

Cognitive Consequences of Formal and Informal Education

New accommodations are needed between school-based learning and learning experiences of everyday life.

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The study of formal education is one of those perennially popular topics that have consistently created more heat than light among social scientists. A little reflection suggests why this should be so: Every theory of education clearly requires a theory of society as a whole and of how social processes shape education. A theory of formal education also requires a theory of how learning and thinking skills develop in an individual member of society, and how educational processes contribute to the shaping of these skills.

Our special interest as psychologists is in the cognitive consequences of education. More particularly, we are interested in investigating whether differences in the social organization of education promote differences in the organization of learning and thinking skills in the individual. It is our hypothesis that this is indeed the case. We will review some of the evidence favoring this hypothesis and examine current theories of informal and formal learning. It is our belief that these theories overestimate the continuity between formal and informal education. We will also argue for the necessity of distinguishing school-based education from the broader category of formal education. Our thesis is that school represents a specialized set of educational experiences which are discontinuous from those encountered in everyday life and that it requires and promotes ways of learning and thinking which often run counter to those nurtured in practical daily activities. In making this argument, we will accentuate the contrasting features of school learning and everyday learning although, in fact, the two are constantly intermingled. We will also be positing an idealized version of school learning, not describing learning as it actually occurs in a New

York City school or in a Mexican village school. We hope in this way to illuminate some of the contradictions inherent in the different ways society organizes education and so to help deepen our understanding of current educational problems in our own and other countries.

Schooling and Cognitive Change

We will begin with a very condensed review of some of the evidence pointing to the differential intellectual consequences of formal learning embodied in the school and the informal learning of practical life. In presenting this evidence, we want to make clear what we mean when we talk about cognitive skills. Skills are to be distinguished from capacities. We think that this distinction, which has not always been clearly made, is of great importance to interpreting the intellectual consequences of formal education. In our view, cross-cultural psychological research confirms anthropological findings of the universality of basic cognitive capacities. All culture groups thus far studied have demonstrated the capacity to remember, generalize, form concepts, operate with abstractions, and reason logically. [This material is reviewed in Cole *et al.* and Cole and Scribner (1); for a contrasting interpretation see Greenfield and Bruner (2).] On this level, it is clear that a great diversity of informal social learning contexts all nurture the same fundamental psychological capacities. What we have found, however, is that there are differences in the way these capacities are brought to bear in various problem-solving situations. We will use the terms "functional learning system" and "skills" to designate the different ways in which

basic capacities are integrated and brought into play for the purposes at hand.

The evidence that different educational experiences give rise to different functional learning systems comes primarily from the work of contemporary psychologists in cross-cultural settings. Best known is the work of Jerome Bruner and Patricia Greenfield (3, 4). In studies among the Wolof of Senegal, Greenfield repeatedly found differences between village children with a few years of education and uneducated children on a variety of classification and Piagetian reasoning tasks. On a concept-formation problem, school children who were older and had attended school longer were more likely to form classes of items on the basis of form and function than were the younger school children, whereas the unschooled children showed no such difference with age, simply becoming more consistent in their use of color as a basis of classification. When presented with a standard Piagetian conservation task, children who attended school showed a developmental curve similar to that found in European and U.S. children, whereas the unschooled ones did not necessarily manifest conservation as they grew older. Greenfield summarized her results in the generalization that Wolof school children thought and performed more like Boston school children on these tasks than like their unschooled brothers and sisters.

A leading Soviet psychologist, Alexander R. Luria, found similar changes in concept formation associated with a change from informal to formal education among Central Asian peasants (5). His two contrasting groups were traditional, uncollectivized peasants living in small villages and peasant farmers who had moved onto collective farms. The latter generally had had a few years of schooling of some kind and were participating in the planning and management of large farm enterprises. In one study the subjects were shown four pictures, three being of members of a well-defined category and the fourth clearly not a member, and were asked to pick out the three that belonged together. One set of pictures, for example, depicted three tools—saw, ax, and shovel—and a piece of wood. Collectivized farmers commonly selected the three

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tools as the items belonging together, forming what Luria called an "abstract category." Not one of the traditional farmers did so. Their choices were made on the basis of concrete, practical situations in which the various objects could be used together; thus the piece of wood, the saw, and the ax might be grouped because "it is necessary to fell the tree, then to cut it up, and the shovel does not relate to that, it is just needed in the garden" (5, p. 268). Luria also investigated the way in which the two groups went about solving verbal reasoning problems. When presented with logical syllogisms, the traditional people refused to accept the system of assumptions embodied in the problems and to draw conclusions from them, while slightly educated people readily drew such conclusions.

Our own cross-cultural investigations (1) have also pointed to the special significance of school-based learning experiences. At the outset, we have to say that schooling did not make a difference on all the tasks we experimented with and that different levels of education influenced certain tasks differentially. The complexity of education-task interaction prohibits any sweeping generalizations about the "effects of schooling." Nevertheless, we did find certain characteristics that distinguished the performance of schooled and unschooled populations over a wide variety of seemingly unrelated tasks. The pervasiveness of these characteristics requires some attention.

First, unschooled populations tended to solve individual problems singly, each as a new problem, whereas schooled populations tended to treat them as instances of a class of problems that could be solved by a general rule. For example: Kpelle children from central Liberia were given a series of discrimination problems involving geometrical figures that differed in color, form, and number. For some groups of children, the problems could be solved only by attending to color and ignoring variations in form and number. When these children solved the first problem correctly (for example, learned to select all the cards with red figures), they were given additional problems in which color remained the basis for solution but the right answer was now blue or black. Overall results of these studies were that young, unschooled children tended to show little improvement, whereas school children of the same age solved

later problems considerably faster than the earlier ones, demonstrating that they had grasped a rule of solution that yielded the correct answer in one problem after another.

Two other striking instances of failure to generalize a solution rule were found in studies with adults who had never attended school. In the first, villagers were given a set of 14 leaves—seven from the natural-language category of vines and seven from that of trees—and were asked to classify them one at a time. Their classification was called correct if they accurately sorted the leaves into the vine and tree categories. When they were told that the leaves came from vines and trees, they accomplished this task with virtually no errors. When they were told that some of the leaves "belong to Togba" and some "belong to Sumo" (names of persons), they failed to use the knowledge of the tree-vine distinction to help them solve the problem. In a somewhat different kind of study, adults were given a classification problem based upon the familiar Kpelle distinction of forest animals and town animals. After they solved the first problem, they were given a new one, to classify different instances of the same two classes. Solving of the second problem was no faster than solving of the first, and no faster than the performance of a control group that had completely different classes for each of two problems. This failure to transfer a rule of solution from the first to the second problem was all the more remarkable in that (i) internal evidence indicated that these people were using conceptual rules to solve the initial problem, and (ii) a group of adults who were asked to free-associate to the names of the animals given in the first problem spontaneously named animals used in the second. We can infer from this that the experimental subjects knew and recognized the common class membership of the items in the two problems but this knowledge did not figure in their solution strategy.

Other examples of nongeneralization of solution principles could be cited, but we will turn instead to the second feature that distinguishes the performance of schooled and unschooled groups in a wide variety of tasks—their use of language to describe the tasks and what they are doing with them. In a recent sorting experiment (6), various populations of Kpelle adults were asked to put 25 familiar objects into groups

so that "those that belong together are in the same group." After the subjects completed sorting, they were asked why the items belonged together. There were more consistent and more striking group differences in the verbal explanations given for the groupings than in the nature of the groups per se. Most of the high schoolers referred to some physical or semantic property of the objects as the criterion for classification. Most of the villagers gave idiosyncratic or arbitrary reasons ("my sense told me") which were unrelated to an analysis of the task materials or the operational requirements of the task.

The same pattern emerged when these same subjects were asked to spend two minutes doing anything they wanted to help them remember a set of common objects and later were asked how they had tried to remember. High schoolers in most cases reported activities they were actually observed carrying out (such as rehearsing the names of objects), whereas the majority of unschooled villagers had great difficulty with the question and frequently fell back on a nonspecific explanation such as "God helped me." We have consistently obtained these kinds of responses whenever uneducated, traditional people have been asked to explain the nature of their learning activity or "the principle of solution" (7).

If we are going to have an explanation for these different performance patterns, we need to know how they are generated. What is the connection among forms of societal organization, their dominant values, the characteristics of the learning contexts they furnish, and the functional learning systems that develop in them? Anthropological studies offer much helpful information about these relationships and important clues about the characteristics distinguishing different forms of social organization of education. These forms are generally classified as informal education, formal education in noninstitutional settings, and the formal education of the school. Is there anything different going on in these different contexts?

Informal Education

Informal education is the subject matter of most major works on children in primitive societies (8–10). Such learning is called informal because it occurs in the course of mundane adult

activities in which the young take part according to their abilities. There is no activity set aside solely to "educate the child." Social processes and institutions are structured to permit the child's acquisition of the basic skills, values, attitudes, and customs which define appropriate adult behavior in the culture. It is informal learning that Margaret Mead celebrates in her descriptions of little Manus children piloting around their elders in outsized canoes, Arapesh children engaging in a hunt with miniature bows and arrows, and Balinese children learning to dance.

A number of anthropological descriptions of informal learning tend to converge around the following three characteristics, which Cohen (11) argues are its distinctive traits:

1) Because informal education (Cohen uses the word "socialization") occurs in the family, it is particularistic. That is, "expectations for performance . . . are phrased in terms of who a person is instead of *what* he has accomplished" (11, p. 25). Furthermore, this particularism is connected to how evidence is evaluated—the value of information is closely related to who imparted it.

2) Informal education fosters traditionalism. This conclusion follows rather directly from the preceding one, since the elders are accorded the highest status in the group.

3) Informal education fuses emotional and intellectual domains. As Cohen puts it (11, p. 34),

One of the most outstanding characteristics of socialization . . . is the high affective charge that is associated with almost everything that is learned within that context. The reason for this is that the content of learning, especially in children, is often inseparable from the identity of their teachers.

Almost all anthropological descriptions of informal learning also make some kind of statement about the learning mechanisms involved. Fortes, for example, talks about the "three fundamental learning mechanisms, mimesis, identification, and cooperation" (8). Mead lists empathy, imitation, and identification as the cornerstones of informal education (12). Cazden and John emphasize the importance of "learning through looking" among young American Indian children (13). These labels and terms are often used with little precision, but what is important for the present discussion is that they all refer to a general domain which we may call "observa-

tional learning." Observational learning, in general, is contrasted with learning that is acquired primarily through the means of language. Mead points out, for example, that in informal learning the adult model rarely formulates a particular practice in words or rules, but instead provides a demonstration of it. Fortes adds the complementary observation from his study of education in Taleland that children there were rarely heard to ask "why" questions. He concludes that such questions are absent because much of the child's learning occurs in real situations where the meaning is intrinsic to the context. We are not certain about the generality of Fortes's observations or his conclusions, but they are important for one of the generalizations to which they have given rise—the idea that informal learning does not promote verbal formulation on the part of the learner any more than it does on the part of the model.

Noninstitutional Formal Education

When we turn to formal education in traditional societies, we find less evidence concerning its nature or the dynamic processes involved. Drawing on recent anthropological discussions (14), we can provisionally define formal education as any process of cultural transmission that is (i) organized deliberately to fulfill the specific purpose of transmission, (ii) extracted from the manifold of daily life, placed in a special setting and carried out according to specific routines, and (iii) made the responsibility of the larger social group.

Anthropological discussion of formal education tends to emphasize the presence of at least some formal education even in the most primitive societies. Cohen, for example, tells us that informal and formal education are aspects of growing up in all social systems although their roles vary quantitatively from one society to another (11, p. 21). The formal learning situations most often analyzed by anthropologists are those intended to educate the young in values and attitudes rather than knowledge and skills. Cohen's example is aborigine initiation rites in which the adults conduct a complex, prerehearsed sequence of behaviors that is more or less invariant from year to year and is viewed as an essential part of the child's education.

Not much scholarly attention has been given to detailed studies of formal education in nonliterate societies that focus on the transmission of knowledge and skills. There are intriguing, but brief, references to the formal nature (in certain societies) of such diverse instructional activities as military training, teaching of music, dissemination of geographic information (15), transmission of totemic names (16), and language teaching (12), among others.

One of the most complete descriptions of a formal learning situation in a nonliterate society is Thomas Gladwin's analysis of the procedures and the materials used by Puluwatan navigators to teach novices the complex skills of navigation (17). He makes abundantly clear that formal instruction of this kind represents more than apprentice training; it involves didactic teaching and the deliberate, disciplined mastery of large bodies of information which are embedded in well-developed theoretical frameworks. Unfortunately, Gladwin's study, like others, fails to illuminate the dynamics of the teaching and learning processes. He tells us only that (i) no "general heuristic principles" are involved, (ii) that the "logic" of the teaching process is different from ours, and (iii) that rote memory may be involved, but that the nature of the learning goes beyond this. Similarly, we have no idea whether new principles are involved in the learning that takes place in an aboriginal initiation ceremony, or when an Iatmul boy commits to memory the extensive esoteric lore that will be demanded of him as an adult. In the absence of such information, we cannot judge whether formal learning situations in traditional societies are merely an extension of ways of learning that operate in the course of everyday life or whether they represent "something new." If they are in fact discontinuous in respect to techniques of teaching and learning, studies thus far indicate that they are continuous with informal learning in respect to other characteristics: they transmit traditional knowledge and skills with a highly positive social value; the learning is not depersonalized but continues to be bound up with the social status of the persons acting as teachers; and it is bounded learning in the sense that it deals with a demarcated set of activities or skills with the result that the learning processes are inseparably related to the given body of material.

School Learning

When we turn to the schools, the evidence seems much clearer that its demands are *not* continuous with those of everyday informal learning. Sifting through the mountains of achievement and evaluation studies which constitute the bulk of research on the schools, we find very few penetrating analyses of the learning and teaching processes actually going on in the school environment (18). Our procedure here will be to select and discuss some of the characteristics of schooling that we speculate are of special significance to the development of functional intellectual skills. We make no claim that these are characteristics that are uniquely to be found in schools. It is more likely that there are some informal, everyday learning situations showing one or another feature of school learning. But we think that it is the combination of these features and the frequency of their occurrence that bring about a learning environment that is qualitatively new.

Anthropologists have long emphasized contrasts between the values, attitudes, and content transmitted by informal education and by the school. To this, we shall add a discussion of the way in which values and content interact to influence the organization of functional learning systems.

Whereas informal education rests upon a system of person-oriented values, "the essence of [formal] education . . . is that one of its principal emphases is on universalistic values, criteria, and standards of performance" (11). What is being taught, instead of who is doing the teaching, becomes paramount. Children are expected to learn by relating themselves solely to subject matter and by disregarding their relationship with the teacher; they are likely to see a new teacher each semester, if not each hour. When schools introduce these universalistic values into traditional societies where particularistic, person-oriented values dominate, the resulting value discrepancy may create obstacles to learning. Considerable attention has been devoted to this situation. But in addition to the value conflicts that are inherent in formal schooling, other, more pernicious conflicts arise from the fact that schools have often represented a culture that oppresses and denigrates the indigenous culture. Success in school may become identified with despising one's parents and heritage, school failure with resistance to injustice. Under

such circumstances, as Wax and Wax (19) describe, value conflicts may transform the school into a place where very little formal education can take place.

When comparing school learning to informal learning, anthropologists and psychologists most commonly emphasize differences in content. "Dick and Jane" readers, textbooks and materials that do not reflect the child's actual living circumstances, have been justifiably criticized. But the conflict between the knowledge the school seeks to impart and the knowledge most children bring to school runs much deeper than this (20). In some subject matter the information dispensed by the school contradicts commonly accepted knowledge and beliefs. The history curriculum obliterates the oral tradition and replaces it with a "world history" whose people and events were previously undreamed of in the child's culture. The subject called geography transforms the child's known physical universe into an unfamiliar one whose properties are not derived from the senses. These changes in overlapping content areas have been epitomized in the saying that in school "science lays common sense to rest."

In addition, school introduces new subjects, such as grammar, mathematics, and the sciences, which may have no cultural counterparts at all. Not only the content but the basic organizing concepts of these fields of knowledge may conflict with the traditional culture's way of understanding and interpreting the world. Robin Horton brings this out in a touching anecdote from his teaching career in Nigeria (21). He describes the absolute disbelief that greeted him when he told his students that he loved chemistry as a youth because the rules for combining elements and compounds were so regular and knowable. Horton preferred the laboratory to socializing with his schoolmates, whom he found confusing and difficult to understand. His Nigerian students, on the other hand, came to school believing, and got all the way to college confirmed in the belief, that the natural world is disorderly and uncontrollable, whereas the human world can be understood and controlled.

All these changes in content are of obvious importance to a theory of formal education. But the discussion cannot rest here. We need to go on to consider the possibility that changes in the content of education are closely connected with changes in the basic organization of learning.

Functional Learning Systems

A useful starting point for comparing the functional learning systems developed in school and nonschool settings is Bruner's description of the school (3, p. 62):

. . . the important thing about school as now constituted is that it is removed from the immediate context of socially relevant action. This very disengagement makes learning an act in itself and makes it possible to embed it in a context of language and symbolic activity . . . words are the major invitations to form concepts rather than the action.

The two principal attributes of the school mentioned in this passage are that language is the predominant mode of transmitting and acquiring information and that teaching and learning occur "out of context." We shall discuss each in turn.

Some discussions about the crucial role of language in school learning seem oversimplified because they ignore the many different functional uses of language in everyday life. Children and adults are always learning through the medium of language, outside the school as well as in it. What is special about the school situation is that there language becomes almost the exclusive means of exchanging information. It is self-evident that when linguistic forms carry the full burden of communication, the amount of information available to the learner is restricted. Compare the many rich sources of information available to the child who learns to weave by watching and doing: he sees particular bits of material varying in width and flexibility, feels their tension and resistance, compares his physical movements to those of the modeler, and integrates all these inputs from different sense modalities into his cognitive scheme of what weaving is all about. Learning to weave by hearing a discourse on it is quite a different situation. As visual and other modalities of information disappear in the classroom, the skills for processing them become irrelevant to the learning situation and possibly become impediments. "Observation" is a limited technique in the overwhelmingly linguistic environment of the school.

A far more interesting aspect of language use in the school is that its relationship to practical activities and concrete referents seems to be the exact converse of the relationship obtaining in everyday life. We have cited anthropologists' observations that infor-

mal learning proceeds in the main by demonstration without accompanying verbal statements of "rules" or "principles." The child sees or participates in a number of demonstrations of the "same event" and from these accumulated instances he acquires some generalized ways of performing the activity in question. This knowledge may regulate his subsequent behavior in this domain without being formulated verbally or generalized to related but different events. In school the contrary often happens. Teaching frequently begins with a verbal formulation of a general rule or a generalized verbal description. Ideally, the verbal schema is eventually connected with the empirical referents from which it has been abstracted. Unfortunately, we all know too many examples of school learners who "know the words" but not the referents, who are limited by their empty verbal constructs just as informal learners may be limited by their inarticulated practical constructs.

Vygotsky drew attention to these different courses of learning in his well-known comparison of "everyday" and "scientific" concepts (22). He maintained that the concepts we acquire in everyday life (he used "brother" as an example) are built from the bottom up through our experience with many concrete exemplars. They are rich in content but often difficult to define and to incorporate in a coherent conceptual system. Scientific concepts transmitted in the school ("exploitation" was his example) proceed in the opposite direction, from the top down. The student begins by knowing the verbal definition, and the course of his learning consists in overcoming his ignorance about the specific aspects of reality to which this definition refers. This analysis suggests the origin of one of the prime characteristics that distinguish educated and uneducated subjects in psychological experiments. Given extensive participation in concept formation on a purely linguistic level, it is not surprising that school populations tested in a variety of psychological tasks give fuller and more accurate verbal descriptions of their classifying operations and rules of solution than do their unschooled counterparts.

Bruner's idea that learning in school is best characterized as "learning out of context" is an important idea, but it needs further clarification. Everyday life also presents occasions in which the child learns material through the use of language when the referents of

the words are not physically present—when someone tells a story, for example, or recalls his family genealogy. But the referents to the words used are familiar natural and social entities, and in that sense the new information can be assimilated "in context." What is special about learning out of context in the school is that the child is asked to learn material that has no natural, that is, nonsymbolic, context. A prototype for this kind of learning is mathematics. In informal learning, numbers are used to count things and are learned in connection with the particular things counted. Among the Kpelle the translation of the numbers 1, 2, 3 is "one of a thing, two of a thing," and so on (23). Similarly, the metrics for length depend upon the thing being measured. By contrast, when the school child is asked to learn numbers the operation has changed. He is no longer using numbers for the purpose of manipulating particular things; he is manipulating numbers *qua* numbers; they are themselves the things.

A substantial part of school learning may be seen as the process of becoming competent in the use of various symbol systems of this kind. A great deal of attention is devoted to teaching the child new techniques for processing information (how to read, to write, to "figure," for example) which mediate later learning. This independent learning of techniques or instrumental skills, apart from the ends to which they will later be functionally related, does not seem to have many parallels in everyday life. At a simple level of technology, the use of a specific tool is ordinarily mastered in the course of exercising it for some particular purpose. This is another sense in which school learning can be considered to occur "out of context."

The intellectual tools of the school seem to differ from the tools used in practical activity in at least one other respect. We know that in daily life learning in different practical domains is mediated by different instruments—a knife for carving, a sickle for cutting grass, an ax for chopping. Within a single conceptual domain—measuring, for example—instruments may vary according to the object being measured—a pinch of salt and a teaspoon of vanilla. By contrast, the intellectual tools used in school range over a wide variety of tasks and contents; how one operates with a book or ruler is not much affected by the subject-matter or goal. An inch of cloth is equivalent to

an inch of wood in a special sense. We believe that the existence of common operations that are applied to a multitude of tasks underlies the tendency we reported of school populations to generalize rules and operations across a number of problems. This tendency to treat a wide class of problems as examples of some general class or rule is an excellent example of what we have been referring to as a functional learning system. Further, we would like to suggest that such learning systems are acquired by the principle of "deutero-learning" or learning-to-learn which Bateson long ago suggested to explain cultural differences in memory (24); learning-to-learn occurs when people are repeatedly presented with "problems of the same type." No better summary of our description of school learning could be wished for.

Some Problems for Research

Before discussing the implications of our analysis, we need to emphasize that it rests upon a shallow empirical base. At each step of the way we have had to deal with insufficient data and conceptual confusion.

In the area of informal learning, there are many gaps in ethnographic data and a great deal of uncertainty about the mechanisms associated with observational learning. These should not remain unattended by anthropologists or ignored by psychologists. Greenfield and Childs (25) provide a research example which we think might serve as a model for future efforts. Beginning with the observation that Zinacantan girls are expected to learn to weave three traditional patterns they were led to inquire whether this traditional task brought about any generalized ability to represent patterns. They found, consistent with our analysis of skills acquired in informal learning contexts, that their young weavers had not developed generalized pattern-representation skills. They also found some, but by no means a great deal of, influence of schooling on pattern representation. This work raises many important questions which simply cannot be answered on the basis of current evidence: Is the failure to generalize patterns a consequence of the way in which weaving is taught, or a result of the fact that there are only three acceptable patterns in Zinacantan? Would generalized pattern-representation skills be found in people who had

learned to weave many patterns? Our discussion of learning-to-learn suggests that only where many examples of a principle are present does generalized learning occur. Is this proposition testable within a traditional, informal educational framework?

A quite different set of questions arises in connection with learning by observation. If a person has grown up in a society where a wide variety of tasks are learned by observation, does he develop special skills in "observational learning"? If such skills could be demonstrated, could they be turned to good use in formal educational settings?

When we turn to the question of formal learning outside the school, our known data base is even more restricted. Gladwin has pointed the way, but more scrupulous accounts of the teaching-learning process and, of course, a variety of examples must be provided. Completely neglected have been studies of the consequences of attending such institutions as the Koranic School in West Africa, where children spend long hours learning to read the Koran with little or no knowledge of Arabic (26).

We have been treating formal and informal learning as disjoint for didactic purposes. But we know that they are constantly interacting in the classroom and we need detailed studies of this interaction with an eye to its impact on the organization of learning systems. For example, we have characterized teaching in the schools as a process that emphasizes scientific concepts and generalization from superordinate categories to instances. But in the real world, a great deal of teaching in the school derives its style directly from the informal learning background of the teacher. How else can we interpret the heavy reliance on authority and rote teaching methods applied to problems that we have characterized as central to formal education? This mixture of formal and informal elements must also underlie the great resistance Peace Corps volunteers meet when they try to introduce discovery techniques into the classroom; their students' basic conception of what it means to learn makes it "unfair" to ask for the solution to $x + 4 = 7$ if they were given $x - 5 = 10$ as an example.

A study of the interaction of formal and informal learning systems is also a prerequisite to resolving the current arguments among psychologists about the cognitive consequences of education. As we mentioned earlier, we have

not found school-nonschool differences in all the tasks we have studied, and other investigators have not always replicated seemingly well-established effects of education on particular cognitive tasks (27). We need to seek the resolution of these contradictions in careful studies of the kinds of informal and formal learning situations that exist in the society outside of school and the mixture of informal and formal learning that goes on in the school. We would expect measurable influences of education only where the school presents a clear contrast in its dominant educational methods.

Implications

We have maintained that the problems and techniques of the school are not the problems and techniques of practical life or the traditional home. The school's knowledge base, value system, and dominant learning situations and the functional learning systems to which they give rise are all in conflict with those of the student's traditional culture. If we take this opposition seriously, certain implications follow for educational policy.

For one thing, it is not necessary to look further for explanation of the difficulties formal education may present to people who rely heavily on informal education as their basic method. The problem does not lie "in them." Searches for specific "incapacities" and "deficiencies" are socially mischievous detours.

Second, if many of the demands of formal schooling are by their very nature discontinuous with those of everyday life, it seems unreasonable to expect masses of children to cope successfully with them so long as they perceive the school to be a hostile institution. Yet this is exactly the situation in many poor and minority neighborhoods in the United States and in many third-world countries. The antagonism the schools generate by their disrespect for the indigenous culture and by ignorance of its customs almost guarantees the production of nonlearners. While indigenous control of the schools cannot by itself undo the basic opposition between informal and school-based education, it is surely a necessary precondition for their reconciliation.

Finally, we think our analysis points to the need for serious and basic changes in the social organization of education. Changes in textbooks, cur-

ricula, and teaching techniques are all needed and important, but they cannot be counted on to bridge the gulf between school and practical life by themselves. A two-way movement is necessary here. The first, which is already under way in some experimental schools (28), is to move everyday life into the school so that its subject matter and activities deal with some of the same aspects of social and physical reality that the pupils confront outside of school.

The second has been little attempted. The techniques of the modern school need to be introduced into the context of recognized practical problems. Education must be stripped from the schoolroom and made instrumental in traditional settings. We take this to be the message behind Paolo Freire's writings on literacy (29) and the import of the changes reported by Luria when modern planning and management techniques were introduced into traditional Russian agriculture. We have seen such approaches work when applied to helping Liberian farmers get a better price for their rice.

These suggestions bring us back to the problem with which we opened this paper. A complete theory of formal education requires analysis of phenomena at several levels of social organization, as well as their interactions. We have only sketched our own theory of how certain social phenomena are related to educational performance. It is painfully clear to us that the facts at hand can do no more than lend credibility to the assertions we have been making. On one matter, however, we can be relatively confident: to expect massive changes in educational outcomes without a readiness to change the social organization of education is to invite cynicism and disillusionment.

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NEWS AND COMMENT

Military R & D: Hard Lessons of an Electronic War

It was the very model of a modern electronic war, fought with the best that nonnuclear technology had to offer. Supersonic Soviet SAM's whooshed up from the desert on puffs of white smoke, climbing radar beams into the bellies of supersonic Phantoms. Israeli pilots deployed the best of America's electronic bamboozlery, and when all else failed they fired Shrike and Standard radar-seeking missiles into SAM launch sites. On the ground, hundreds of tanks swirled through the fiercest armored battles since World War II, but this time some of them aimed their fire with laser range finders. Wire-guided Snapper and Sagger anti-tank missiles, made in the Soviet Union, took a devastating toll of tanks made in the United States and Britain; Israel retaliated with the products of Vietnam: smart bombs, cluster bombs, and the Maverick—the latter not a compact car but a new U.S. antitank missile with a television camera in its nose and an uncanny ability to remember what its chosen target looks like.

By the time the fighting ground to an uneasy truce on 22 October, something on the order of \$4 billion worth of high-technology wreckage lay strewn along the Golan Heights and both sides of the Suez Canal. Surveying this costly detritus, a number of military analysts in Washington have begun to

extract some technological lessons that will, or, these observers believe, ought to, influence the course of tactical weapons R & D in the United States and Europe for years to come.

How one interprets the lessons of the fourth and most expensive Arab-Israeli war in a quarter of a century depends to some extent on whether one is inside the Pentagon or out. To some respected analysts on the outside, the handwriting on the wall, in Cyrillic script, says bluntly that missile technology has outstripped any protective countermeasures currently available to tactical fighter aircraft and tanks. If the evident potency of cheap antitank missiles has not rendered the tank obsolete, these analysts say, then at least it is due for a demotion from its present role of offensive spearhead to one of mundane mopping-up operations.

Similarly, Israel's loss of more than 75 planes (about 15 percent of its combat-ready air force) in the first week of fighting is interpreted by a variety of independent observers outside the Defense Department as evidence that the United States does not have an effective response to the best Soviet SAM (surface-to-air missile) defense. Accordingly, they hope, development of a new generation of unmanned drone jets for "SAM suppression" will begin to seem more appeal-

ing to a military establishment that has long been chary of such a radical departure from traditional tactical aircraft.

The Defense Department, while not inclined to view the Middle East war in such stark terms, nevertheless is likely to apply its lessons to good advantage in justifying existing R & D programs. "Whether there are any jarring lessons or not," an aide to Representative Les Aspin (D-Wis.) predicts, "they'll be up here next year to make the point." This source, and several other congressional staffers involved in defense affairs, believe the Arab-Israeli experience is likely to fortify already substantial congressional support for a number of R & D programs in tactical air warfare. The programs most likely to benefit range across the services, from Air Force work on electronic countermeasures (ECM) for foiling SAM defenses, to the Army's antitank helicopter program, to the SAM-D, a sophisticated new antiaircraft missile.

By the same token, though, the Army will probably have a tougher time next year in selling Congress on continuing its \$2.3 billion effort to produce a new "main battle tank" for U.S. and NATO forces in the 1980's. The Army's tank program, in fact, appears to be one of the very few major development programs likely to suffer from the Arab-Israeli experience.

A program with a somewhat checkered career, it began in 1963 as a joint effort with West Germany to produce an ultramodern counterpoint to superior numbers of Soviet tanks arrayed against NATO forces in Europe. As the unit price of the tank (initially dubbed the MBT-70, later redesigned and rechristened the XM-803) climbed past the \$1 million mark,