10

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Learning Styles and Disciplinary Differences

Along the Cleveland heights there is a vantage point where I can view the university spreading beneath me toward the horizon—in the foreground is the new medical complex of concrete and glass towers placed among older yellow brick hospitals and laboratories. To the left, stretched along the road that separates it from the medical buildings is the long, low, steel, glass and brick home of the natural science laboratories.

Nested against this brick and steel spine, lie vestiges of science past. On one side, the old physics building, large and austere with a red tile roof slowly turning black, and tall, narrow windows that belie the high-ceilinged dark rooms within. On the other side, two black stone fortress-like buildings, one capped by an observatory telescope. Paralleling these buildings around a mall punctuated at one end by a towering smokestack and at the other by a computer center office tower, lie the squat, functional ceramic brick and concrete buildings of the engineering and management schools, almost defiantly ugly, as though to emphasize that appearances are secondary to reality.

In the distance across Euclid Avenue, still another world—strong gothic stone

Note: I am indebted to David Brown, Arthur Chickering, and Suresh Srivastva for their comments and suggestions on this chapter.

buildings beside awkward Victorian red brick constructions, the old Western Reserve campus now home for the humanities and social sciences. Beyond is the flashy, contemporary law school building, its black one-way windows revealing as little inside as a state trooper's sunglasses. And finally, the serene, classic beauty of Severance Hall and the Museum of Art.

I have stopped here several times as I framed this essay. The diversity that lies below is staggering—not one university but many, each with its own language, norms, and values, its own ideas about the nature of truth and how it is to be sought. By crossing the street, or in some cases even the hallway, I can visit cultures that differ on nearly every dimension associated with the term. There are different languages (or at least dialects). There are strong boundaries defining membership and corresponding initiation rites. There are different norms and values about the nature of truth and how it is to be sought. There are different patterns of power and authority and differing criteria for attaining status. There are differing standards for intimacy and modes for its expression. Cultural variation is expressed in style of dress, furnishings, architecture, and use of space and time. Most important, these patterns of variation are not random but have a meaning and integrity for the members. There is in each department or profession a sense of historical continuity and in most cases historical mission.

While there are obviously points of interpenetration among these "cultures" and in some cases, true integration, I want here to emphasize the themes of differentiation and diversity.

In considering the student careers that are spawned and shaped in the university community and the university's responsibility for the intellectual, moral, and personal development of its members, we have often emphasized the unitary linear trend of human growth and development at the expense of acknowledging and managing the diverse developmental pathways that exist within different disciplines and professions. These paths foster some developmental achievements and, as we shall see, inhibit others. The channels of academic specialization are swift and deep, the way between them tortuous and winding. For example, these days the major career transitions in college are from science to the humanities (Davis, 1965). When I taught at M.I.T., I served for a while as a freshman adviser. Two or three of my students in each group faced the awkward realization near the end of their freshman year that a career in engineering was not quite what they had imagined it to be. What to do? Transfer to a liberal arts school and possibly lose the prestige of an M.I.T. education? Endure the institute's technological requirements and "bootleg" a humanities major? Switch to management? Most decided to wait and see but, in so doing, experienced a distinct loss of energy and increase in confusion. I felt powerless about what to advise or even how to advise.

It was only later that I was to discover that these shifts represented something more fundamental than changing interests—that they stemmed in many cases from fundamental mismatches between personal learning styles and the learning demands of different disciplines. That disciplines incline to different styles of learning is evident from the variations among their primary tasks, technologies and products, criteria for academic excellence and productivity, teaching methods, research methods, and methods for recording and portraying knowledge. Disciplines even show sociocultural variation—differences in faculty and student demographics, personality and aptitudes, as well as differences in values and group norms. For students, education in an academic field is a continuing process of selection and socialization to the pivotal norms of the field governing criteria for truth and how it is to be achieved, communicated, and used, and secondarily, to peripheral norms governing personal styles, attitudes, and social relationships.

Over time these selection and socialization pressures combine to produce an increasingly impermeable and homogeneous disciplinary culture and correspondingly specialized student orientations to learning. This, briefly, is the thesis I will attempt to articulate in this chapter.

In reviewing the research on differences among academic disciplines, I have been struck by the fact that relatively little comparative research has been done on academic disciplines and departments. In fact, Biglan (1973a) has stated:

> One of the most easily overlooked facts about university organization is that academic departments are organized according to subject matter. . . . While the organization of university departments has received increasing attention from social scientists . . . , the way in which subject matter characteristics may require particular forms of department organization has not been examined [p. 195].

The reason for this lies in the same difficulties that characterize all cross-cultural research —the problem of access and the problem of perspective. The relatively closed nature of academic subcultures makes access to data difficult, and it is equally difficult to choose a perspective for interpreting data that is unbiased. To analyze one system of inquiry according to the ground rules of another is to invite misunderstanding and conflict and further restrict access to data.

Studying disciplines from the perspective of learning and the learner offers some promise for overcoming these difficulties, particularly if learning is defined not in the narrow psychological sense of modification of behavior but in the broader sense of acquisition of knowledge. The access problem is eased because every discipline has a prime commitment to learning and inquiry and has developed a learning style that is at least moderately effective. Viewing the acquisition of knowledge in academic disciplines from the perspective of the learning process promises a dual reward—a more refined epistemology that defines the varieties of truth and their interrelationships and a greater psychological understanding of how individuals acquire knowledge in its different forms. Over fifteen years ago, in the distinguished predecessor to this volume, *The American College*, Carl Bereiter and Mervin Freedman envisioned these rewards:

> There is every reason to suppose that studies applying tests of these sorts to students in different fields could rapidly get beyond the point of demonstrating the obvious. We should, for instance, be able to find out empirically whether the biological taxonomist has special aptitudes similar to his logical counterpart in the field of linguistics. And there are many comparisons whose outcomes it would be hard to foresee. In what fields do the various memory abilities flourish? Is adaptive flexibility more common in some fields than in others? Because, on the psychological end, these ability measures are tied to theories of the structure or functioning of higher mental processes, and because, on the philosophical end, the academic disciplines are tied to theories of logic and cognition, empirical data linking the two should be in little danger of remaining for long in the limbo where so many correlational data stay [1962, pp. 567-68].

It is surprising that, with the significant exception of Piaget's pioneering work on genetic epistemology, few have sought to reap these rewards.

The research that has been done has focused primarily on what from the above perspective are the peripheral norms of academic disciplines rather than the pivotal norms governing learning and inquiry. Thus, studies have examined political and social attitudes and values (Bereiter and Freedman, 1962; Kirtz, 1966), personality patterns (Ral, 1956), aspirations and goals (Davis, 1964), sex distribution and other demographic variables

(Feldman, 1974), and social interactions (Biglan, 1973b; Hall, 1969). The bias of these studies is no doubt a reflection of the fact that psychological research has until quite recently been predominantly concerned with the social and emotional aspects of human behavior and development. Concern with cognitive or intellectual factors has been neatly wrapped into concepts of general intelligence. Thus, most early studies of intellectual differences among disciplines were only interested in which discipline had the smarter students (for example, Wolfle, 1954; Terman and Oden, 1947).

In the fifteen years since *The American College* was written, there has been a great burgeoning of research and theory focused on intellectual development and cognitive style—on how one comes to know his world and cope with it. The preceding chapters in this volume reflect this new focus of concern. As a result, we now have new tools and concepts available for the study of the learning process. My own research work during this time has focused on an approach to learning that seeks to integrate cognitive and socioemotional factors into an "experiential learning theory."

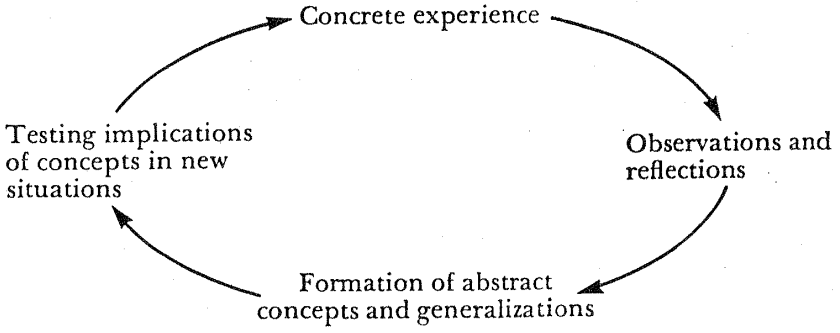
Experiential Learning Theory

The experiential learning model represents an integration of many of the intensive lines of research on cognitive development and cognitive style. The result is a model of the learning process that is consistent with the structure of human cognition and the stages of human growth and development. It conceptualizes the learning process in such a way that differences in individual learning styles and corresponding learning environments can be identified. The learning model is a dialectical one, similar to Jung's (1923) concept of personality types, according to which development is attained by higher-level integration and expression of nondominant modes of dealing with the world.

The theory is called *experiential learning* for two reasons. First, this term ties the theory historically to its intellectual origins in the social psychology of Kurt Lewin in the forties and the sensitivity training of the fifties and sixties. Second, it emphasizes the important role that experience plays in the learning process, an emphasis that differentiates this approach from other cognitive theories of the learning process. The core of the model is a simple description of the learning cycle—of how experience is translated into concepts, which, in turn, are used as guides in the choice of new experiences.

Learning is conceived as a four-stage cycle (see Figure 1). Immediate concrete experience is the basis for observation and reflection. An individual uses these observations to build an idea, generalization, or "theory" from which new implications for action can be deduced. These implications or hypotheses then serve as guides in acting to create new experiences. The learners, if they are to be effective, need four different kinds of

Figure 1. The Experiential Learning Model



abilities: *Concrete Experience* abilities (CE), *Reflective Observation* abilities (RO), *Abstract Conceptualization* abilities (AC), and *Active Experimentation* (AE) abilities. That is, they must be able to involve themselves fully, openly, and without bias in new experiences (CE); they must be able to observe and reflect on these experiences from many perspectives (RO); they must be able to create concepts that integrate their observations into logically sound theories (AC); and they must be able to use these theories to make decisions and solve problems (AE). Yet this ideal is difficult to achieve. Can anyone become highly skilled in all these abilities, or are they necessarily in conflict? How can one be concrete and immediate and still be theoretical?

A closer examination of the four-stage learning model indicates that learning requires abilities that are polar opposites, and that the learner, as a result, must continually choose which set of learning abilities to bring to bear on various learning tasks. More specifically, there are two primary dimensions to the learning process. The first dimension represents the concrete experiencing of events, at one end, and abstract conceptualization at the other. The other dimension has active experimentation at one extreme and reflective observation at the other. Thus, in the process of learning, one moves in varying degrees from actor to observer, from specific involvement to general analytic detachment.

These two dimensions represent the major directions of cognitive development identified by Piaget. In his view, the course of individual cognitive development from birth to adolescence moves from a phenomenolistic (concrete) view of the world to a constructivist (abstract) view and from an egocentric (active) view to a reflective internalized mode of knowing. Piaget also maintains that these have also been the major directions of development in scientific knowledge (Piaget, 1970). Much other research has focused on one or the other of these two basic dimensions.

Many other cognitive psychologists (for example, Flavell, 1963; Bruner, 1960, 1966; Harvey, Hunt, and Schroeder, 1961) have identified the concrete-abstract dimension as a primary dimension on which cognitive growth and learning occur. Goldstein and Scheerer (1941, p. 4) suggest that greater abstractness results in the development of the following abilities:

1. To detach our ego from the outer world or from inner experience.
2. To assume a mental set.
3. To account for acts to oneself; to verbalize the account.
4. To shift reflectively from one aspect of the situation to another.
5. To hold in mind simultaneously various aspects.
6. To grasp the essential of a given whole; to break up a given into parts to isolate and to synthesize them.
7. To abstract common properties reflectively; to form hierarchic concepts.
8. To plan ahead ideationally, to assume an attitude toward the more possible, and to think or perform symbolically.

By contrast, concreteness, according to these theorists, represents the absence of these abilities, the immersion in and domination by one's immediate experiences. Yet the circular, dialectical model of the learning process would imply that abstractness is not exclusively good and concreteness exclusively bad. Witkin's (1962, 1976) extensive research on the related cognitive styles of global versus analytic functioning has shown that both extremes of functioning have their costs and benefits; the analytic style includes competence in analytical functioning combined with an impersonal orientation, while the global style reflects less competence in analytical functioning combined with greater social orientation and social skill. Similarly, when we consider the highest form of learning—

through creativity insights—we note a requirement that one be able to experience anew, freed somewhat from the constraints of previous abstract concepts. In psychoanalytic theory, this need for a concrete childlike perspective in the creative process is referred to as "regression in service of the ego" (Kris, 1952). Bruner (1966), in his essay on the conditions for creativity, emphasizes the dialectical tension between abstract and concrete involvement. For him, the creative act is a product of detachment and commitment, of passion and decorum, and of a freedom to be dominated by the object of one's inquiry.

The active-reflective dimension is the other major dimension of cognitive growth and learning that has received a great deal of attention from researchers. In the course of cognitive growth, thought becomes more reflective and internalized, based more on the manipulation of symbols and images than overt actions. The modes of active experimentation and reflection, like abstractness and concreteness, stand in opposition to one another. Kagan and Kogan's (1970) research on the cognitive-style dimension of reflection-impulsivity suggests that extremes of functioning on this continuum represent opposing definitions of competence and strategies for achieving. The impulsive strategy is based on seeking reward for active accomplishment, while the reflective strategy is based on seeking reward through the avoidance of error. Reflection tends to inhibit action and *vice versa.* For example, Singer (1968) has found that children who have active internal fantasy lives are more capable of inhibiting action for long periods of time than are children with little internal fantasy life. Kagan and others (1964) have found, however, that very active orientations toward learning situations inhibit reflection and thereby preclude the development of analytic concepts. Herein lies the second major dialectic in the learning process—the tension between actively testing the implications of one's hypotheses and reflectively interpreting data already collected.

Individual Learning Styles

As a result of our hereditary equipment, our particular past life experience, and the demands of our present environment, most of us develop learning styles that emphasize some learning abilities over others. Through socialization experiences in family, school, and work, we come to resolve the conflicts between action and reflection and between immediate experience and detached analysis in characteristic ways. Some people develop minds that excel at assimilating disparate facts into coherent theories, yet these same people may be incapable of, or uninterested in, deducing hypotheses from those theories. Others are logical geniuses but find it impossible to involve themselves in active experience. And so on. A mathematician may emphasize abstract concepts, while a poet may value concrete experience more highly. A manager may be primarily concerned with the active application of ideas, while a naturalist may concentrate on developing observational skills. Each of us develops a unique learning style, which has both strong and weak points. Evidence for the existence of consistent unique learning styles can be found in the research of both Kagan and Witkin, cited earlier (Kagan and Kogan, 1970). Their research, while supporting Piaget's view that there is a general tendency to become more analytic and reflective with age, indicates that individual rankings within the population tested remain highly stable from early years to adulthood. That is, individuals seem to develop consistent and distinctive cognitive styles.

We have developed a brief self-descriptive inventory called the Learning Style Inventory (LSI) to measure differences in learning styles along the two basic dimensions of abstract-concrete and active-reflective (Kolb, 1976a). Although the individuals tested on the LSI show many different patterns of scores, we have identified four statistically

prevalent types of learning styles. We have called these four styles the Converger, the Diverger, the Assimilator, and the Accommodator. The characteristics of these types are based both on research and clinical observation of these patterns of LSI scores.

Convergers' dominant learning abilities are Abstract Conceptualization and Active Experimentation. Their greatest strength lies in the practical application of ideas. We have called this learning style the *Converger* because persons with this style seems to do best in those situations, like conventional intelligence tests, where there is a single correct answer or solution to a question or problem (Torrealba, 1972). These persons organize knowledge in such a way that, through hypothetical-deductive reasoning, they can focus it on specific problems. Liam Hudson's (1966) research in this style of learning (using different measures than the LSI) shows that convergers are relatively unemotional, preferring to deal with things rather than people. They tend to have narrow interests and often choose to specialize in the physical sciences. Our research shows that this learning style is characteristic of many engineers (Kolb, 1976a).

Divergers have the opposite learning strengths from those of the Convergers. They are best at Concrete Experience and Reflective Observation. Their greatest strength lies in imaginative ability. They excel in the ability to view concrete situations from many perspectives and to organize many relationships into a meaningful "gestalt." We have labeled this style *Diverger* because persons of this type perform better in situations that call for generation of ideas, such as "brainstorming" sessions. Divergers are interested in people and tend to be imaginative and emotional. They have broad cultural interests and tend to specialize in the arts. Our research shows that this style is characteristic of persons with humanities and liberal arts backgrounds. Counselors, organization development consultants, and personnel managers often have this learning style.

Assimilators' dominant learning abilities are Abstract Conceptualization and Reflective Observation. Their greatest strength lies in the ability to create theoretical models. They excel in inductive reasoning, in assimilating disparate observations into an integrated explanation (Grochow, 1973). They, like the convergers, are less interested in people and more concerned with abstract concepts, but less concerned with the practical use of theories. It is more important that the theory be logically sound and precise. As a result, this learning style is more characteristic of the basic sciences and mathematics than of the applied sciences. In organizations, this learning style is found most often in the research and planning departments (Kolb, 1976a; Strasmore, 1973).

Accommodators have the opposite strengths from those of the Assimilators. They are best at Concrete Experience and Active Experimentation. Their greatest strength lies in doing things, in carrying out plans and experiments and becoming involved in new experiences. They tend to be risk-takers more than persons with the other three learning styles. We have labeled this style *Accommodator* because persons with this style tend to excel in situations that call for adaptation to specific immediate circumstances. In situations where the theory or plan does not fit the facts they will most likely discard the plan or theory. (The opposite type, the Assimilator, would be more likely to disregard or reexamine the facts.) They tend to solve problems in an intuitive trial-and-error manner (Grochow, 1973), relying heavily on other people for information rather than their own analytical ability (Stabel, 1973). Accommodators are at ease with people but are sometimes seen as impatient and "pushy." Their educational backgrounds are often in technical or practical fields such as business. In organizations, people with this learning style are found in "action-oriented" jobs, often in marketing or sales.

It is important to stress that these types should not become stereotypes. Perhaps the greatest contribution of research on cognitive style has been the documentation of

the diversity and complexity of cognitive processes and their manifestation in behavior. Three important dimensions of diversity have been identified:

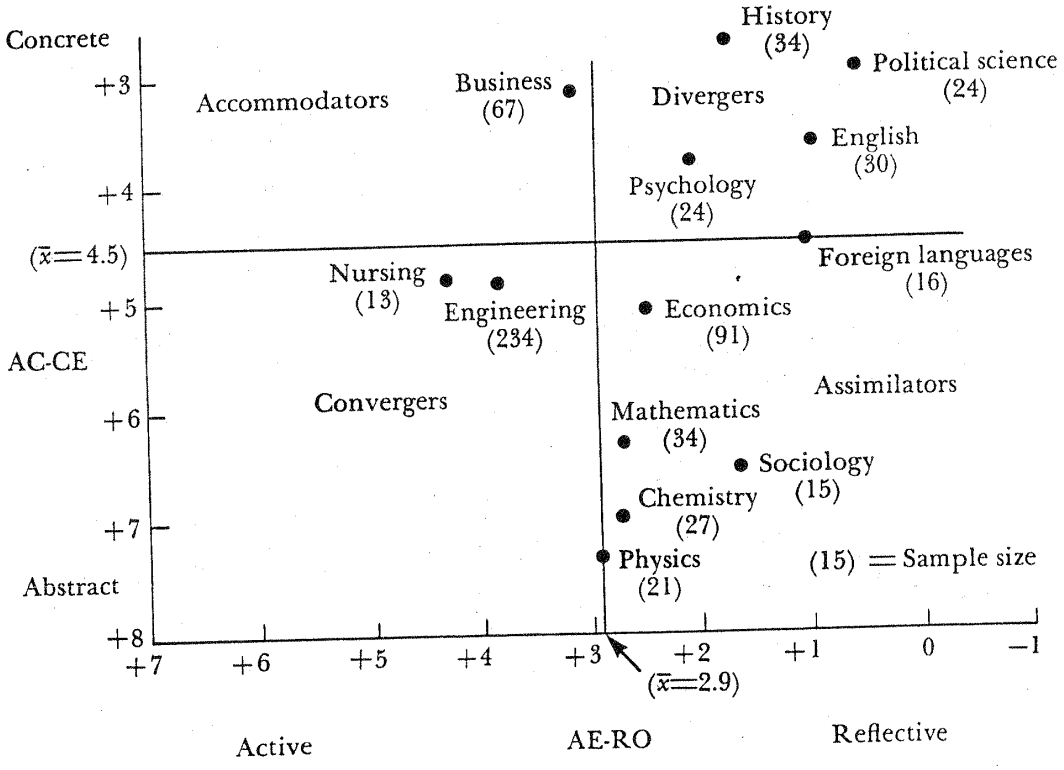
1. Within any single theoretical dimension of cognitive functioning it is possible to identify consistent subtypes. For example, it appears that the dimension of cognitive complexity-simplicity can be further divided into at least three distinct subtypes: (1) the tendency to judge events with few variables versus many, (2) the tendency to make fine versus gross distinctions on a given dimension, and (3) the tendency to prefer order and structure versus tolerance of ambiguity (Vannoy, 1965).
2. Cognitive functioning in individuals will vary as a function of the area or content it is focused on—the so-called *cognitive domain.* Thus, an individual may be concrete in interactions with people and abstract in work (Stabel, 1973), and children will analyze and classify persons differently than nations (Signell, 1966).
3. Cultural experience plays a major role in the development and expression of cognitive functioning. Lessor (1976) has shown consistent differences in thinking style across different American ethnic groups; Witkin (1967) has shown differences in global and abstract functioning in different cultures; and Bruner and others (1966) have shown differences in the rate and direction of cognitive development across cultures. Though the evidence is not conclusive, it would appear that these cultural differences in cognition, in Michael Cole's words, "reside more in the situations to which cognitive processes are applied than in the existence of a process in one cultural group and its absence in another" (1971, p. 233). Thus, Cole found that African Kpelle tribesmen were skillful at measuring rice but not at measuring distance. Similarly, Wober (1967) found that Nigerians functioned more analytically than Americans when measured by a test that emphasized proprioceptive cues, whereas they were less skilled at visual analysis.

Inquiry Norms of Academic Disciplines

My first hint that experiential learning theory might provide a useful framework for describing variations in the inquiry norms of academic disciplines came when we examined the undergraduate majors of a large sample of 800 practicing managers and graduate students in management. We found that, although these individuals shared a common occupation, they showed variations in learning style that were strongly associated with their undergraduate educational experience (Kolb, 1976b). Figure 2 shows the average Learning Style Inventory scores for various undergraduate majors reported by the managers. (Only majors with more than ten respondents are included.) Undergraduate business majors tended to have accommodative learning styles, while engineers, on the average, fell into the convergent quadrant. History, English, political science, and psychology majors all had divergent learning styles. Mathematics and chemistry majors had assimilative learning styles, as did economics and sociology majors. Physics majors were very abstract, falling between the convergent and assimilative quadrants. These data suggested that undergraduate education was a major factor in shaping individual learning style, whether by the process of selection into a discipline, or by socialization in the course of learning in that discipline, or both.

Results from other studies are consistent with these findings. Anthony Biglan (1973a) used a method well suited to answering these questions in his studies of faculty members at the University of Illinois and at a small western college. Using the technique of multidimensional scaling, he analyzed the underlying structures of scholars' judgments

Figure 2. Learning Style Inventory Scores on Active-Reflective (AE-RO) and Abstract-Concrete (AO-CE) Dimensions by College Major

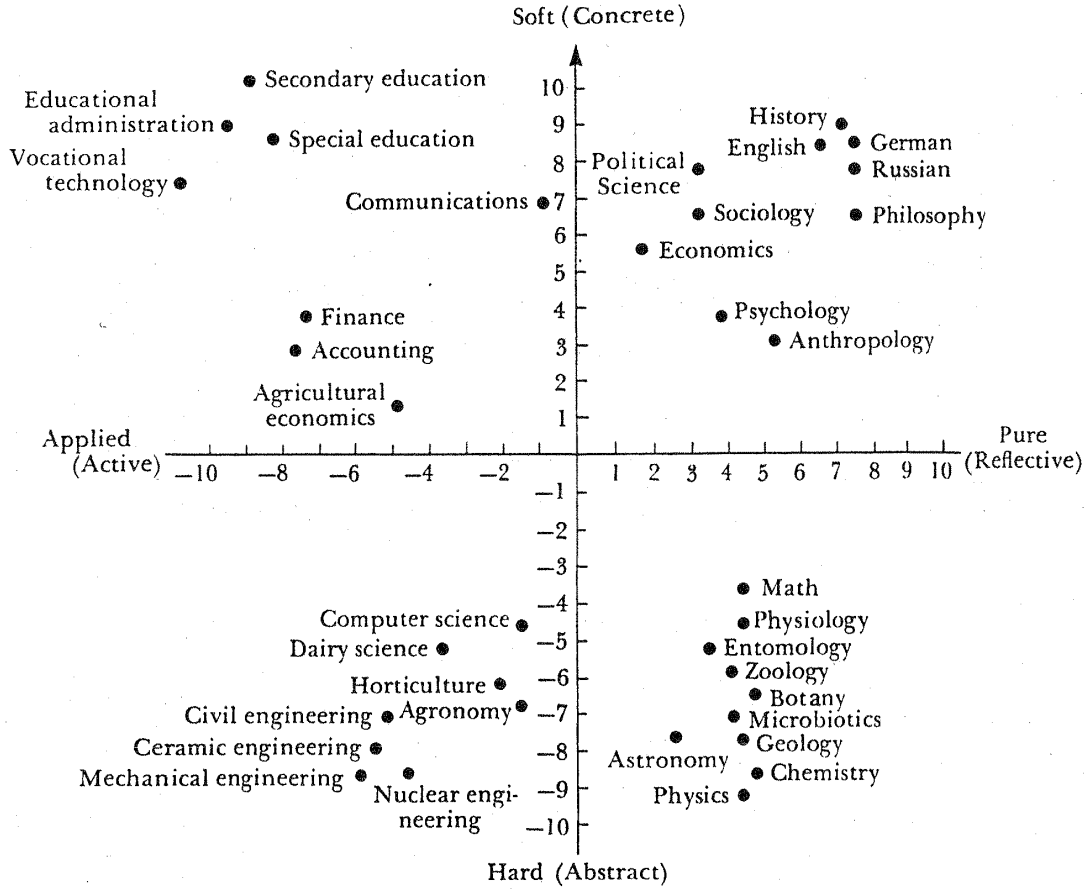


about the similarities of subject matter in different academic disciplines. The procedure required faculty members to group subject areas on the basis of similarity, without any labeling of the groupings. Through a kind of factor analysis, the similarity groupings were then mapped onto an *n*-dimensional space, *n* being determined by closeness of fit and interpretability of the dimensions. The two dimensions accounting for the most variance in the University of Illinois data were identified by Biglan as *hard-soft* and *pure-applied*. The mapping of the academic disciplines on this two-dimensional space (Figure 3), reveals a great similarity between Biglan's data and the clustering of data on the learning style dimensions of abstract-concrete and reflective-active. Of the twelve disciplines common to the two studies, nine are in identical quadrants. Business (assumed equivalent to accounting and finance) is accommodative in learning style terms. Engineering is convergent, whereas physics, mathematics, and chemistry are assimilative. The humanistic fields of history, political science, English, and psychology fall into the divergent quadrant. Foreign languages, economics, and sociology were divergent in Biglan's study rather than assimilative. Biglan reported that the pattern of relationships between disciplines shown by the small college data was very similar to that shown by the Illinois data.

These two studies suggest that the abstract-concrete and active-reflective dimensions identified by experiential learning theory differentiate sharply among academic disciplines. A more extensive data base is needed, however. The learning style data came from a single occupation, and in the case of some academic areas sample sizes were small. Biglan's study was limited to two universities, and differences here could be attributed to the specific characteristics of these academic departments.

In search of a more extensive and representative sample, I examined data collected in the Carnegie Commission on Higher Education 1969 study of representative American

Figure 3. Classification of Academic Disciplines at the University of Illinois on Hard-Soft and Pure-Applied Dimensions



Source: Adopted from Biglan, 1973a.

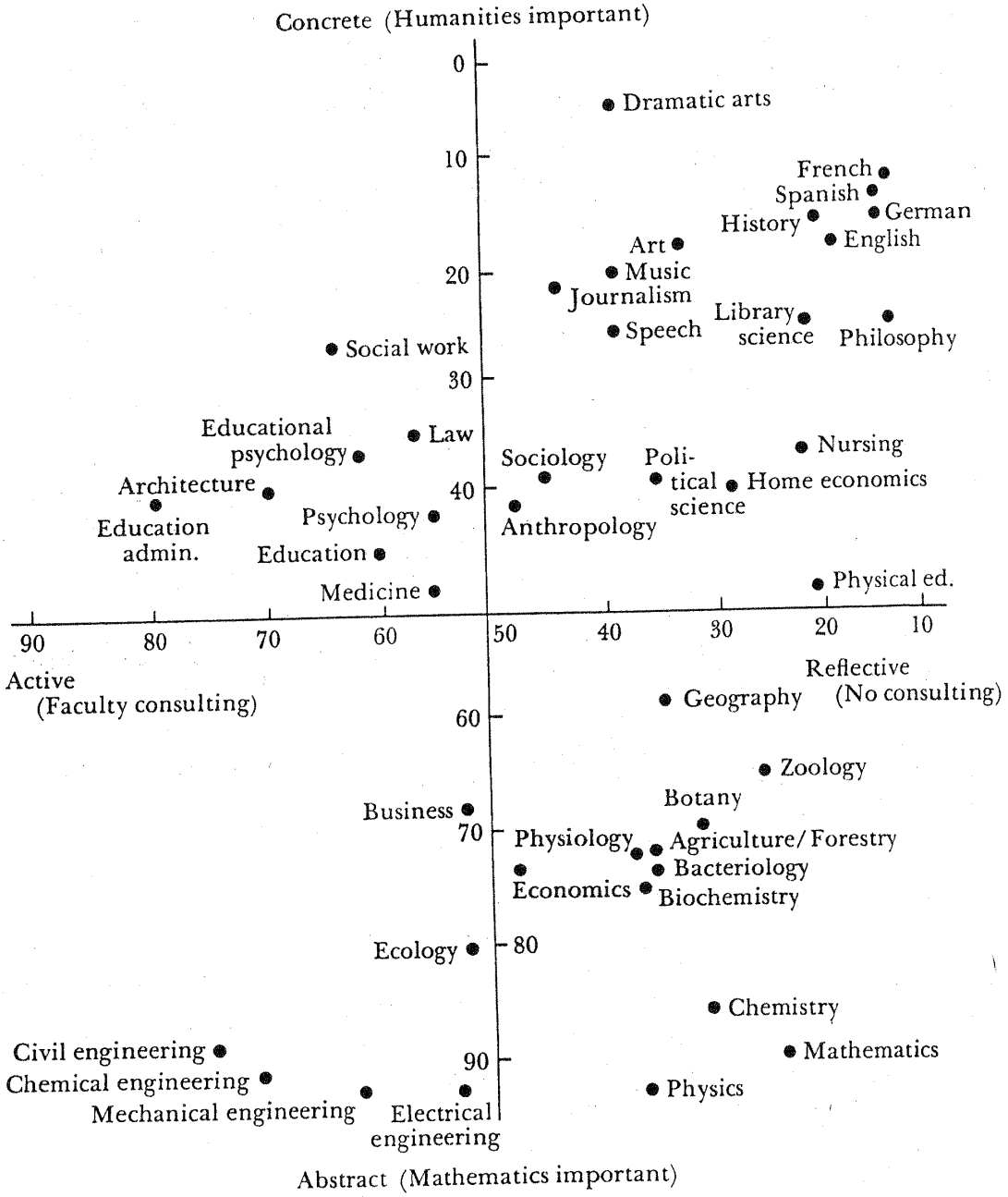
colleges and universities. These data consisted of 32,963 questionnaires from graduate students in 158 institutions and 60,028 questionnaires from faculty in 303 institutions. Using tabulations of this data reported in Feldman (1974), I created ad hoc indexes of the abstract-concrete and active-reflective dimensions for the forty-five academic fields identified in the study. The abstract-concrete index was based on graduate students' responses to two questions asking how important undergraduate backgrounds in mathematics and humanities were for their fields. Mathematics is an abstract field, relying heavily on models, theories, and symbolic manipulation, whereas the humanities are concrete, involving human feelings, intuition, and metaphorical representation of knowledge. There was, as predicted, a strong negative correlation (−.78) between the answers to the mathematics and humanities questions. The index was computed using the percentage of graduate student respondents who strongly agreed that either humanities or mathematics was very important:

$$\frac{\%\ \text{Math important} + (100 - \%\ \text{Humanities important})}{2}$$

Thus, high index scores indicated an abstract field in which a mathematics background was important and humanities not important.

The active-reflective index used faculty data on the percentage of faculty in a given field who were engaged in paid consultation to business, government, or other organizations. This seemed to be the best indicator on the questionnaire of the active, applied orientation of the field. As Feldman (1974) observed, "Consulting may be looked upon not only as a source of added income but also as an indirect measure of the 'power' of a discipline, that is, as a chance to exert the influence and knowledge of a discipline outside the academic setting" (p. 52). The groupings of academic fields based on these indexes are shown in Figure 4.

Figure 4. Concrete-Abstract and Active-Reflective Orientations of Academic Fields Derived from the Carnegie Commission Study



The indexes reveal a pattern of relationships among academic fields that is highly consistent with Biglan's study and the managerial learning style data. The results suggest that the commonly accepted division of academic fields into two camps, the scientific and the artistic, or abstract and concrete (for example, Snow, 1963; Hudson, 1966), might be usefully enriched by the addition of a second dimension, namely, active-reflective or applied-basic. When academic fields are mapped on this two-dimensional space, a fourfold typology of disciplines emerges. In the abstract-reflective quadrant are clustered the *natural sciences and mathematics,* while the abstract-active quadrant includes the *science-based professions,* most notably the engineering fields. The concrete-active quadrant encompasses what might be called the *social professions,* such as education, social work, and law. The concrete-reflective quadrant includes the *humanities and social sciences.* Further evidence for the validity of this typology can be seen in the different ways that knowledge is structured and created in these fields.

Knowledge Structures and Inquiry Processes

When one examines the four major groupings of disciplines just cited—the natural sciences and mathematics, the science-based professions, the social professions, and the humanities and social sciences—it becomes apparent that what constitutes valid knowledge differs widely from one to another. This is easily observed in differences in how knowledge is reported (for example, numerical or logical symbols, words or images), in inquiry methods (for example, case studies, experiments, logical analysis), and in criteria for evaluation (for example, practical versus statistical significance). Currently we are developing a typology that describes the basic structural dimensions of different knowledge systems (see Table 1). In this typology, the professions can be seen to employ predominantly discrete inquiry strategies, aimed at understanding particular events or phenomena,

Table 1. A Typology of Knowledge Structures and Inquiry Processes in Four Types of Academic Disciplines

Discipline Type	*Social Professions*	*Science-based Professions*	*Natural Science and Mathematics*	*Humanities and Social Science*
Inquiry strategy	Discrete synthesis	Discrete analysis	Integrative analysis	Integrative synthesis
Dominant philosophy	Pragmatism	Empiricism	Structuralism	Organicism
Theory of truth	Workability	Correspondence	Correlation of structure with secondary qualities	Coherence
Basic inquiry question	How	When, Where	What	Why
Basic units of knowledge	Events	Natural laws, empirical uniformities	Structures	Processes
How knowledge is portrayed	Actions	Things	Symbols	Images
Typical inquiry method	Case study	Classical experiment	Model building	Historical analysis Field study Clinical observation

whereas the basic disciplines employ more integrated strategies, in their search for structures or processes that apply universally. The scientific professions and basic disciplines are predominantly analytical, seeking to understand wholes by identifying their component parts, whereas the social-humanistic fields tend to be synthetic, believing that the whole can never be explained solely by its component parts. The impact of a poem, play or painting, for example, cannot be understood by analytic dissection but only by grasping the totality. Human behavior and economic systems require similar synthetic approaches.

In the social professions the dominant philosophy is pragmatism, and truth as defined by workability. Inquiry centers around the question of how actions shape events. The case study is a common method of inquiry and analysis. In the science-based professions, empiricism is the dominant philosophy, and correspondence is the main criterion for truth. Thus, knowledge is created by locating phenomena in time (when) and space (where). Here the emphasis is on the analysis, measurement, and categorization of observable experience and the establishment of empirical uniformities defining relationships between observed categories (natural laws), with a minimum of reliance on inferred structures or processes that are not directly accessible to public experience. The classical experimental method is the typical inquiry method.

Mathematics and natural science are dominated by a structuralist philosophy, which seeks to distinguish the primary, essential elements and relationships in a phenomenon from the secondary, accidental relationships. Piaget (1968) defines these structures as follows:

> As a first approximation we may say that a structure is a system of transformations. Inasmuch as it is a system and not a mere collection of elements and their properties, these transformations involve laws: the structure is preserved or enriched by the interplay of its transformation laws, which never yield results external to the system nor employ elements that are external to it. In short, the notion of structure is comprised of three key ideas: the idea of wholeness, the idea of transformation, and the idea of self-regulation [p. 5].

Thus, quantitative model building is a typical inquiry method. The humanities and the social sciences share an organicist philosophy concerned with basic processes. The primary criterion for truth is coherence, a meaningful "gestalt" that integrates phenomena. Here there is a concern with ultimate values, with why things are as they are. The anthropological field study, historical analysis, and clinical observation are typical inquiry methods.

Some fields seem to include within their boundaries considerable variation in inquiry norms and knowledge structures. Several of the professions (particularly management, medicine, and architecture) are themselves multidisciplinary, including specialties that emphasize different learning styles. Medicine requires both a concern for human service and scientific knowledge. Architecture has requirements for artistic and engineering excellence. Management involves skill at both quantitative and qualitative analysis. Several of the social sciences, particularly psychology, sociology, and economics, can vary greatly in their basic inquiry paradigms. Clinical psychology emphasizes divergent learning skills, while experimental psychology emphasizes convergent skills; industrial and educational psychology emphasize practical, accommodative skills. Sociology can be highly abstract and theoretical (as in Parsonian structural functionalism) or concrete and active (as in phenomenology or ethnomethodology). Some economics departments may employ very convergent modes of inquiry, emphasizing the use of econometric models in public policy; others may employ divergent modes, emphasizing economic history and philosophy.

This brief description cannot do justice to the complexity and variation of inquiry processes and knowledge structures in various disciplines. Nevertheless, it may suggest how the forms of knowledge in different fields can be differentially attractive and meaningful to individuals with different learning styles. Indeed, every field will show variation on these dimensions within a given department, between departments, from undergraduate to graduate levels, and so on. The purpose of this analysis is not to pigeonhole fields but to identify useful dimensions for describing variations in individual learning styles and in the inquiry processes of different disciplines, in order to better understand and manage the educational process.

Impact of Disciplinary Norms on Student Learning

The selection of Charles Eliot as President of Harvard in 1869 marked the end of classical education in American colleges; no longer would all students take the same courses in Greek, Latin, and mathematics. By introducing electives and "majors" into the Harvard curriculum, Eliot began what, considering the rapid growth of knowledge, was the inevitable specialization and fragmentation that characterizes the modern university. In the system that has emerged in the last 100 years, students have been increasingly free to select their courses and to define a program suited to their needs, interests, and abilities. Academic disciplines have enjoyed a corresponding freedom to choose those students who best fit their requirements.

The result is an educational system that emphasizes specialized learning and development through the accentuation of the student's skills and interests. The student's developmental process is a product of the interaction between his or her choices and socialization experiences in academic disciplines. That is, the student's dispositions lead to the choice of educational experiences that match those dispositions, and the resulting experiences further reinforce the same choice dispositions for later experiences.

Witkin (1976) has shown, for example, that global (field-dependent) students choose specializations that favor involvement with people, such as teaching, sales, management, and the humanities, while analytical (field-independent) students choose areas that favor analysis, such as the physical sciences, engineering, and technical and mechanical activities. Clinical psychology graduate students tend to be global, whereas experimental psychology graduate students tend to be analytical. In addition, Witkin has found that when cognitive style matches the demands of a given career specialization, higher performance results.

It is important to note that cognitive style affects not only the content of choices but also the choice *process* itself. Thus, global students make choices preferred by their peer group, while analytical students are more likely to use systematic planning and goal setting. Plovnick (1974) found a similar pattern when he used the Learning Style Inventory (LSI) to study medical students' choice of medical specialty. There are significant relationships between the LSI scores and specific choices made—accommodators chose family medicine and family care; assimilators chose academic medicine; divergers chose psychiatry; and convergers chose medical specialties. In addition, LSI scores were related to the process of choosing—students who thought in concrete terms tended to base their choices on role models and acquaintances, while abstract thinkers relied on theoretical material and interest in subject matter.

Robert Altmeyer (1966) has dramatically illustrated the result of the accentuation process on cognitive abilities in his comparative study of engineering/science and fine arts students at Carnegie Tech. In a cross-sectional study, he administered two batteries of tests to students at all levels in the two schools—one battery measured analytical reason-

ing, the other creative thinking. As predicted, engineering and science students scored highest on analytical reasoning and fine arts students highest on creative thinking; over the college years these gaps widened; engineering and science students became more analytical and arts students more creative. The surprising finding was that engineering and science students decreased in creative thinking and fine art students decreased in analytical reasoning over the college years. Thus, educational processes that accentuated one set of cognitive skills also appeared to produce loss of ability in the contrasting set of skills.

We found further evidence for the accentuation process in a large survey of M.I.T. seniors (Kolb and Goldman, 1973). Results showed a correspondence between learning style and departmental major consistent with the findings reported earlier in this chapter. In most cases, students who planned graduate study in their major field had learning styles more strongly biased toward the inquiry norms of their field than those who did not; for example, management students pursuing graduate study were more accommodative, while potential mathematics graduate students were more assimilative. To examine the dynamics of the accentuation process in greater detail, four departments whose learning style demands matched the four dominant learning styles were selected for case study. The four departments chosen and their learning style demands were mechanical engineering = accommodation; humanities = divergent thinking; mathematics = assimilation; and economics = convergent thinking (see Kolb and Goldman, 1973, for details of this selection process). Students in these four departments who planned careers in their major field tended to have learning styles that matched the inquiry demands of the field. Those whose learning styles were not matched tended to choose careers outside of their field of study. In addition, matched students indicated greater commitment to their chosen career than mismatched students.

Learning Styles, Academic Performance, and Adaptation

To ascertain if students' learning styles were an important determinant of their social adaptation and performance in the university, we compared, on a number of variables, the students whose learning styles fit their disciplines' demands with the students whose learning styles did not fit in the four departments mentioned previously. To begin with, student cumulative grade averages were examined. The mechanical engineering and economics departments both showed results consistent with our prediction; accommodative students in mechanical engineering had higher grades ($p < .10$) than mechanical engineering students with other learning styles, while convergent students in economics had much higher grades ($p < .001$) than economics students with other learning styles. In the mathematics department, however, there was no difference between the two groups of students, and in humanities the six students whose learning style was not divergent had somewhat higher grades. While the humanities department results represent a reversal of our original prediction, the results offer evidence for the hypothesis that humanities and the divergent learning style associated with this academic area are incongruent with the convergent engineering norms of M.I.T. as a whole; thus, humanities students who are not divergers should perform better academically.

The same pattern of results was found when another aspect of academic performance, student perceptions of how heavy the academic workload is, was examined. In mechanical engineering, mathematics, and economics, those students whose learning styles were congruent with their discipline norms felt the workload to be lighter than those students whose learning styles did not "fit." (Statistical significance levels for mathematics and economics were $p < .05$ and $p < .10$, respectively.) Again, the humanities department showed a trend in the opposite direction.

We were also interested to see if mismatches between learning style and discipline demands had any effect on the student's social adaptation to the university. Incongruence between students' learning styles and the norms of their majors might well undermine their feelings of belonging to the university community and alienate them from the power structure (faculty and administration). To test these hypotheses we used a version of Olsen's political alienation scale (1969) and McCloskey and Schaar's anomie scale (1963), which were adapted to apply specifically to the M.I.T. environment (see Kolb, Rubin, and Schein, 1972, for complete details of these scales). These scales measure two uncorrelated aspects of alienation that influence student adaptation. Political alienation results from the failure of authorities, teachers, administrative officials, and the "system" as a whole to meet the student's needs. The politically alienated student feels that the authority structure of the university is not legitimate because it is unconcerned about students, because it does not involve them in its decision procedures, because it allows its priorities to be set by vested interests, and because it is incapable of solving the problems it faces. Anomie stems not from dissatisfaction with the formal authority system but from a lack of contact with the norms and values that determine and direct behavior of individuals in the university. These norms and values are communicated most directly through conflict with one's peers. We have found, for example, that feelings of anomie among M.I.T. students are strongly associated with lack of involvement in a personally important group of peers (Kolb, Rubin, and Schein, 1972). Anomic students feel lonely, isolated, and out of place at M.I.T. They have difficulty determining what is expected of them and what they themselves believe. Political alienation and anomie scores for matched and mismatched students were generally consistent with our prediction: more anomie and political alienation were found among those students whose learning styles were incongruent with their discipline norms. (None of the political alienation differences were significant statistically, however. Anomie significance levels for humanities and economics were $p < .10$ and $p < .01$, respectively). One interesting result was the very high political alienation scores of all students in the humanities department. Humanities, in fact, scored highest on this variable of all the departments in the institute. This further develops the pattern of humanities as a deviant learning environment at M.I.T.

Further insight into the impact of learning styles on social adaptation was gained by examining student involvement with an important peer group. As we have already noted, our previous research showed high involvement with peers to be associated with low anomie. In all four departments, students with learning styles matching departmental norms tended to be highly involved with their peers. This pattern was most pronounced in the humanities ($p < .05$) and economics ($p < .01$) departments. These results suggest that student peer groups may be an important vehicle for the communication of the learning style requirements of a department, although, as we already know from many studies of formal and informal organizations, peer group norms may sometimes run counter to the formal organizational requirements. Some evidence for this special role of the peer group can be seen in a comparison of the economics and humanities departments. In both of these departments, students whose learning styles matched the discipline demands were very involved with their peers; and both groups of students scored very low in anomie, as we predicted. Yet the convergent economics students scored very low in political alienation, while the divergent humanities students felt extremely politically alienated from the university. Thus, in humanities, student peer group solidarity among divergers was apparently based on norms of alienation and rebellion from the university, while in economics the convergent peer group norms supported the goals and procedures of the formal authorities. This may in part account for the fact that the grades of the divergent humanities students were lower than those of other humanities students, while

the grades of the convergent economics students were far higher than those of other students in economics.

The M.I.T. study was undertaken to ascertain the usefulness of the experiential learning model and the typology of learning styles derived from it for describing variations in the ways individuals learn and variations in the learning demands of different academic disciplines. The results of the study show that, at least in this one institution, the learning style typology is useful for describing the learning demands of different academic departments and for predicting the direction of student career choices. Additionally, through examination of the matches and mismatches between student learning styles and departmental learning demands, the typology helps to explain variations in academic performance and adaptation to the university. These results suggest that the experiential learning model may well provide a useful framework for the design and management of learning experiences. As we have noted, the dominant trend in research on classroom and cut-of-class learning environments has been to focus on the impact on performance and adaptation, of such social-emotional variables as motivation, attitudes, participation, liking for the teacher, and social isolation. Many of these variables have been shown to be important. However, the results of the M.I.T. study suggest that learning environments might as productively be examined in terms of their impact on the learning process itself, and on the learning styles of students. Rather than being a cause of successful academic performance, motivation to learn may well be a result of learning climates that match learning styles and thereby produce successful learning experiences. Similarly, the sources of student alienation and protest may lie as much in failures to achieve the university's central mission—learning—as they do in its social milieu.

Experiential Learning Model of Personal Growth

In addition to providing a framework for conceptualizing individual differences in learning styles and social adaptation, the experiential learning model suggests more normative directions for human growth and development. As we have seen, individual learning styles affect not only academic learning but also broader aspects of adaptation to life, such as decision making, problem solving, and life-style in general. Experiential learning is not a molecular educational concept but rather a molar concept describing the central process of human adaptation to the social and physical environment. Like Jungian theory (Jung, 1923), it is a holistic concept that seeks to describe the emergence of basic life orientations as a function of dialectical tensions between basic modes of relating to the world. As such, it encompasses other more limited adaptive concepts, such as creativity, problem solving, decision making, and attitude change, which focus heavily on one or another of the basic aspects of adaptation. Thus, creativity research has tended to focus on the divergent (concrete and reflective) factors in adaptation, such as tolerance for ambiguity, metaphorical thinking, and flexibility, while research on decision making has emphasized more convergent (abstract and active) adaptive factors, such as the rational evaluation of solution alternatives.

From this broader perspective, learning becomes a central life task, and how one learns becomes a major determinant of the course of personal development. The experiential learning model provides a means of mapping the different developmental strategies and also a normative adaptive ideal—a learning process wherein the individual has highly developed abilities to experience, observe, conceptualize, and experiment.

The human growth process can be divided into three broad developmental stages (Kolb and Fry, 1975). The first stage, Acquisition, extends from birth to adolescence and

marks the acquisition of basic learning abilities and cognitive structures. The second stage, Specialization, extends through formal education or career training and the early experiences of adulthood in work and personal life. In this stage, development primarily follows paths that accentuate a particular learning style. Individuals shaped by social, educational, and organizational socialization forces develop increased competence in a specialized mode of adaptation that enables them to master the particular life tasks they encounter in their chosen career path. This stage, in our thinking, terminates at mid career, although the specific chronology of the transition to the third stage will vary widely from person to person and from one career path to another. The third stage, Integration, is marked by the reassertion and expression of the nondominant adaptive modes or learning styles. Means of adapting to the world that have been suppressed or have lain fallow during development of the more highly rewarded dominant learning style now find expression in the form of new career interests, changes in life-styles, or new creativity in one's chosen career.

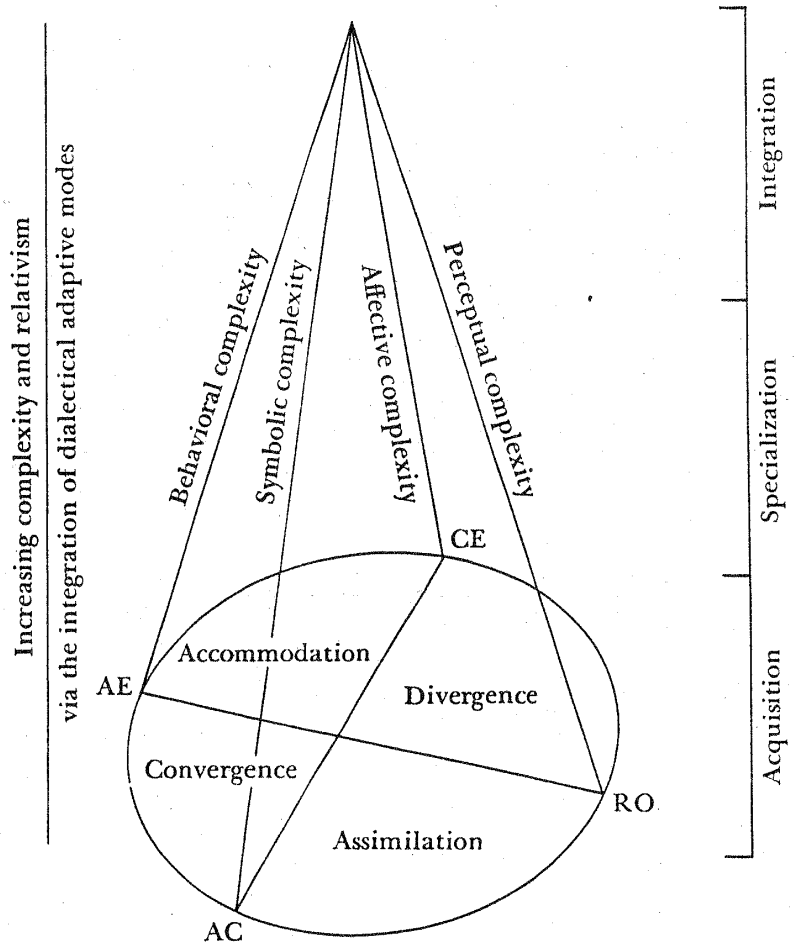
Through these three stages, development is marked by increasing complexity and relativism in dealing with the world and one's experiences, and by higher-level integrations of the dialectical conflicts between the four primary adaptive modes—Concrete Experience, Reflective Observation, Abstract Conceptualization, and Active Experimentation. With each of these four modes, a major dimension of personal growth is associated. Development in the Concrete Experience adaptive mode is characterized by increases in *affective complexity*. Development in the Reflective Observation mode is characterized by increases in *perceptual complexity*. Development in the Abstract Conceptualization and Active Experimentation modes is characterized, respectively, by increases in *symbolic complexity* and *behavioral complexity*.

In the early stages of development, progress along one of these four dimensions can occur with relative independence from the others. The child and young adult, for example, can develop highly sophisticated symbolic proficiencies and remain naive emotionally. At the highest stages of development, however, the adaptive commitment to learning and creativity produces a strong need for integration of the four adaptive modes. Development in one mode induces development in the others. Increases in symbolic complexity, for example, refine and sharpen both perceptual and behavioral capabilities. Thus, complexity and the integration of dialectical conflicts among the adaptive modes are the hallmarks of true creativity and growth.

Figure 5 graphically illustrates the experiential learning model of growth and development as it has been outlined thus far. The four dimensions of growth are depicted in the shape of a cone, whose tapering toward the apex represents the fact that the four dimensions become more highly integrated at higher stages of development. Any individual learning style would be represented on this cone by four data points on the four vertical dimensions of development. Thus, a converger in the second (Specialization) stage of development would be characterized by high complexity in the symbolic and behavioral modes and lower complexity in the affective and perceptual modes. As this person moved into the third stage of development, complexity scores in the affective and perceptual modes would increase.

While we have depicted the stages of the growth process in the form of a simple three-layer cone, the actual process of growth in any single individual life history probably proceeds through successive oscillations from one stage to another. Thus, a person may move from stage two to three in several separate subphases of integrative advances, followed by consolidation or regression into specialization. (For a more detailed description of this development model, see Kolb and Fry, 1975.)

Figure 5. The Experiential Learning Theory of Growth and Development



Specialization Versus Integration in Adult Development

As we have seen in previous chapters in this volume, there is considerable agreement among students of adult development that growth occurs through processes of differentiation and hierarchical integration and that the highest stages of development are characterized by personal integrations of complex, highly articulated views of the world and one's experience in it. From the perspective of experiential learning theory, this goal is attained through a dialectical process of adaptation, achieved through the expression of nondominant modes of dealing with the world and their higher-level integration with specialized functions. For many, however, the needs of modern society seem to be in direct conflict with these individual developmental needs. Jung (1923) puts this case as follows:

> The favoritism of the superior function is just as serviceable to society as it is prejudicial to the individuality. This prejudicial effect has reached such a pitch that the great organizations of our present-day civilization actually strive for the complete disintegration of the individual, since their very existence depends upon a mechanical application of the preferred individual functions of men. It is not man that counts but his one differentiated function. Man no longer appears as man in collective civilization; he is merely represented by a function—nay, further, he is even exclusively identified with this function and denied any responsible membership to the other inferior functions. Thus, the modern individual sinks to

the level of a mere function because this it is that represents a collective value and alone affords a possibility of livelihood. But as Schiller clearly discerns, differentiation of function could have come about in no other way: "There was no other means to develop man's manifold capacities than to set them one against the other. This antagonism of human qualities is the great instrument of culture; it is only the instrument, however, for so long as it endures man is only upon the way to culture" [p. 94].

Yet the implication of Schiller's (1826) observation is that, although human beings are the instruments of culture in their specialized adaption, they are creators of culture through integrative fulfillment. This can be illustrated by comparing the development of scientific knowledge and the personal career paths of scientists. As Piaget (1970) and others (for example, Kuhn, 1962) have documented, the historical development of scientific knowledge has been increasingly specialized, moving from egocentricism to reflection and from phenomenalism to constructivism—in experiential learning terms, from active to reflective and concrete to abstract. Yet the careers of successful scientists follow a different path. These individuals usually make their specialized abstract-reflective contributions quite early in their careers. With recognition of their achievements comes a new set of tasks with active and concrete demands. Nobel Prize winners must help to shape social policy and to articulate the ethical and value implications of their discoveries. Researchers become department chairmen and concern themselves with nurturing the development of the younger generation. So in this career, and most others as well, the higher levels of responsibility require an integrative perspective that can help shape cultural responses to emergent issues. In fact, there are integrative developmental challenges at all occupational levels.

Implications for Higher Education

At present, higher education encourages early specialization, which necessarily accentuates particular interests and skills. Should we continue to follow the trend toward increasingly specialized education or should we be creating new educational programs that reassert the integrative emphasis lost in the demise of classical education? Coincidentally, as I write this conclusion, I have just received Derek Bok's 1976-77 President's report for Harvard University (Bok, 1978), outlining a revised undergraduate curriculum plan—a plan that some have characterized as a return to classical education, with its compulsory core courses in science and mathematics, literature and the arts, history, philosophy and social analysis, and foreign cultures. The pendulum swing toward specialization that Charles Eliot began in 1869 with the modest introduction of electives and the concept of a major may have reached its peak in the late 1960s in the course proliferation that came with student demands for relevance and participation in the educational decisions that affected their lives. The "back to basic skills" climate that seemed to permeate American education at all levels in the 1970s may among other things signal the reassertion of an integrative emphasis in the educational process.

There is little question that integrative development is important for both personal fulfillment and cultural development. It appears essential for growth and mastery of the period of adult development that Erikson has called the crisis of generativity versus stagnation. The educational issue is how and when to intervene in a way that facilitates this development. The "hows" are not easy. Bok compared the introduction of the new core curriculum to "reorganizing a graveyard." Specialization in the university is greatly reinforced by faculty reward systems, selection and evaluation criteria, and disciplinary

values. The impact of these organizational processes is brought into sharp focus when we examine the difficulties and obstacles that attend the establishment of truly interdisciplinary programs of research or teaching, or when we examine the struggles for survival and viability that face "deviant" disciplines in an institution where attention, resources, and prestige are focused on the dominant academic culture. Even at a scientific institute like M.I.T. where the humanities are firmly established with a distinguished faculty, we see intense student alienation, departmental evaluation standards that appear more attuned to the inquiry norms of engineering than the humanities, and a subtle but powerful imperialism of the dominant scientific culture on research and teaching activities. However useful scientific analyses of the humanities (for example, computer models of Greek myths) may be in their own right, one must ask how well such activities serve to broaden the world view of the science or engineering specialist.

Thus, it would seem that a central function for the larger university organization is to provide the integrative structures and programs that counterbalance the tendencies toward specialization in student development and academic research. Continuous lifelong learning requires learning how to learn, and this involves appreciation of and competence in diverse approaches to creating, manipulating, and communicating knowledge.

To assume that this integrated appreciation and competence can be achieved solely by distribution requirements or other legislative approaches is highly questionable. As with racial integration, we must closely scrutinize any strategy that requires students to do what we ourselves cannot or will not do. To build integrative programs of teaching and research requires that reward systems, selection and evaluation criteria, and inquiry values be confronted and adjusted to sustain interdisciplinary activity. In addition, some kind of focal point may be required for successful integrative education. Successful interdisciplinary programs I have seen have had a common reference point for integrative activity. In the professions, this reference point is often the professional role itself, in which critical functions and tasks emphasize the need for specialized knowledge from various disciplines. In the "pure" academic disciplines, this focus can come through the broad application of a methodology such as systems analysis or through a research problem that requires multiple perspectives. Other practical approaches to the achievement of this integrative emphasis are explored in Parts Two and Three of this volume.

The "when" question may suggest even more fundamental changes. The continuing knowledge explosion and the corresponding rapid rate of change raise serious questions about the current strategy of "front-loading" educational experience in the individual's life cycle. When, as current labor statistics indicate, the average person will change jobs seven times and careers three times during his or her working life, it makes more sense to distribute educational experiences throughout adult life in order to assist in the preparation for and mastery of these changes. In this model, the university becomes a center for lifelong learning. Integrative learning experiences take on new meaning and vitality when they are directly connected with the integrative challenges of adult life. Discussions of human values and the quality of life are very different with high school graduates than they are with managers of an oil refinery. Quality patient care has one connotation to the idealistic pre-med student and quite another to the harried medical specialist. Perhaps the richest resources for integrative development lie in the dialogue across age levels that the university for lifelong learning can provide.

References

Altmeyer, R. "Education in the Arts and Sciences: Divergent Paths." Unpublished paper, Carnegie Institute of Technology, 1966.