on implicit faith, and intuition. It is quite different from the knowlege syntheses that occur in the advancement of science. One does not find a return to implicit faith structures or "synthetic thought" but rather on synthesis that follows analysis.

Knowledge synthesis takes a different form in different modes of inquiry. For example, in a highly rationalist mode of inquiry, knowledge synthesis requires that first principles be discovered under which particulars are subsumed. The extreme opposite, the purely empiricist mode of inquiry, requires synthesis by an inductive process. Both of these are, in a sense, superseded by a Kantian mode of inquiry in which a knowledge synthesis is seen as the structuring of an

architecture of forms that unites the data of experience and the principles of theory. Here, the synthesis becomes the structure of a framework. An even more complex mode of synthesis can be found in the dialectic, in which each synthesis "sublates," that is preserves in some form the opposites of thesis and antithesis but at a higher level. Synthesis here is the superseding of contradictions.

Strike and Posner (1980a) provide an interesting typology of syntheses of knowledge. They are first concerned with the category of inductive syntheses. Here they deal with the type of synthesis that is a process of generalization which moves from concrete descriptions of a relatively limited range of phenomena to abstract formulations. This includes the following types:

(1) Synthesis as generalizing over instances.

(2) Synthesis as simple theory construction.

(3) Synthesis as the creation of superordinate theory.

(4) Synthesis as the creation of a world view.

Clearly, these different levels of inductive syntheses provide very different challenges to innovation. Generalizing over instances may take the form of a simple summary. However, there is clearly a hierarchy of intellectual challenges for innovation in their typology as one moves from simple theory construction to the synthesis as the creation of a world view.

Their second major category deals with synthesis in the context of dialectics. Here we find synthesis as a dialectical resolution. The third cluster of types of synthesis they discuss in the context of Thomas Kuhn's imagery for the understanding of the progress of science (Strike and Posner, 1980b). Synthesis can occur as what Kuhn calls

changes the dominant assumptions in a field. It may, further, involve overcoming incommensurable points of view and lead, finally, to the emergence of a new paradigm.

Their fourth category deals with interdisciplinary synthesis which, for example, is involved in the rise of interdisciplinary fields such as biochemistry or computational linguistics.

Finally, they deal with what they call "quasi syntheses." These are types of knowledge syntheses which do not fit the rather rigorous criteria of cognitive integrations discussed this far. These quasi syntheses tend to be unified by the knowledge needs generated in practice. For example, they discuss "assessment" as a form of synthesis, e.g., when the task tackled is the weighing of the bulk of the evidence with regard to a particular issue. Other forms of "quasi syntheses" are "assemblages" of knowledge as, for example, in manuals, in assembling knowledge for a particular domain of policy and the like.

This typology of knowledge syntheses appears to us particularly useful because it demonstrates that the predominant modes of synthesizing in science and in practice do not necessarily converge. Practicing professions, policy makers, agents of development are likely to rely much more on what Strike and Posner desribe as "quasi syntheses" than the syntheses resting on rigorous theoretical integration of what is known in a particular domain.

We need to add to the typology of Strike and Posner a form of synthesis of knowledge of particular significance in practice and policy, and particularly visible in those linkages that cross institutional domains as well as center/periphery gradients. The type of knowledge synthesis we have in mind is problem structuring. The

cognitive activity in defining what a problem actually is requires an assessment of knowledge needs as well as an identification of knowledge regions that might supply the needed information. For example, in the United States there was a vigorous debate concerning the social problem of alcoholism. Was it to be considered primarily a moral, or a primarily judicial and police problem? Or is it to be considered a problem of mental health? The manner in which this problem is structured determines what knowledge components as well as what knowledge regions are brought together in order to assess it (Brown, 1980).

The modalities of practice-oriented knowledge syntheses need to be structured around the needs for knowledge in use, for working knowledge at hand. This would require considerable attention to the descriptive understanding of the particular region in the knowledge system involved.

6. CONCLUSIONS: LINKAGES, THE ORGANIZATION OF KNOWLEDGE FOR USE, AND KNOWLEDGE SYNTHESES

On the basis of the foregoing presentation of typologies of linkages and knowledge syntheses, we might conclude, at least tentatively, that certain types of linkages will call predominantly (but never exclusively) for certain kinds of knowledge syntheses. For example, the type of knowledge synthesis likely to occur in the linkage between knowledge production and use within an institutional domain such as health is likely to take the form of the manual and the knowledge update structured around the working manual format. The modality of synthesis is here not primarily theoretical integration, but the knowledge requirements arising in the context of daily pratice, so that

reference works, diagnostic handbooks, newsletters are structured to provide easy access to knowledge in the timed and structured activities of practice.

When we turn to linkages that cross institutional domains, matters become decisively more problematic. Since the regions to be linked are often not well informed about each other, efforts at problem structuring will become more prominent. Often, in today's society, knowledge embodied in the material aspects of technology may become the first vehicle of transfer. Our example of the difficulties encountered with the computer use in schools illustrates some of the issues involved here.

In the linkage between a relatively central use oriented region and a relatively peripheral research oriented region we found in the illustrations again an emphasis initially on knowledge synthesis in the form of problem structuring, then however followed vigorously by analysis rather than synthesis. In the linkage problems between relatively central research regions and relatively peripheral use regions, we found a need to alleviate the center/periphery differentials by an emphasis on problem structuring and on interactive relations. However, with continued and intensive interaction, this linkage type is likely to be transformed into an at least emergent institutional domain of the knowledge system. This, for example, has certainly happened in modern agriculture.

We have in this paper explored the relationship between the social structure of knowledge systems and the communicative actions of linkage

agents and knowledge syntheses. We have set forth a conceptual scheme capable of describing knowledge systems, regions within them, and types of linkages. We have drawn heavily on previous work, especially that of Strike and Posner, to set up a typology of syntheses. The conceptual framework was illustrated by using empirical research reports, mostly concentrating on studies within U. S. society. The interrelation of the typologies is capable of yielding several hypotheses we find interesting, but awaiting further investigation by ourselves, as well as, we hope, by others.

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