Chapter 9

Aspects of teaching and learning*

David Wood

Introduction: images of the learner and reflections on the teacher

Teaching is a complex, difficult and often subtle activity. Although I will be arguing that a gteat deal of teaching is spontaneous, 'natural' and effective, deliberate teaching of groups of children in formally contrived contexts is an intellectually demanding occupation. It is also a relatively new one. Compulsory formal education for all has a short history, and the technologies and consequences it has spawned, both material and mental, are still poorly understood and the subject of political and academic debate.

Some years ago, Greenfield and Bruner (1969) argued that the invention and widespread availability of schooling has had dramatic effects on the nature of human knowledge, creating not simply wider dissemination of facts but fundamental changes in the nature of thinking itself. Although ensuing studies of the impact of schooling on the human intellect have shown that the effects are somewhat less general than this hypothesis suggested (e.g. Cole and Scribner, 1974), they have shown that schooling, in company with other technologies (notably literacy), has marked effects on various intellectual 'skills'. Donaldson (1978), in a critical examination of Piagetian theory, argues that schooling does help to create certain varieties of human reasoning, particularly a capacity to deploy powers of reasoning to solve problems that involve abstract hypothetical entities. In such contexts, thinking out problems and understanding what is implied by them demands attention to the formal structure of the problem and cannot be achieved by appeals to common sense or plausible inferences. Thus, Donaldson concludes that schooling is the source of special ways of thinking about and operating upon the world.

One implication of this view is that teachers (broadly rather than narrowly conceived) are responsible for inculcating certain ways of thinking in children. They pass on not only facts and information about things but also ways

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of conceptualizing and reasoning. Where they succeed, teachers recreate their own ways of thinking in their pupils; where they fail, they may inhibit or prevent a child's access to power within his or her own society.

Our knowledge of the 'psychology of teaching' is derived from several sources. The first and most obvious is from theories and studies of learning and development. Theorists of human development, notably Bruner, Vygotsky and Piaget, offer not only radically different views of what children are like, what *knowledge* is and how it develops; they also sketch out radically different images of the teacher. In this chapter we will examine some of the major features of these theories in relation to the issue of what teaching *is*.

A second source of information about teaching stems from the now numerous attempts to describe and analyse teaching as it occurs in classrooms. Unfortunately, many such studies are largely atheoretical and even idiosyncratic, so it is seldom possible to utilize the data they provide to inform our arguments about theories of what teaching is. One possible reason for this is that teachers do not actually do what any of the theories dictate they should do, either because teachers are ignorant of theories or because theorists are ignorant of teaching. One view is that theories developed out of psychological research cannot be used to develop categories to describe what goes on in classrooms because their relevance is limited to what happens in laboratories. There has been a good deal of debate in recent years about the status and relevance of theories about children based largely on experimental psychological research. For example, Cole and his colleagues (1979) observed children in home-like contexts and reported that they seldom found evidence of the sorts of demands, tasks and interactions that cognitive psychologists use in the laboratory to explore learning and development. Thus, psychologists *qua* psychologists are likely to be working with very different raw material in fashioning their theories of children's thinking from that which informs the views of parents and others. Herein, perhaps, lie some reasons for different conceptualizations of the nature of children by psychologists and non-psychologists. Psychologists may be accused of having created 'straw children' and imaginary learners who haunt the psychological laboratory but not the 'real' world.

I shall be arguing, however, that the differences between children's behaviour in different contexts (e.g. laboratory versus home) are of more interest and importance than this interpretation suggests. More specifically, I will be exploring the idea that interactions between adults and children in 'spontaneous' and 'contrived' encounters are different in nature. By contrived, I mean teaching/learning/testing encounters that are deliberately brought about by those with power (e.g. teachers or psychologists), as opposed to those that 'arise' spontaneously out of adult–child contacts. I shall also work on the assumption (not totally without evidence) that most interactions at home are spontaneous and child-initiated, and those in schools or psychological laboratories are usually contrived and adult-controlled. I also suggest

that when adults and children in the two different contexts appear to be working on the 'same' tasks or doing superficially similar things, the processes involved are dissimilar. The interactions follow different 'ground rules' and create different demands of both the adult and the child, and this explains why children often appear to display varying levels of intellectual or linguistic competence in different situations. We will consider, for example, why children who are inquisitive and loquacious at home may show little initiative in school.

What are 'ground rules'? Mercer and Edwards (1981) have provided some examples in a consideration of classroom interactions, drawing attention to differences between the constraints that operate in classroom and everyday discourse. For example, being able to answer questions such as 'It takes three men six hours to dig a certain sized hole. How long would it take two men to dig the same hole?' demands more than a knowledge of how to apply and execute the sums involved. One must also appreciate what constitutes appropriate and inappropriate answers. Problems demanding similar decisions in everyday life (e.g. working out how long a certain job will take) might legitimately concern issues such as when the ground was last dug over; what tools are to be used; how experienced the men are and so forth. In mathematics lessons, however, such considerations are 'irrelevant'. To know what is relevant, a child has to discover or infer the rules underlying what is a very special form of discourse. Arguments, for example, about making mathematics 'relevant' are likely to founder if they simply choose 'everyday' situations and ignore the fact that the ground rules for solving everyday practical numerical problems and abstract formal mathematical problems are different.

If one accepts that activities occurring across contexts may be governed by different implicit social practices and rules, then what may seem like the 'same' task in different contexts may, to children who have yet to acquire all the rules, appear very different. Several researchers (e.g. Donaldson, 1978) have shown that young children often appear able to do things in some contexts but not others. They possess competence that does not always emerge in their performances. One may seek to understand such discrepancies in the fact that some contexts are more threatening, unfamiliar or less motivating to children; but it is also likely that the apparent similarities between the competences demanded in such situations are misleading. Thus, identifying the reasons why observations of teaching and learning in home, school and laboratory often yield different views of the processes involved is no simple matter. What might seem to be essentially similar tasks and activities in various contexts may well be located in quite different 'rules' of conduct and interpretation.

Another line of evidence relating to the question of what effective teaching is would seem, on first sight, to offer the most direct and compelling way of adjudicating between competing theories. A number of educational

programmes have been set up, particularly in the USA, to help provide young children from economically poor homes with a 'Headstart' in their educational life by providing preschool educational experiences (see Woodhead, 1985 for an overview). There have been some successful intervention programmes, but these were inspired by a range of *different* theories of learning and development. No one theory held the day. Weikart (1973), commenting upon the success of his own, neo-Piagetian, programme and those of others who had based their interventions on other theories, concludes that the important common element in success was not the curriculum *per se* nor the material it employed but the commitment and competence of its teachers! The *nature* of such competence remains obscure.

We will examine just a few aspects of what teaching competence might involve. I do not claim, however, to be more than scratching the surface of what is undoubtedly an extremely complex issue.

Learning and development

I will in this part of the chapter be discussing in some detail a series of studies of the teaching–learning process that have employed a common task. The children being taught range from three to five years of age. Left to their own devices, the children would not be able to do the task at hand. Nor do they learn how to do the task if they are taught ineffectively. Given effective instruction, however, they can be taught how to do most or all of it alone (Wood and Middleton, 1975).

Although the task we shall be considering is a specific and concrete one, I shall argue that some aspects of the teaching–learning process it identifies are general ones that are relevant to and implicated in many naturalistic encounters between adults and children. I shall also try, however, to identify some important differences between the nature of interactions observed in such contrived teaching–learning encounters and those found in more spontaneous encounters between adults and children in homes and schools.

The conceptual framework adopted in this chapter is derived from the theorizing of Vygotsky (1978) and Bruner (1968). Vygotsky, for example, contributed the concept of a 'zone of proximal development'. This expression refers to the gap that exists for a given child at a particular time between his level of performance on a given task or activity and his potential level of ability following instruction. Vygotsky offers a conceptualization of intelligence that is radically different from that promoted by either conventional psychometric intelligence tests or Piagetian theory. Vygotsky's theory of intelligence takes the capacity to learn through instruction as central. The intelligence of a species is determined by a capacity not only *to* learn but also to teach. Furthermore, two children who behave similarly in a given task situation, suggesting similar levels of competence, may in fact be quite

different, in that one may prove able to benefit far more from instruction in that task than another.

Underlying this view of the role of instruction in learning are radically different conceptions of the nature of knowledge, development and maturity from those embodied in Piagetian theory. Piaget's child is an epistemologist - a natural seeker after, and architect of, his own understanding. He learns largely through his own activity in the world. He constructs progressively more powerful, abstract and integrated systems of knowing by discovering how his actions affect reality. All a teacher can do is to facilitate that understanding by providing appropriate materials and contexts for the child's actions and by helping the child to discover inconsistencies in his own views. The primary motivator of developmental change for Piaget is 'disequilibration' — a state of conflict between what the child expects as a result of his interactions with the world and what actually transpires. Knowing the stages of development and materials and activities that are likely to be relevant to the activities dictated by each stage, a teacher can facilitate developmental change by helping the child to discover implicit contradictions in his own thinking. Any contradictions must, however, be *latent* in the child's structure of knowledge. They can be activated but not induced. There is no point and may even be harm in confronting the child with hypotheses, demonstrations or explanations that are not 'natural' to his stage of development.

Whilst there is evidence favouring the view that one basis for developmental change or learning is cognitive conflict and contradiction (e.g. Glachan and Light, 1982), I will be arguing that far more is involved in effective teaching than simply providing material for the child to 'digest' or activating competing ideas that are already implicit in his thinking. We will explore the view that adult and child, working together, can construct new schemes through shared interaction. The potential effects of teaching will prove to be far greater than Piagetian theory allows. What the child develops, in this alternative conceptualization, are not mental operations derived from his actions on the world but 'concepts' that are jointly constructed through interaction with those who already embody them, together with ways of doing and thinking that are cultural practices, recreated with children through processes of formal and informal teaching.

The nature of effective instruction: contingent control of learning

We are confronted with two individuals who are in asymmetrical states of knowledge about a problem facing them. The more knowledgeable, the teacher, is attempting to communicate a more informed understanding to the less knowledgeable, the learner. How are practical skills and ideas transferred from one body to the other?

Our task here is to discover an analysis of teaching and learning

interactions that will enable us to relate instructional activity to the learning process. If we are successful in identifying the crucial features of effective teaching, then it should be possible to examine a range of different teaching styles or strategies and make testable predictions about their relative effectiveness.

Some years ago we attempted to meet these goals in an analysis of mother-child interactions in an experimental situation (Wood and Middleton, 1975). The children involved were four years old and the task the mothers were asked to teach them was a specially designed construction toy. When a child first encountered the task, he or she saw 21 wooden blocks of varying size and shape. The mother had already been shown how these could be assembled to create a pyramid, but the child had no knowledge of the solution to the problem. The mother was asked to teach the child how to put the blocks together in any way she saw fit. She was also told that when the pyramid had been put together, it would be taken apart and the child asked to assemble it alone.

Each block in the toy is unique and will fit into only one position in the final construction, but the task was designed to incorporate a number of repeated rules of assembly. The pyramid (more accurately, a ziggurat) comprises five square levels, each a different size. The bottom level is approximately nine inches square and is constructed out of four, equally sized, square pieces. Two of these assemble by fitting a peg in one into an equally sized hole in the second. When this pair is assembled in the correct orientation, two half-pegs, one on each block, are brought together. Similarly, two other blocks assemble by a hole and peg arrangement but to bring two half-holes together. When the two pairs are constructed, the peg and hole formed can be fitted together to produce a level of the pyramid. This rule of assembly is repeated with sets of blocks of diminishing size to construct four more levels. The assembly of each set of four also creates connectives to enable them to be piled on top of each other. On the 'top' of each block is a quarter section of a round peg. When each level is assembled correctly, these come together to form a peg which fits into a circular depression in the base of the level above, which is similarly created from four quarter depressions in each block. Thus, the levels can be piled to form a rigid structure. The assembly is completed by placing a single block with a depression in its base on the top level.

The blocks were designed so that any peg would fit into any hole and any level could fit onto any other. Thus, the task presents many possibilities for 'incorrect' assembly. Left to their own devices, four-year-olds cannot do the task, but given effective instruction they can. What, however, does effective instruction look like? How are we to describe the maternal attempts to teach children?

Imagine we are watching a mother and child in a teaching-learning encounter with these blocks. The mother has just given an instruction. First, we determine how much *control* the instruction implicitly exerts over what

happens next. Five categories are listed in Table 9.1 which, we have found in a number of studies, can accommodate any instruction a teacher might make in this situation. These vary in terms of degree of control.

The first category, general verbal prompts, includes instructions that demand activity but do not specify how the child should proceed to meet such demands. Specific verbal instructions give the child information about features of the task that need to be borne in mind as he or she makes the next move. If the teacher not only tells the child what to attend to in making his or her next move but also shows him or her what is referred to by pointing at or picking out relevant material, then the instruction is classified as Level 3. If the teacher not only identifies material but goes on to prepare it for assembly, then the child is simply left with the problem of how to complete the operation in question. Finally, if the teacher demonstrates, he or she takes full control of the next step in the construction while the child, hopefully, looks on and learns.

As we come down the list, then, the instructions become more controlling, with the teacher implicitly taking more, and offering the child correspondingly less, scope for initiative.

Mothers vary enormously in the way in which they attempt to teach their young children how to do this task, and children also vary widely in their ability to do the task alone after instruction. Does the style of teaching affect what is learned? It does. Mothers whose children do well after instruction are those who are most likely to act in accordance with two 'rules' of teaching. The first dictates that any failure by a child to bring off an action after a given level of help should be met by an immediate increase in help or control. Thus, if the teacher, say, had provided the child with a specific verbal instruction and then found that the child did not succeed in complying with it, the appropriate response is to give more help either by indicating the material implicated in the previous instruction or by preparing it for assembly.

The second rule concerns what should happen when a child succeeds in complying with an instruction. This dictates that any subsequent instruction should offer less help than that which pre-dated success. In other words, after success the teacher should give the child more space for success (and error).

The pattern of responses by the teacher to a child's momentary successes

Table 9.1 Levels of control

Level	*Example*
1 General verbal prompts	'Now you make something'
2 Specific verbal instructions	'Get four big blocks'
3 Indicates materials	Points to block(s) needed
4 Prepares for assembly	Orients pairs so hole faces peg
5 Demonstrates	Assembles two pairs

and failures judged in re/ation to the instructions *that pre-dated* them is the basis for our evaluation. Every time a teacher acts in accordance with the rules, she is deemed to have made a contingent response. Every time she does something different (e.g. fails to provide an instruction immediately after a child fails or gives one at an inappropriate level), the instruction is non-contingent. What we find is that the more frequently contingent a teacher is, the more the child can do alone after instruction.

Stated simply and boldly, the rules of contingent teaching sound easy. However, even in our experimental situation involving a practical task with a single solution, it is difficult to teach all children contingently all the time. Indeed, when we trained an experimenter to teach children according to different rules, we found that she was able to follow the contingency rules only about 85 per cent of the time (Wood, Wood and Middleton, 1978). Monitoring children's activity, remembering what one had said or done to prompt that activity, and responding quickly to their efforts at an appropriate level is a demanding intellectual feat. Effective teaching is as difficult as the learning it seeks to promote.

Scaffolding the learning **process**

We have defined the process of effective instruction as the contingent control of learning. Elsewhere, using the metaphor of 'scaffolding', we have identified some of the functions that instruction may fulfil for the learner (Wood, Bruner and Ross, 1976). Since this notion has been extended beyond laboratory studies to help describe more naturalistic teaching–learning processes, it is necessary to explore the characteristics of scaffolding and its relationship to control and contingency before moving on to consider more general aspects of teaching and learning.

One of the most influential approaches to the study of human intelligence stems from a view of a human being as a 'limited information processor'. Individuals can take in only so much information about their situation at any moment in time, so they must organize their activities over time (develop a plan) in order to assimilate and operate within that situation. The development of knowledge and skill involves the discovery of what is best paid attention to, borne in mind and acted upon in an appropriate (goal-achieving) sequence.

At the heart of this conception of human abilities is the notion of 'uncertainty'. When we find ourselves needing to act in a very unfamiliar situation, uncertainty is high and our capacity to attend to and remember objects, features and events within the situation is limited. Observation, practice, trial and error, the growing appreciation of regularities and learning, involve the progressive reduction of that uncertainty. Accompanying its reduction are increased accuracy of perception and powers of memory. Thus, experts in a task are able to observe, take in and remember more of what they experience (within the task situation) than novices.

Children, being novices of life in general, are potentially confronted with more uncertainty than the more mature, and, hence, their abilities to select, remember and plan are limited in proportion. Without help in organizing their attention and activity, children may be overwhelmed by uncertainty. The more knowledgeable can assist them in organizing their activities, by reducing uncertainty, breaking down a complex task into more manageable steps or stages. As children learn, their uncertainty is reduced and they are able to pay attention to and learn about more of the task at hand.

Such assisted learning, however, presupposes that the children are actively involved in trying to achieve task-relevant goals. Clearly, what individuals attend to and remember in a given context is dictated by their purposes and goals; relevance is relative to the purpose in mind. Children may perceive a situation differently from an adult because they face greater uncertainty and/or because they may be entertaining different ideas about the opportunities for activity offered by the task situation.

Where a child is already involved in the pursuit of a goal or the fulfilment of an intention, then provided that the would-be teacher is able to discover or infer what that goal is, the child may be helped to bring it off. In formal or contrived situations, where the teacher decides what purpose the child must pursue, tas*k inducti0«* becomes a primary scaffolding function and a s*i*ne *qua n0n* for effective learning. Children also face additional problems in contrived encounters because, given that they are compliant, they have to discover what their intentions are supposed to be.

How does one invoke intentions or a sense of goal directedness in the young child? More specifically, can demonstrations or verbal instructions be used effectively to invoke relevant activity? Clearly, showing children things or asking them to perform activities that they are currently unable to do will be successful only if the child understands enough of what was said or shown to lead to relevant, if not fully successful, task activity. Instruction must, to use Vygotsky's term, operate within the learner's 'zone of proximal development'. For such a concept to be useful, perception must, in some way, help to lead or constrain action and understanding.

I suggest that young children often think they understand and are capable of doing what an adult shows or tells them when, in fact, they do not. Young children, in short, often overestimate their own abilities. However, children's beliefs about their own competence lead to intentional activity and trap them in problem-solving: in trying to do what they think they can do. Provided that effective help is forthcoming, the child may be led to construct new skills. These, in turn, accompany modified perceptions of what is seen and heard. The learner comes closer to mature understanding. Put another way, both demonstrations and verbal instructions can be used to define problem spaces within which adult and child can work co-operatively and contingently to promote learning. Perhaps a few examples will illustrate this argument.

In the experimental situation already outlined we found that three-year-old children showed signs of *recognizing* what was an appropriate task goal before they were able to *achieve* that goal. For instance, they appreciated the fact that four dissimilar blocks could be put together to create a single and more parsimonious *Gestalt.* They would usually attempt to reproduce such a configuration after a demonstration. When their attempted constructions did not look similar to that demonstrated, they would usually take them apart and try again. However, they almost never took apart a construction that did look like the model - evidence both that they possessed some sense of what was task-relevant and that their activities were goal-directed.

Although purely verbal instruction proved an ineffective teaching strategy, every child so taught did begin by attempting to do what was requested. We suggest that the young child possesses sufficient linguistic competence to derive plans from verbal instructions that are partially but not fully understood. Thus, when told to 'Put the four biggest ones together', they never selected the smallest blocks and usually attempted to fit pegs into holes. Although they did not realize, early in the instructional session, all the constraints that were implicated in such general verbal instructions, they understood enough of what they implied to lead them into task-relevant activity.

Even when children do not fully understand what we show them or ask of them, they may believe that they understand, and understand enough to lead them into task-relevant, if initially unsuccessful, action. We suggest, then, that a learner's *incomplete* understanding of what he or she is shown and told (what is perceived) is a vital basis for learning through instruction. Perhaps incomplete but relevant understanding of what children see adults doing and hear them saying is at the heart of what Vygotsky termed the 'zone of proximal development'.

Once the learner is involved in task-relevant activity, other scaffolding functions become operative. I have already said that young children, like all of us, are limited in how much they can attend to and remember in problematic situations. There is also evidence that, left to their own devices, they are unlikely to realize whether or not they have actually examined a situation 'fully' (Vurpillot, 1976). Preschool children do not search exhaustively or systematically for evidence that might be relevant to what they are trying to do; they tend to make up their minds on the basis of a limited inspection of the situation at hand (in contrived problem situations, at least).

There is also evidence, again from contrived situations, that young children are unlikely to 'rehearse' what they are trying to remember. Thus, their powers of memory may be limited not only by an uncertain world but also because they have yet to learn (or to be taught) how best to remember what they seek to retain.

• Given children's propensity to attend to a limited range of features of problematic situations and, perhaps, their immature strategies for deliberate memorization, a teacher will often have to scaffold their immediate actions.

They may, for example, *highlight* crucial features of the task situation that have been ignored or forgotten. In so doing, they also help the child to *analyse* the task. They may act as an external source of memory and planning for the child, either by prompting recall of a previous activiry or, more subtly, by holding constant the fruits of past activities while the child concentrates his or her limited resources on another domain. For example, children in our task situation would often put together two pieces and then try to add a third one. The blocks are so designed that it is extremely difficult to put together four pieces without first constructing the two pairs. By directing the child's attention away from the first-assembled pair or by keeping hold of it while the child attempted to assemble the second pair, the instructor helped the child by breaking down a goal into a series of less complex sub-goals.

Scaffolding functions effectively support and augment learners' limited cognitive resources, enabling them to concentrate upon and master manageable aspects of the task. With experience, such elements of the task become familiar and the child is able to consider further related task elements. Contingent control helps to ensure that the demands placed on the child are likely to be neither too complex, producing defeat, nor too simple, generating boredom or distraction.

Teaching: natural and contrived

So far, we have been exploring the concepts of scaffolding, control and contingency in contrived encounters between adults and children in laboratory settings. We have also been dealing with very specific short-term learning outcomes in a well-structured, concrete task with a specific 'right' answer. Are such concepts useful in more naturalistic situations? Are the effects of contingent teaching task-specific or does it engender more general effects?

In this section, I will explore some attempts to extend the concepts of scaffolding and contingency to adult–child interactions in studies of language acquisition to see how far their use in this, more naturalistic, research involves more than a metaphorical relationship with their use in more formal specific contexts.

Bruner's (1983) account of the development of the pre-verbal foundations of language acquisition extends the concept of scaffolding to the analysis of mother–child interactions. He argues that the development of early linguistic competence in the child depends upon the (informal) teaching roles played by the adult. The development of the infant's communication abilities takes place within frequently recurring 'formats' of interaction. Initially, such formats (families of interactions such as simple games, feeding sessions, nappy changing etc., which take on a predictable pattern) are largely regulated by the adult and are the basis of what Bruner terms 'Language Acquisition Support Systems'. The frequent repetition of formats provides infants with opportunities to discover and exploit regularities in their experiences. Adults,

however, play the major role in initiating and structuring the early interactional formats. Bruner writes:

> If the 'teacher' in such a 'system' were to have a motto, it would surely be 'where before there was a spectator, let there now be a participant'. One sets the game, provides a scaffold to assure that the child's ineptitudes can be rescued by appropriate intervention, and then removes the scaffold part by part as the reciprocal structure can stand on its own.
>
> (Bruner, 1983: 60)

Whilst he sees adults taking the leading role in the construction of such systems of support, it seems that what is involved is not so much a process of *directing* the child but one more akin to 'leading by following'. Once the child's involvement has been gained and he is inducted into activity that can be orchestrated into an emerging system of interaction, adults tend to make what they do contingent upon their interpretation of what is likely to be the current focus of interest or relevance to the child. Thus, 'it becomes feasible for the adult partner to highlight those features of the world that are already salient to the child and that have a basic or simple grammatical form'. To the extent that adults make where they look and what they do and say contingent upon their interpretation of the child's current interest, what they are likely to be putting into words is relevant to what is in the child's mind. Thus, adults help to bring the infant's experience of the world and linguistic communication about that world into contact.

Bruner's use of the concepts of scaffolding and contingency shares formal similarities with the processes described in the analysis of contrived teaching. The task of inducting the infant into what is to become a predictable format of interaction; supplementing and orchestrating the child's role in the interaction by actions designed to highlight critical features of the joint task or activity; reducing degrees of freedom for action (buffering from distraction) to encourage the infant to focus on critical aspects of the situation; trying to hand over increasing responsibility for the execution of actions that have been constructed with the child; attempting to perform such functions in a manner that is contingent upon the child's activities, are important features of the teaching process, whether natural or contrived. Whilst I would argue, however, that the scaffolding functions are common to both types of activity with children of very different ages, the means whereby such functions are achieved change with the developing competence of the infant. Induction, for example, changes from a process that we might term 'capture' to one of 'recruitment'. This change occurs in response to the (co-ordinated) development of planning and self-consciousness in the child.

For example, in the early encounters described by Bruner and others, what might initially be a 'chance' or unintentional act by the child may be highlighted and responded to by the adult 'as if' it were an intended component of

an envisaged performance. Such highlighting can be achieved by the adult performing a marked, exaggerated action or *display* that is contingent upon and follows closely in time behind the infant's activity. To the extent that this display captures the infant's attention and interest, it may evoke a repetition of the child's initial activity. Initially spontaneous, unpremeditated movements by the baby may thus form the basis for the emergence of intentional acts of communication.

A number of studies have highlighted the degree of 'fit' between both the content and timing of events that are likely to grasp the infant's attention and the 'natural' or spontaneous displays of adults (or even very young children) e*n face* with the infant (e.g. Brazelton, 1982). The adult achieves induction of the infant by *capturing* his attention.

With older children, induction is easier in some contexts and more difficult in others. Once attention and interest can be solicited by verbal invitations or demonstrations, the teacher may evoke intentional action towards a goal from the child. As early as nine to 18 months, young children also display some knowledge of the fact that the adult can be *recruited* to help them in an activity that they are unable to bring off alone (Geppert and Kuster, 1983). By 30 months, teaching–learning encounters may be solicited by either party. Around the same age, however, infants also show evidence of wishing, at some times, to maintain the independence of their own actions, of wanting to 'do it myself.

Although, as we have seen, it is possible to induce the preschooler into joint problem-solving, evidence from naturalistic observations in the home indicates that most encounters between young children and their parents are of the children's own choosing. In short, they tend to solicit rather than be inducted into most exchanges with parents.

The evidence comes from Wells (1979) who found, from audio-taped recordings of exchanges between parents and their three-year-olds at home, that 70 per cent of interactions were initiated by the child. Thus, what adults and child are likely to be working on, attending to and talking about is still largely determined by the *child's* interests.

Wells's analyses also indicate that parents who respond contingently to the child's utterances by elaborating, developing and negotiating about what they mean are more likely to engender conditions for establishing mutual understanding and the development of linguistic competence in the child. Although his analyses do not make explicit use of concepts such as scaffolding and control, he does employ the term contingency in a similar way. I suggest that his findings are consistent with the view that effective scaffolding and control are factors that influence the development of linguistic competence in children. To extend this argument, however, I need to make reference to other research in which the notions of control and contingency have been exploited to study the effects of different styles of talking to children on the child's performances in school contexts.

Asking and telling: who is contingent upon whom?

We are studying two complex systems that know things: teacher and child. We believe that these two systems are in asymmetrical states, in that the teacher knows more than the child and has responsibility for transferring that knowledge. The asymmetry is not entirely one-sided, however: the child also knows things about the world and himself that the teacher does not know. The desire to make teaching 'relevant', 'learner centred', to 'start where the learner is at' or to be contingent upon their attempts to learn is implicated in most theories of learning and development (Wood, 1980b). Thus, teachers must also seek to understand what the child knows if they are to help develop, extend, clarify and integrate that knowledge.

Wells's studies, in company with research by Tizard and her colleagues (Tizard and Hughes, 1984), suggest that preschool children tend to initiate interactions, ask questions and seek information more readily at home than at school. Much of their 'epistemic' activity is directed towards achieving explanations about facts of everyday life and is occasioned by happenings in the local culture. The parent tends to be in a privileged position in relation to these requests and demands, being a *part* of that culture. Their practices and talk are embedded in what it is that the child seeks to know. Further, their privileged access to the child's history provides a basis for intersubjectivity. Their implicit hypotheses about what is likely to have motivated an epistemic act from the child; what the child is already likely to have experienced in relation to it, to know, think and feel about it, are more likely than those of strangers to prove workable or enactable.

Thus, the conditions that promote the quest for knowledge from the child are often present in the home, and the needs of the child are most likely to be interpretable to those who know them. Conditions for the generation of a contingent learning environment are more likely to be endemic to the home or local culture in a way that they are not to school. Thus, the preschool child at nursery or school is less likely to be prompted to wonder about the 'whys' and 'wherefores' of what is going on, which is perhaps why their discourse often centres on the happenings of the moment and thus seems 'context-dependent'. When children *do* talk about things outside the classroom, not surprisingly it tends to be to mention significant others in their daily life (relatives), or the events, happenings, promises and surprises that occur at home (Wood, McMahon and Cranstoun, 1980).

Children, then, 'present' themselves differently at home and at school. Even when teachers set out to work with individual children, they face considerable difficulties in establishing a contingent interaction because children generally give them relatively few epistemic offerings to be contingent upon. Thus, task induction becomes a more demanding activity for the teacher than the parent (and, by the same token, for a psychologist in a laboratory setting: Wood, 1983). Other factors also operate against the establishment of child-

initiated adult-contingent encounters. One is group size. At home, the presence of a third person, particularly a younger sibling, is likely to promote talk between parent and child about the actions, needs and morality of another (Dunn and Kendrick, 1982). Children, in their second year of life, begin to wonder about the nature of other people. At school, however, surrounded by numbers of relative strangers, observations by children about the 'psychology' of other people around are relatively rare (Wood et *a*/., 1980). Faced with groups of children, the teacher encounters purely numerical difficulties in any effort to promote and sustain productive encounters with individuals. Management of self, time and resources becomes an important feature of the teaching role. Any attempts to instruct or inform are thus embedded within a wider set of roles and objectives.

The common teacher response to these difficulties is to initiate and sustain interactions not by showing or telling but by demanding and asking. Both demands and questions are exercises in *control.* In a number of different studies, several classroom observers have noted the very high frequency of teacher questions. Such studies range from preschoolers to children about to leave school (Wood and Wood, 1985). Furthermore, teacher questions tend to display a number of 'special' characteristics. They are often specific, demanding a narrow range of possible 'right' answers (e.g. MacLure and French, 1981; Tizard, Philips and Plewis, 1976; Wood *et al.*, 1980). Teachers often know the answers to the questions they ask, and children, by four years of age, possess the ability to recognize this fact, in some contexts at least (Wood and Cooper, 1980). Furthermore, the readiness of children to talk about what they know is likely to be inhibited by such questions.

Several reasons have been given for the frequency and nature of teacher questions. Questioning groups is one strategy whereby (at best) the minds of all involved can be focused on the same idea or topic. Questions are one tactic for the achievement of 'group intersubjectiviry'. When a child is not forthcoming with numerous spontaneous epistemic acts, then questions will usually achieve a response and, therefore, may be used as tactics for initiating and, perhaps, modelling epistemic inquiry. Speculating further, it might be the case that the use of questioning represents a historical reaction to 'talk and chalk' or 'didactic' methods of education. Questioning may be seen as a tactic designed to engage the child actively in the teaching–learning process. Rather than 'passively' sitting and listening to the teacher's declarations, the child should be enjoined, through questions, to wonder and think about the topic at hand.

Whatever the rationale or 'cause' of frequent questioning by teachers, I would argue that the strategy is counter-productive.

If we accept the fact that, particularly with young children, what we seek to show them and tell them demands a knowledge of what they can already do and what and how they think about the task at hand, how are we to encourage them to display their knowledge? Focusing for the moment on

mainly verbal exchanges, I suggest the following 'operationalized' definition of knowledge display. Children will ask questions about the topic, revealing their uncertainty and what they seek to know. They will take up openings to contribute to and comment upon the topic at hand. They may go beyond a direct answer to the teacher's questions to add additional information, ideas or observations that they consider supplement or qualify their answers. Further, if, as Wells argues, adult and child need to negotiate their perspectives on and objectives in a given domain, we may find that a child responds to the teacher's questions with requests for clarification or to negotiate the conditions under which they are prepared to answer.

These aspects of children's discourse define a set of conditions in which the teacher can gain access to the *child's* thoughts and uncertainties about opinions and attitudes towards the topic at hand.

These conditions are inhibited to the extent that teachers manage the interaction through questions. The more they question, the less children say. Children's contributions (even when an opportunity is given) become rarer and more terse, the more questions are asked (e.g. Wood and Wood, 1983). Children are only likely to go beyond the force of teachers' questions to give additional ideas and explanations if questions are relatively infrequent. In some contexts at least, they are less likely to seek information through questions themselves when the teacher is asking a lot of questions.

Pupils tend to take single 'moves' in dialogue with the teacher. Whereas teachers display a number of offerings in their turns (e.g. accepting what a child has said, offering a contribution to the discourse and immediately asking a question), pupils are most likely to make a single type of move. Thus, if the teacher terminates his or her utterance with a contribution (i.e. statement, opinion, speculation), children are likely to respond with a contribution of their own, more so if the teacher's contributions are frequent. Similarly, if a teacher accepts or acknowledges what a child says but offers no further question or observation, the child is likely to continue with the topic at hand. There are also a number of second-order effects of teaching style. The less a teacher interrogates children, the more likely they are to listen to, make contributions about and ask questions of what the other children say (Griffiths, 1983; Wood and Wood, 1983). Such findings occur as correlations between teaching style and pupil responses in natural classroom discourse, and can be brought about in experimentally contrived encounters in which teachers vary their style of responding to groups of children (Wood and Wood, 1983, 1984).

The extent to which a child reveals his or her own ideas and seeks information is thus inversely proportional to the frequency of teacher questions - and this finding embraces studies of preschool children through to 16-year-olds, deaf children and children acquiring English as a second language.

Some of the teachers who have participated in experimentally contrived classroom sessions, in which they have modified their style of talking to

children by asking fewer questions, becoming less controlling and giving more of their own views and opinions, have commented that they found out things about the children's experiences, views and ideas that they did not know and would not have thought to ask questions about (Lees, 1981). Questions may solicit the information demanded by the teacher and serve as specific probes and checks for retention of information or of a child's capacity to draw inferences. As tools for finding out things that a child thinks or knows but that are not already anticipated or known by the teacher, however, they are ineffective, at least when used in excess. If it is a teacher's goal ro discover 'where the child is at' in order to respond contingently to their ideas and thoughts, the established 'register' of the classroom is generally ineffective in achieving this goal. Teachers can, however, engender sessions in which children show more initiative, if they are prepared to ask fewer questions and say more about their own ideas and views. Just as effective teaching of practical skills demands a contingent combination of showing and telling, so the extension of children's understanding through discourse demands an integration of the declarative and interrogative voice.

There is now an extensive and growing literature on the 'effective use of questioning' (e.g. Blank, Rose and Berlin, 1978). Although the issue of what constitutes a 'good' and timely question is not resolved, and the literature on the effects and effectiveness of questions has produced somewhat equivocal results, a few general points and reasonable speculations are emerging from the literature. First, as we saw above, several researchers have concluded that too many teacher questions are 'closed' and lead children to search for specific right answers rather than into processes of reasoning and weighing evidence. Second, teachers tend to leave relatively short pauses after their questions before taking back control of the interaction. When they are helped to extend these pauses (from one to three seconds), the frequency and level of student response increase (Rowe, 1974; Swift and Gooding, 1983). It seems that pupils usually need more time to think about their answers to teacher questions than teachers normally allow. Questions to which the teacher already knows the answer are also common. Thus, the implicit theory of learning involved is one in which the teacher knows all the answers and the child's task is simply to find them. Sigel and his colleagues (Sigel and McGillicuddy-Delisi, 1988), analysing discourse between parents and children, have shown, for example, that more open-ended demanding parental questions (which, in Sigel's terms 'distance' the child from and encourage him to reflect upon his immediate experiences and concerns) are positively correlated with various measures of the child's intellectual development, whereas more closed questions are not. Similarly, Redfield and Rousseau (1981), in a review of questioning, concluded that the use of questions high in 'cognitive demand' by teachers has a positive effect on student achievement.

Unfortunately, however, studies in this area usually concentrate on comparisons of different types of questions and fail to explore any effects of

different levels of teacher contributions of statements. In a small-scale study (Wood and Wood, 1983), we found that where a teacher offers contributions that are high in level of presentation (e.g. speculations, opinions, reasoning, *etc.),* children are likely to respond in kind. Questions high in cognitive demand (similar to the definitions of Blank et a/., 1978) also solicit high cognitive responses from children, but at the cost of inhibiting follow-through, elaboration or spontaneous comments from them. Where teachers, in one sense, answer their own putative questions to provide possible answers, opinions and so on, children as young as four years of age reciprocate by adopting a similar cognitive–linguistic stance and remain relatively active and forthcoming at the same time.

High control of interactions by teachers in natural or contrived encounters, in laboratory, home or school, are likely to inhibit overt epistemic activity from children. Furthermore, the fact that children are not contributing ideas, asking questions or elaborating on their answers to the teacher's questions, but spending the vast majority of their time in complying or answering questions means that their thinking (unless they 'drop out' of the interaction) is almost entirely contingent upon the demands of the teacher. If teachers are not gaining knowledge from the children, then they have few opportunities for making any questions, comments or ideas that they have contingent upon the children's own thoughts, for these are simply not revealed or displayed.

The role played by children in teaching–learning encounters is fundamentally constrained by the way in which teachers manipulate control. If a child is not active, forthcoming and curious about the task at hand, the main cause of this inactivity may lie not in some 'inner resource' lacked by the child, but in the level of control and ensuing lack of opportunity for contingent instruction determined by the manner in which the teacher orchestrates the interaction.

Teaching as epistemic inquiry

Teaching is usually defined as the *transmission* of knowledge and the inculcation of skills and understanding. Such definitions seem reasonable but are inadequate and even misleading. Teaching also involves learning; it provides opportunities for the acquisition of knowledge. It is epistemic activity. Furthermore, the knowledge obtained from acts of teaching informs the process of effective teaching.

Piaget has characterized the child as a 'natural' epistemologist. We have not rejected this basic stance but have argued that the epistemological activity of the child is, and often must be, enveloped within that of a teacher. Piaget has also demonstrated how the study of the systematic and 'universal' errors that children make can be exploited to investigate the nature and development of knowledge. Similarly, I have suggested that the study of 'errors after instructions' is a primary basis for learning about the learner,

learning, what is being learned and teaching. An instruction from a teacher is, potentially, an epistemic probe as well as an attempt to prompt epistemic activity in the child. If it is treated as a hypothesis about the child's 'zone of proximal development', for example, then a failure to comply by the child suggests that the hypothesis may be invalid and that he or she needs more help. Conversely, success serves as a signal to the teacher to update her hypothesis about where the child is 'at' and, hence, to revise future instruction or, in Bruner's economic metaphor, to 'up the ante'. Teachers may utilize the fate of their own instructions as a basis for learning and revising their 'theory' of the child and what he or she is learning. The tremendous difficulties in doing this in school environments, however, often preclude such contingent instruction, and demand, essentially, that it is the child who must make his or her thinking contingent upon that of the teacher. If children are able and willing to be contingent upon the thought processes and actions of another, then learning may proceed. If they are not, then it seems unlikely that learning will follow.

Although we have been stressing the importance of teaching and exploring the complex questions of what effective instruction involves, this does not imply that effective teaching is a sufficient or always a necessary condition for learning. We have not been advocating a return to classical learning theory nor rejecting the now extensive evidence that shows that young children form hypotheses, infer and generalize rules to make creative and productive use of their experiences. What we have tried to identify are some factors in natural and contrived encounters that serve to facilitate or inhibit such epistemic activities by the young child. Such a view leads us, for example, to attribute failure or lack of progress by a learner not simply to factors located 'in' the child but to constraints that arise as an emergent property of teacher–learner interactions. These, in turn, are tightly constrained by the nature of the institutions that we have invented to bring teachers and learners together. If we find ourselves dissatisfied with the interactions that take place in such institutions, measured against what we take to be the optimum contexts for learning, then we must question not simply the teacher's 'skills' but the form of the institution within which we expect these to be deployed.

References and further reading

Blank, M., Rose. S. A. and Berlin, L. J. (1978) *The Language of Learning: the Preschool Years,* New York: Grune & Stratton.

Brazelton, T. B. (1982) 'Joint regulation of neonate–parent behavior', in E. Z. Tronick (ed.) *Social Interchange in Infancy: Affect, Cognition and Communication,* Baltimore, MD: University Park Press.

Bruner, J. S. (1968) *Toward a Theory of Instruction*, New York: Norton.

Bruner, J. S. (1973) 'The organisation of early skilled action', *Child Development 44:* 1-11.

Bruner, J. S. (1983) *Child's Talk: Learning to Use Language,* Oxford: Oxford University Press.

Cole, M. and Scribner, S. (1974) *Culture and Thought: a Psychological Introduction*, New York: Wiley.

Cole, M., Hood, L. and McDermott, R. (1979) *Ecological Niche Picking,* New York: Rockefeller University Monographs.

Donaldson, M. (1978) *Children's Minds,* London: Fontana.

Dunn, J. and Kendrick, C. (1982) *Siblings: Love, Envy and Understanding*, London: Grant McIntyre.

Geppert, U. and Kuster, U. (1983) 'The emergence of "wanting to do it oneself": a precursor of achievement motivation', *International Journal of Behavioral Development* 6: 355–70.

Glachan, M. and Light, R (1982) 'Peer interaction and learning: can two wrongs make a right?', in G. Burterworth and P. Light (eds) *Social Cognition: Studies of the Development of Understanding,* Brighton: Harvester.

Greenfield, P. M. and Bruner, J. S. (1969) 'Culture and cognitive growth', in D. A. Goslin (ed.) *Handbook of Socialisation Theory and Research,* New York: Rand McNally.

Griffiths, A. J. (1983) 'The linguistic competence of deaf primary school children', Ph.D. thesis, University of Nottingham.

Lees, J. M. (1981) 'Conversational strategies with deaf children', M.Phil. thesis, University of Nottingham.

MacLure, M. and French, P. (1981) 'A comparison of talk at home and school', in G. Wells (ed.) *Learning Through Interaction: the Study of Language Development*, London: Cambridge University Press.

Mercer, N. and Edwards, D. (1981) 'Ground rules for mutual understanding', in N. Mercer (ed.) *Language in School and Community*, London: Edward Arnold.

Murphy, C. M. and Wood, D. J. (1981) 'Learning from pictures: the use of pictorial information by young children', *Journal of Experimental Child Psychology* 32: 279-97.

Piaget, J. and Inhelder, B. (1969) *The Psychology of the Child,* London: Routledge & Kegan Paul.

Redfield. D. L. and Rousseau, E. W (1981) 'A meta-analysis of experimental research on teacher questioning behavior', *Review of Educational Research* 51: 237—45.

Rowe, M. B. (1974) 'Wait-time and rewards as instructional variables, their influence on language, logic and fate control. I. Wait time', *Journal of Research in Science Teaching* 11: 81-94.

Sigel. I. and McGillicuddy-Delisi, I. (1988) 'Parents as teachers to their children', in A. Pellegrini and T Yawkey (eds) *The Development of Oral and Written Language,* Norwood, NJ: Ablex.

Swift, J. N. and Gooding, C. T. (1983) 'Interaction of wait time, feedback and questioning instruction on middle school science teaching', *Journal of Research in Science Teaching* 20: 721—30.

Tizard. B. and Hughes, M. (1984) *Young Children Learning: Talking and Thinking at Home and School,* London: Fontana.

Tizard, B., Philips, J. and Plewis, I. (1976) 'Staff behaviour in pre-school centres', *Journal of Child Psychology and Psychiatry* 17: 251–64.

Vurpillot. E. (1976) *The Visual World of the Child,* London: George Allen & Unwin.

Vygotsky, L. S. (1978) *Mind in Society: the Development of Higher Psychological Processes,* Cambridge, Mass.: Harvard University Press.

Walkerdine, V. (1982) 'From context to text: a psychosemiotic approach to abstract thought', in M. Beveridge (ed.) *Children Thinking Through Language,* London: Arnold.

Weikart, D. P. (1973) Cited in Brainerd, C. J. (1983) 'Modifiability of cognitive development', in S. Meadows (ed.) *Developing Thinking: Approaches to Children's Cognitive Development,* London and New York: Methuen. .

Wells, G. (1979) 'Variation in child language', in P. Fletcher and M. Garman (eds) *Language Acquisition,* Cambridge: Cambridge University Press.'

Wood, D. J. (1980a) 'Teaching the young child: some relationships between social interaction, language and thought', in D. Olson (ed.) *Social Foundations of Language and Cognition: Essays in Honor of J. S. Bruner,* New York: Norton.

Wood, D. J. (1980b) 'Models of childhood', in A. J. Chapman and D. M. Jones (eds) *Models of Man,* London: The British Psychological Society.

Wood, D. J. (1983) 'Teaching: natural and contrived', *Child Development Society Newsletter,* no. 32, London: Institute of Education.

Wood, D. J. and Cooper, P. J. (1980) 'Maternal facilitation of 4-5 year old children's memory for recent events', *Proceedings of the XXIInd International Congress of Psychology,* Leipzig, East Germany: International Union of Psychological Science.

Wood, D. J. and Middleton, D. J. (1975) 'A study of assisted problem solving', *British Journal of Psychology 66:* 181—91.

Wood, D. J. and Wood, H. A. (1985) 'Teacher questions and pupil initiative', paper to the American Educational Research Association, Chicago, USA.

Wood, D. J., Bruner, J. S. and Ross, G. (1976) 'The role of tutoring in problem solving', *Journal of Child Psychology and Psychiatry* 17: 89—100.

Wood, D. J., Wood, H. A. and Middleton, D. J. (1978) 'An experimental evaluation of four face-to-face teaching strategies', *International Journal of Behavioral Development* 1: 131–47.

Wood, D. J., McMahon, L. and Cranstoun, Y. (1980) *Working with Under-fives,* London: Grant McIntyre.

Wood, D. J., Wood, H. A., Griffiths, A. J., Howarth, P. and Howarth, C. I. (1982) 'The structure of conversations with 6- to 10-year-old deaf children', *Journal of Child Psychology and Psychiatry* 23: 295-308.

Wood, H. A. and Wood, D. J. (1983) 'Questioning the pre-school child', *Educational Review* 35: Special Issue (15), 149-62.

Wood, H. A. and Wood, D. J. (1984) An experimental evaluation of five styles of teacher conversations on the language of hearing-impaired children', *Journal of Child Psychology and Psychiatry* 25: 45—62.

Woodhead, M. (1985) 'Pre-school education has long effects: but can they be generalized?', *Oxford Review of Education* 11: 133–55.