

Interaction between Learning and Development

The problems encountered in the psychological analysis of teaching cannot be correctly resolved or even formulated without addressing the relation between learning and development in school-age children. Yet it is the most unclear of all the basic issues on which the application of child development theories to educational processes depends. Needless to say, the lack of theoretical clarity does not mean that the issue is removed altogether from current research efforts into learning; not one study can avoid this central theoretical issue. But the relation between learning and development remains methodologically unclear because concrete research studies have embodied theoretically vague, critically unevaluated, and sometimes internally contradictory postulates, premises, and peculiar solutions to the problem of this fundamental relationship; and these, of course, result in a variety of errors.

Essentially, all current conceptions of the relation between development and learning in children can be reduced to three major theoretical positions.

The first centers on the assumption that processes of child development are independent of learning. Learning is considered a purely external process that is not actively involved in development. It merely utilizes the achievements of development rather than providing an impetus for modifying its course.

In experimental investigations of the development of thinking in school children, it has been assumed that processes such as deduction and understanding, evolution of notions about the world, interpretation of physical causality, and mastery of logical forms of thought and abstract logic all occur by themselves, without any influence from school

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learning. An example of such a theory is Piaget's extremely complex and interesting theoretical principles, which also shape the experimental methodology he employs. The questions Piaget uses in the course of his "clinical conversations" with children clearly illustrate his approach. When a five-year-old is asked "why doesn't the sun fall?" it is assumed that the child has neither a ready answer for such a question nor the general capabilities for generating one. The point of asking questions that are so far beyond the reach of the child's intellectual skills is to eliminate the influence of previous experience and knowledge. The experimenter seeks to obtain the tendencies of children's thinking in "pure" form, entirely independent of learning.¹

Similarly, the classics of psychological literature, such as the works by Binet and others, assume that development is always a prerequisite for learning and that if a child's mental functions (intellectual operations) have not matured to the extent that he is capable of learning a particular subject, then no instruction will prove useful. They especially feared premature instruction, the teaching of a subject before the child was ready for it. All effort was concentrated on finding the lower threshold of learning ability, the age at which a particular kind of learning first becomes possible.

Because this approach is based on the premise that learning trails behind development, that development always outruns learning, it precludes the notion that learning may play a role in the course of the development or maturation of those functions activated in the course of learning. Development or maturation is viewed as a precondition of learning but never the result of it. To summarize this position: Learning forms a superstructure over development, leaving the latter essentially unaltered.

The second major theoretical position is that learning is development. This identity is the essence of a group of theories that are quite diverse in origin.

One such theory is based on the concept of reflex, an essentially old notion that has been extensively revived recently. Whether reading, writing, or arithmetic is being considered, development is viewed as the mastery of conditioned reflexes; that is, the process of learning is completely and inseparably blended with the process of development. This notion was elaborated by James, who reduced the learning process to habit formation and identified the learning process with development.

Reflex theories have at least one thing in common with theories such as Piaget's: in both, development is conceived of as the elaboration and substitution of innate responses. As James expressed it, "Education,

in short, cannot be better described than by calling it the organization of acquired habits of conduct and tendencies to behavior."² Development itself is reduced primarily to the accumulation of all possible responses. Any acquired response is considered either a more complex form of or a substitute for the innate response.

But despite the similarity between the first and second theoretical positions, there is a major difference in their assumptions about the temporal relationship between learning and developmental processes. Theorists who hold the first view assert that developmental cycles precede learning cycles; maturation precedes learning and instruction must lag behind mental growth. For the second group of theorists, both processes occur simultaneously; learning and development coincide at all points in the same way that two identical geometrical figures coincide when superimposed.

The third theoretical position on the relation between learning and development attempts to overcome the extremes of the other two by simply combining them. A clear example of this approach is Koffka's theory, in which development is based on two inherently different but related processes, each of which influences the other.³ On the one hand is maturation, which depends directly on the development of the nervous system; on the other hand is learning, which itself is also a developmental process.

Three aspects of this theory are new. First, as we already noted, is the combination of two seemingly opposite viewpoints, each of which has been encountered separately in the history of science. The very fact that these two viewpoints can be combined into one theory indicates that they are not opposing and mutually exclusive but have something essential in common. Also new is the idea that the two processes that make up development are mutually dependent and interactive. Of course, the nature of the interaction is left virtually unexplored in Koffka's work, which is limited solely to very general remarks regarding the relation between these two processes. It is clear that for Koffka the process of maturation prepares and makes possible a specific process of learning. The learning process then stimulates and pushes forward the maturation process. The third and most important new aspect of this theory is the expanded role it ascribes to learning in child development. This emphasis leads us directly to an old pedagogical problem, that of formal discipline and the problem of transfer.

Pedagogical movements that have emphasized formal discipline and urged the teaching of classical languages, ancient civilizations, and mathematics have assumed that regardless of the irrelevance of these

particular subjects for daily living, they were of the greatest value for the pupil's mental development. A variety of studies have called into question the soundness of this idea. It has been shown that learning in one area has very little influence on overall development. For example, reflex theorists Woodworth and Thorndike found that adults who, after special exercises, had achieved considerable success in determining the length of short lines, had made virtually no progress in their ability to determine the length of long lines. These same adults were successfully trained to estimate the size of a given two-dimensional figure, but this training did not make them successful in estimating the size of a series of other two-dimensional figures of various sizes and shapes.

According to Thorndike, theoreticians in psychology and education believe that every particular response acquisition directly enhances overall ability in equal measure.⁴ Teachers believed and acted on the basis of the theory that the mind is a complex of abilities—powers of observation, attention, memory, thinking, and so forth—and that any improvement in any specific ability results in a general improvement in all abilities. According to this theory, if the student increased the attention he paid to Latin grammar, he would increase his abilities to focus attention on any task. The words "accuracy," "quick-wittedness," "ability to reason," "memory," "power of observation," "attention," "concentration," and so forth are said to denote actual fundamental capabilities that vary in accordance with the material with which they operate; these basic abilities are substantially modified by studying particular subjects, and they retain these modifications when they turn to other areas. Therefore, if someone learns to do any single thing well, he will also be able to do other entirely unrelated things well as a result of some secret connection. It is assumed that mental capabilities function independently of the material with which they operate, and that the development of one ability entails the development of others.

Thorndike himself opposed this point of view. Through a variety of studies he showed that particular forms of activity, such as spelling, are dependent on the mastery of specific skills and material necessary for the performance of that particular task. The development of one particular capability seldom means the development of others. Thorndike argued that specialization of abilities is even greater than superficial observation may indicate. For example, if, out of a hundred individuals we choose ten who display the ability to detect spelling errors or to measure lengths, it is unlikely that these ten will display better abilities regarding, for example, the estimation of the weight of objects. In the

same way, speed and accuracy in adding numbers are entirely unrelated to speed and accuracy in being able to think up antonyms.

This research shows that the mind is not a complex network of general capabilities such as observation, attention, memory, judgment, and so forth, but a set of specific capabilities, each of which is, to some extent, independent of the others and is developed independently. Learning is more than the acquisition of the ability to think; it is the acquisition of many specialized abilities for thinking about a variety of things. Learning does not alter our overall ability to focus attention but rather develops various abilities to focus attention on a variety of things. According to this view, special training affects overall development only when its elements, material, and processes are similar across specific domains; habit governs us. This leads to the conclusion that because each activity depends on the material with which it operates, the development of consciousness is the development of a set of particular, independent capabilities or of a set of particular habits. Improvement of one function of consciousness or one aspect of its activity can affect the development of another only to the extent that there are elements common to both functions or activities.

Developmental theorists such as Koffka and the Gestalt School—who hold to the third theoretical position outlined earlier—oppose Thorndike's point of view. They assert that the influence of learning is never specific. From their study of structural principles, they argue that the learning process can never be reduced simply to the formation of skills but embodies an intellectual order that makes it possible to transfer general principles discovered in solving one task to a variety of other tasks. From this point of view, the child, while learning a particular operation, acquires the ability to create structures of a certain type, regardless of the diverse materials with which she is working and regardless of the particular elements involved. Thus, Koffka does not conceive of learning as limited to a process of habit and skill acquisition. The relationship he posits between learning and development is not that of an identity but of a more complex relationship. According to Thorndike, learning and development coincide at all points, but for Koffka, development is always a larger set than learning. Schematically, the relationship between the two processes could be depicted by two concentric circles, the smaller symbolizing the learning process and the larger the developmental process evoked by learning.

Once a child has learned to perform an operation, he thus assimilates some structural principle whose sphere of application is other than just

the operations of the type on whose basis the principle was assimilated. Consequently, in making one step in learning, a child makes two steps in development, that is, learning and development do not coincide. This concept is the essential aspect of the third group of theories we have discussed.

ZONE OF PROXIMAL DEVELOPMENT: A NEW APPROACH

Although we reject all three theoretical positions discussed above, analyzing them leads us to a more adequate view of the relation between learning and development. The question to be framed in arriving at a solution to this problem is complex. It consists of two separate issues: first, the general relation between learning and development; and second, the specific features of this relationship when children reach school age.

That children's learning begins long before they attend school is the starting point of this discussion. Any learning a child encounters in school always has a previous history. For example, children begin to study arithmetic in school, but long beforehand they have had some experience with quantity—they have had to deal with operations of division, addition, subtraction, and determination of size. Consequently, children have their own preschool arithmetic, which only myopic psychologists could ignore.

It goes without saying that learning as it occurs in the preschool years differs markedly from school learning, which is concerned with the assimilation of the fundamentals of scientific knowledge. But even when, in the period of her first questions, a child assimilates the names of objects in her environment, she is learning. Indeed, can it be doubted that children learn speech from adults; or that, through asking questions and giving answers, children acquire a variety of information; or that, through imitating adults and through being instructed about how to act, children develop an entire repository of skills? Learning and development are interrelated from the child's very first day of life.

Kořfka, attempting to clarify the laws of child learning and their relation to mental development, concentrates his attention on the simplest learning processes; those that occur in the preschool years. His error is that, while seeing a similarity between preschool and school learning, he fails to discern the difference—he does not see the specifically new elements that school learning introduces. He and others assume that the difference between preschool and school learning consists of non-

systematic learning in one case and systematic learning in the other. But "systemativeness" is not the only issue; there is also the fact that school learning introduces something fundamentally new into the child's development. In order to elaborate the dimensions of school learning, we will describe a new and exceptionally important concept without which the issue cannot be resolved: the zone of proximal development.

A well known and empirically established fact is that learning should be matched in some manner with the child's developmental level. For example, it has been established that the teaching of reading, writing, and arithmetic should be initiated at a specific age level. Only recently, however, has attention been directed to the fact that we cannot limit ourselves merely to determining developmental levels if we wish to discover the actual relations of the developmental process to learning capabilities. We must determine at least two developmental levels.

The first level can be called the *actual developmental level*, that is, the level of development of a child's mental functions that has been established as a result of certain already *completed* developmental cycles. When we determine a child's mental age by using tests, we are almost always dealing with the actual developmental level. In studies of children's mental development it is generally assumed that only those things that children can do on their own are indicative of mental abilities. We give children a battery of tests or a variety of tasks of varying degrees of difficulty, and we judge the extent of their mental development on the basis of how they solve them and at what level of difficulty. On the other hand, if we offer leading questions or show how the problem is to be solved and the child then solves it, or if the teacher initiates the solution and the child completes it or solves it in collaboration with other children—in short, if the child barely misses an independent solution of the problem—the solution is not regarded as indicative of his mental development. This "truth" was familiar and reinforced by common sense. Over a decade even the profoundest thinkers never questioned the assumption; they never entertained the notion that what children can do with the assistance of others might be in some sense even more indicative of their mental development than what they can do alone.

Let us take a simple example. Suppose I investigate two children upon entrance into school, both of whom are ten years old chronologically and eight years old in terms of mental development. Can I say that they are the same age mentally? Of course. What does this mean? It means that they can independently deal with tasks up to the degree of difficulty that has been standardized for the eight-year-old level. If I

stop at this point, people would imagine that the subsequent course of mental development and of school learning for these children will be the same, because it depends on their intellect. Of course, there may be other factors, for example, if one child was sick for half a year while the other was never absent from school; but generally speaking, the fate of these children should be the same. Now imagine that I do not terminate my study at this point, but only begin it. These children seem to be capable of handling problems up to an eight-year-old's level, but not beyond that. Suppose that I show them various ways of dealing with the problem. Different experimenters might employ different modes of demonstration in different cases: some might run through an entire demonstration and ask the children to repeat it, others might initiate the solution and ask the child to finish it, or offer leading questions. In short, in some way or another I propose that the children solve the problem with my assistance. Under these circumstances it turns out that the first child can deal with problems up to a twelve-year-old's level, the second up to a nine-year-old's. Now, are these children mentally the same?

When it was first shown that the capability of children with equal levels of mental development to learn under a teacher's guidance varied to a high degree, it became apparent that those children were not mentally the same age and that the subsequent course of their learning would obviously be different. This difference between twelve and eight, or between nine and eight, is what we call *the zone of proximal development*. It is the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers.

If we naively ask what the actual developmental level is, or to put it more simply, what more independent problem solving reveals, the most common answer would be that a child's actual developmental level defines functions that have already matured, that is, the end products of development. If a child can do such-and-such independently, it means that the functions for such-and-such have matured in her. What, then, is defined by the zone of proximal development, as determined through problems that children cannot solve independently but only with assistance? The zone of proximal development defines those functions that have not yet matured but are in the process of maturation, functions that will mature tomorrow but are currently in an embryonic state. These functions could be termed the "buds" or "flowers" of development rather than the "fruits" of development. The actual developmental level characterizes mental development retrospectively, while the zone of

proximal development characterizes mental development prospectively.

The zone of proximal development furnishes psychologists and educators with a tool through which the internal course of development can be understood. By using this method we can take account of not only the cycles and maturation processes that have already been completed but also those processes that are currently in a state of formation, that are just beginning to mature and develop. Thus, the zone of proximal development permits us to delineate the child's immediate future and his dynamic developmental state, allowing not only for what already has been achieved developmentally but also for what is in the course of maturing. The two children in our example displayed the same mental age from the viewpoint of developmental cycles already completed, but the developmental dynamics of the two were entirely different. The state of a child's mental development can be determined only by clarifying its two levels: the actual developmental level and the zone of proximal development.

I will discuss one study of preschool children to demonstrate that what is in the zone of proximal development today will be the actual developmental level tomorrow—that is, what a child can do with assistance today she will be able to do by herself tomorrow.

The American researcher Dorothea McCarthy showed that among children between the ages of three and five there are two groups of functions: those the children already possess, and those they can perform under guidance, in groups, and in collaboration with one another but which they have not mastered independently. McCarthy's study demonstrated that this second group of functions is at the actual developmental level of five-to-seven-year-olds. What her subjects could do only under guidance, in collaboration, and in groups at the age of three-to-five years they could do independently when they reached the age of five-to-seven years.⁵ Thus, if we were to determine only mental age—that is, only functions that have matured—we would have but a summary of completed development, while if we determine the maturing functions, we can predict what will happen to these children between five and seven, provided the same developmental conditions are maintained. The zone of proximal development can become a powerful concept in developmental research, one that can markedly enhance the effectiveness and utility of the application of diagnostics of mental development to educational problems.

A full understanding of the concept of the zone of proximal development must result in reevaluation of the role of imitation in learning. An unshakable tenet of classical psychology is that only the inde-

pendent activity of children, not their imitative activity, indicates their level of mental development. This view is expressed in all current testing systems. In evaluating mental development, consideration is given to only those solutions to test problems which the child reaches without the assistance of others, without demonstrations, and without leading questions. Imitation and learning are thought of as purely mechanical processes. But recently psychologists have shown that a person can imitate only that which is within her developmental level. For example, if a child is having difficulty with a problem in arithmetic and the teacher solves it on the blackboard, the child may grasp the solution in an instant. But if the teacher were to solve a problem in higher mathematics, the child would not be able to understand the solution no matter how many times she imitated it.

Animal psychologists, and in particular Köhler, have dealt with this question of imitation quite well.⁹ Köhler's experiments sought to determine whether primates are capable of graphic thought. The principal question was whether primates solved problems independently or whether they merely imitated solutions they had seen performed earlier, for example, watching other animals or humans use sticks and other tools and then imitating them. Köhler's special experiments, designed to determine what primates could imitate, reveal that primates can use imitation to solve only those problems that are of the same degree of difficulty as those they can solve alone. However, Köhler failed to take account of an important fact, namely, that primates cannot be taught (in the human sense of the word) through imitation, nor can their intellect be developed, because they have no zone of proximal development. A primate can learn a great deal through training by using its mechanical and mental skills, but it cannot be made more intelligent, that is, it cannot be taught to solve a variety of more advanced problems independently. For this reason animals are incapable of learning in the human sense of the term; *human learning presupposes a specific social nature and a process by which children grow into the intellectual life of those around them.*

Children can imitate a variety of actions that go well beyond the limits of their own capabilities. Using imitation, children are capable of doing much more in collective activity or under the guidance of adults. This fact, which seems to be of little significance in itself, is of fundamental importance in that it demands a radical alteration of the entire doctrine concerning the relation between learning and development in children. One direct consequence is a change in conclusions that may be drawn from diagnostic tests of development.

Formerly, it was believed that by using tests, we determine the mental development level with which education should reckon and whose limits it should not exceed. This procedure oriented learning toward yesterday's development, toward developmental stages already completed. The error of this view was discovered earlier in practice than in theory. It is demonstrated most clearly in the teaching of mentally retarded children. Studies have established that mentally retarded children are not very capable of abstract thinking. From this the pedagogy of the special school drew the seemingly correct conclusion that all teaching of such children should be based on the use of concrete, look-and-do methods. And yet a considerable amount of experience with this method resulted in profound disillusionment. It turned out that a teaching system based solely on concreteness—one that eliminated from teaching everything associated with abstract thinking—not only failed to help retarded children overcome their innate handicaps but also reinforced their handicaps by accustoming children exclusively to concrete thinking and thus suppressing the rudiments of any abstract thought that such children still have. Precisely because retarded children, when left to themselves, will never achieve well-elaborated forms of abstract thought, the school should make every effort to push them in that direction and to develop in them what is intrinsically lacking in their own development. In the current practices of special schools for retarded children, we can observe a beneficial shift away from this concept of concreteness, one that restores look-and-do methods to their proper role. Concreteness is now seen as necessary and unavoidable only as a stepping stone for developing abstract thinking—as a means, not as an end in itself.

Similarly, in normal children, learning which is oriented toward developmental levels that have already been reached is ineffective from the viewpoint of a child's overall development. It does not aim for a new stage of the developmental process but rather lags behind this process. Thus, the notion of a zone of proximal development enables us to propound a new formula, namely that the only "good learning" is that which is in advance of development.

The acquisition of language can provide a paradigm for the entire problem of the relation between learning and development. Language arises initially as a means of communication between the child and the people in his environment. Only subsequently, upon conversion to internal speech, does it come to organize the child's thought, that is, become an internal mental function. Piaget and others have shown that reasoning occurs in a children's group as an argument intended

to prove one's own point of view before it occurs as an internal activity whose distinctive feature is that the child begins to perceive and check the basis of his thoughts. Such observations prompted Piaget to conclude that communication produces the need for checking and confirming thoughts, a process that is characteristic of adult thought.⁷ In the same way that internal speech and reflective thought arise from the interactions between the child and persons in her environment, these interactions provide the source of development of a child's voluntary behavior. Piaget has shown that cooperation provides the basis for the development of a child's moral judgment. Earlier research established that a child first becomes able to subordinate her behavior to rules in group play and only later does voluntary self-regulation of behavior arise as an internal function.

These individual examples illustrate a general developmental law for the higher mental functions that we feel can be applied in its entirety to children's learning processes. We propose that an essential feature of learning is that it creates the zone of proximal development; that is, learning awakens a variety of internal developmental processes that are able to operate only when the child is interacting with people in his environment and in cooperation with his peers. Once these processes are internalized, they become part of the child's independent developmental achievement.

From this point of view, learning is not development; however, properly organized learning results in mental development and sets in motion a variety of developmental processes that would be impossible apart from learning. Thus, learning is a necessary and universal aspect of the process of developing culturally organized, specifically human, psychological functions.

To summarize, the most essential feature of our hypothesis is the notion that developmental processes do not coincide with learning processes. Rather, the developmental process lags behind the learning process; this sequence then results in zones of proximal development. Our analysis alters the traditional view that at the moment a child assimilates the meaning of a word, or masters an operation such as addition or written language, her developmental processes are basically completed. In fact, they have only just begun at that moment. The major consequence of analyzing the educational process in this manner is to show that the initial mastery of, for example, the four arithmetic operations provides the basis for the subsequent development of a variety of highly complex internal processes in children's thinking.

Our hypothesis establishes the unity but not the identity of learning

processes and internal developmental processes. It presupposes that the one is converted into the other. Therefore, it becomes an important concern of psychological research to show how external knowledge and abilities in children become internalized.

Any investigation explores some sphere of reality. An aim of the psychological analysis of development is to describe the internal relations of the intellectual processes awakened by school learning. In this respect, such analysis will be directed inward and is analogous to the use of x-rays. If successful, it should reveal to the teacher how developmental processes stimulated by the course of school learning are carried through inside the head of each individual child. The revelation of this internal, subterranean developmental network of school subjects is a task of primary importance for psychological and educational analysis.

A second essential feature of our hypothesis is the notion that, although learning is directly related to the course of child development, the two are never accomplished in equal measure or in parallel. Development in children never follows school learning the way a shadow follows the object that casts it. In actuality, there are highly complex dynamic relations between developmental and learning processes that cannot be encompassed by an unchanging hypothetical formulation.

Each school subject has its own specific relation to the course of child development, a relation that varies as the child goes from one stage to another. This leads us directly to a reexamination of the problem of formal discipline, that is, to the significance of each particular subject from the viewpoint of overall mental development. Clearly, the problem cannot be solved by using any one formula; extensive and highly diverse concrete research based on the concept of the zone of proximal development is necessary to resolve the issue.