

Both the learner and the teacher are actively involved in such instruction. The child participates in problem solving with the adult, rather than listening to explicit explanation or watching demonstration by the adult. Information and skills are transmitted tacitly through pragmatic communication in the context of solving the problem, as the child's understanding is extended through participation in the problem's solution. The instruction occurs in the interaction between novice and expert, who together structure their communication so that the novice is brought into the expert's more mature understanding of the problem. They jointly manage the transfer of responsibility for the task so that the novice is participating at a comfortable yet challenging level in the problem's solution. The expert revises the scaffolding for learning as the novice's capabilities develop, adjusting the support for the novice's performance to a level just beyond that which the novice could independently manage. In this manner, adults routinely guide children's growth in understanding problems and ways to solve them.

From: Rogoff, B. and Lave, J. (Eds.) Everyday Cognition  
Its Development in Social Context (1984) Cambridge, MA:  
Harvard University Press.

## 5. A Theory of the Teacher in the Learning Activities of Everyday Life

*Patricia Marks Greenfield*

*Any function in the child's cultural development appears on the stage twice, on two planes, first on the social plane and then on the psychological, first among people as an intermental category and then within the child as an intramental category. (Vygotsky, 1966:44)*

This chapter will focus on the Vygotskian idea that intra-individual skills have their origin in interindividual activity. As Vygotsky put it, "the transformation of an interpersonal process into an intrapersonal one is the result of a long series of developmental events" (Vygotsky, 1978:57). This idea can be illustrated in diverse domains of informal learning, where individual skills originate in cooperative activity through a scaffolding process. Initially in the learning of language or other skills, the teacher carries the greatest responsibility in the activity, erecting a scaffold for the child's limited skills. As the child's learning and development progress in a given domain, the scaffold gradually diminishes, the roles of learner and teacher become increasingly equal, and the point is finally reached where the child or learner is able to do alone what formerly could be done only in collaboration with the teacher.

The data which will be used to illustrate this concept come from a study of the transition from nonverbal to linguistic communication in language acquisition carried out in Los Angeles with a middle-class sample (Reilly, Zukow & Greenfield, 1978, Zukow, Reilly & Greenfield, 1982), and from a study of the acquisition of weaving skills carried out in Chiapas, Mexico, with a sample of Zinacanteco women (Childs & Greenfield, 1980). The aim is to show that, although a learner's age, culture, native language, and skill are

totally different, the same developmental and educational process from interindividual activity to individual accomplishment applies. Our evidence extends the work of Wertsch and colleagues who have intensively studied this process in informal situations where American mothers must teach their preschool children how to do a puzzle or build a model (Hickman & Wertsch, 1978; Wertsch, 1979a-b).

### *Scaffolding and the Zone of Proximal Development*

The scaffold is a metaphor, originated by Wood, Bruner, and Ross (1976), to describe the ideal role of the teacher. This metaphor is the basis for a theoretical model of the teacher in informal education. The scaffold, as it is known in building construction, has five characteristics: it provides a support; it functions as a tool; it extends the range of the worker; it allows the worker to accomplish a task not otherwise possible; and it is used selectively to aid the worker where needed. To illustrate this last point, a scaffold would not be used, for example, when a carpenter is working five feet from the ground.

These characteristics also define the interactional scaffold provided by the teacher in an informal learning situation. That is, the teacher's selective intervention provides a supportive tool for the learner, which extends his or her skills, thereby allowing the learner successfully to accomplish a task not otherwise possible. Put another way, the teacher structures an interaction by building on what he or she knows the learner can do. Scaffolding thus closes the gap between task requirements and the skill level of the learner, creating what Hunt (1961) called "the match" between the cognitive level of the learner and the characteristics of instruction, or what Brown (1975, 1979) referred to as "headfitting."

When a teacher closes the gap between task requirements and what the learner can accomplish on his or her own, this process of collaborative work between teacher and learner often advances the learner's skills as well as accomplishing the task at hand. The reason for this effect lies in what Vygotsky conceptualized as the "zone of proximal development." This 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. . . . 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" (1978:86). Thus, adult guidance, when it functions as a scaffold in the zone of proximal development, not only leads the child to solve problems collaboratively that could not be solved alone, but also moves the embryonic skill toward its full-blown manifestation.

This "region of sensitivity" to instruction lies in the gap between comprehension and production (Wood, Wood & Middleton, 1978). The new skill component must be comprehensible although it has not as yet been produced. This idea, applied to scaffolding, means that the teacher provides the minimum necessary scaffolding for the learner to produce new skill components that are understood but not yet performed. Wood, Wood, and Middleton have demonstrated experimentally that a scaffolding technique incorporating this pacing principle, which they call "contingent instruction," is more effective in teaching 3- and 4-year-old children a difficult construction task than pure demonstration, pure verbal instruction, or alternation of demonstration and verbalization without reference to the learner's current skill level.

Scaffolding resembles the concept of shaping from Skinnerian psychology (1938). Both create an environment which reduces both error and failure experiences at the early stages of learning a new skill. There is, however, a major difference between them. Shaping involves a series of successive approximations to the ultimate task goal. While the learner is successful at every point in the process, he or she starts with a simplified version of the ultimate task. Scaffolding, in contrast, does not involve simplifying the task during the period of learning. Instead, it holds the task constant, while simplifying the learner's role through the graduated intervention of the teacher. Although scaffolding is more important in both language acquisition and learning to weave, the gradation of task difficulty characteristic of shaping also plays a role in both informal learning situations.

These two learning situations are extremely far apart in type of skill, age of learner, and culture of participants, which illustrates the broad applicability of scaffolding and the zone of proximal development to understanding the nature of instructional interaction in situations of informal learning. In the first example, the

beginnings of language learning (between the ages of one and two) were studied among middle-class children in the United States. In the second example, learning to weave was studied among 7- to 15-year-old members of a subsistence Indian culture in rural Mexico, the Zinacantecos. In both cases the research method involved video recording in naturally occurring situations of informal learning. This method permitted microanalysis of the social interaction through which instruction was taking place.

### *Language Learning in Los Angeles*

The study sample was composed of six children at various stages in the one-word period of language development, that is, the stage at which children are mainly uttering one word at a time. In terms of age, the children ranged from 9 months to 22 months at the beginning of the study. Each child was observed twice; the two observation periods were four to six weeks apart. The focus of the study was the role of the caregiver in the development of comprehension. In other words, language acquisition was approached as a situation involving informal education. The study dealt with the comprehension of one class of message, the adult-initiated offer. It looked at the development of the response to verbally expressed offers and the role of the caregiver in this communication process (Reilly, Zukow, & Greenfield, 1978; Zukow, Reilly & Greenfield, 1982).

Two types of offer messages were identified: the offer of an object, and the offer of an activity. An example of the former would be, "Do you want a banana?" An example of the latter would be, "Do you want to go for a walk?" In terms of the caregiver's role, the study investigated how the mother uses nonverbal cues to help the baby respond to otherwise incomprehensible verbal messages and how the baby's need for such cues changes with development. More specifically, it looked at how the representation of the offer message on a nonverbal level and the manipulation of the baby's attention by the caregiver function as a scaffold to enable the baby to give a meaningful response to a verbal offer which he or she would not otherwise understand.

The children were divided into three language levels, all within the one-word period, on the basis of diary reports of language production. The levels were defined according to the complexity of the implied propositions which they communicate. Children at

Level 1 are limited to implied propositions involving a single entity, for example, pointing at an object and naming it. Children at Level 2 are able to communicate an implied proposition consisting of an entity and an action, for example, naming the action of an agent. At Level 3, children are able to communicate an implied proposition consisting of two entities, for example, naming the possessor of an object.

After the children were categorized by language level, the videotapes were analyzed for meaningful responses to offers, with emphasis on the scaffolding required at each language level and the process by which it was constructed. Very often it was found that mothers do interactive work, creating additional scaffolding if the offer does not immediately elicit an acknowledgment. In this interactive situation, the child's response plays a role. For example, if the child was not looking, the mother might tap on the table to get the child to turn toward the banana, or if the banana was lying on the table, she might pick it up and extend it toward the child with an offer gesture, thus completing the nonverbal representation of the offer. That is, the mother translates the offer on a sensorimotor level, the level of visible action. The term *sensorimotor* is used here in a general sense to refer to perception and action, so its scope is not limited to the specific tasks described by Piaget (1951, 1952, 1954).

In this way, the mother elicits a comprehending response through a sequence of interactional work in which she adds cues one at a time, gradually enlarging the scaffold until it is adequate for the task. This construction of a scaffold piece-by-piece constitutes an interactive situation in which the child's response plays a role in stimulating additional scaffolding by the mother. Hence, the scaffold results not simply from the mother's action but also from a process of interaction between mother and child. In this process, the child's responses play an active role in shaping the nature and extent of the scaffold. This interactive process of mutual influence between mother and child is the specific mechanism by which the match or headfitting comes about.

This type of interactive process was manifested in a large class of communications labeled "eventually successful." In an eventually successful offer the mother frequently creates a scaffold one step at a time. For example, one sequence contained an initial verbal offer, "D'ya wan call Daddy?" which was transformed into a successful

communication through the gradual construction of a nonverbal scaffold.

Successful communication is operationally defined, in terms of the organizational structure of the offer. The study revealed the following organizational structure:

- I. Offer establishment
  - a. Offer presentation
  - b. Offer acknowledgment
- II. Offer consummation
  - a. Offer realization
  - b. Offer enactment

Ia and IIa are carried out by one participant (the mother in this corpus of adult-initiated offers), Ib and IIb by the other participant (here the child). Sometimes an object offer is nested in an activity offer. This occurs when, after offering an activity, the mother offers the child an object that is required to carry out the activity. Thus, a toy telephone is required by the offered activity of "calling Daddy." The embedded object offer can be denoted by superscripts corresponding to the parts of the offer structure (Ia', Ib').

Communicative success is defined by the acknowledgment of the offer on the part of the child (Ib). To be counted as an acknowledgment, the response must be specifically appropriate to a particular offer, and it must be interpreted as a specific response by the caregiver (IIa).

The following episode illustrates the step-by-step scaffolding process. The mother's initial offer presentation to Jeremy is, "Jeremy, d'ya wan call Daddy?" (Ia). Calling someone on the phone is a complex activity involving at least three component actions. The child must lift the receiver to his ear, dial the phone, and finally talk into the receiver.

When Jeremy's mother first makes the offer, they are both sitting on the floor, Jeremy's back is to his mother, and the telephone is on the floor between them. The question alone provokes no response, other than Jeremy crawling away from his mother toward the camera. The mother gains his attention by calling his name twice. He responds by turning around to look at her. She raises the receiver to her own shoulder and proceeds to dial, demonstrating the first two component actions and the appropriate physical configuration for talking on the telephone. While dialing, she repeats

the verbal offer, "D'ya wanna call Daddy? You wanna call Daddy?" Jeremy's gaze is still focused on his mother and the telephone. She then begins to talk into the receiver, demonstrating the final component, action, and thus completing a demonstration of the entire activity. The scaffold thus far has provided a nonverbal enactment of the activity initially offered on the verbal level. This enactment functions as a translation for the child who is in the process of acquiring language.

Jeremy continues to look at his mother as she holds the phone body and offers him the receiver, thus creating an object offer that is embedded in the activity offer (Ia'). His gaze continues to follow his mother's movements. She crawls closer to Jeremy to establish a more appropriate general configuration, which in this case is the orientation between Jeremy and the phone. She then asks, "You wanna talk?" This offer presentation simplifies the original offer presentation by making explicit one of the actions, talking, which is merely implied by the initial offer, "D'ya wan call Daddy?"

Jeremy acknowledges the embedded offer of the phone by lifting his chin into position to have the receiver next to his ear (Ib'). His mother then extends the receiver to Jeremy's ear, thus simultaneously realizing both the activity offer (IIa) and its embedded object offer (IIa'). This specific configuration then provides a scaffold for the third action, talking, which is the final enactment of the original offer (IIb). The mother uses an imperative form to induce Jeremy to participate and then models Jeremy's part, "Tell Daddy. Say hello," providing a demonstration of the final component. At this point, Jeremy finally produces some unintelligible sounds which the mother acknowledges as a partially satisfactory enactment (IIb) by saying, "Uh huh. Hello, Daddy. Hello, Daddy."

Although the telephone was initially present and Jeremy was looking at it, this situation is certainly not sufficient for the offer sequence to be consummated. In fact, before the offer sequence succeeded at all, the mother provided not only the configuration but all of the implied constituent components of the activity. All Jeremy does to acknowledge the offer presentation is to sit attentively and then attempt a repetition of his mother's utterance, very much like a routine.

The nonverbal scaffolding required for the comprehension of offers systematically decreases as language level increases. For ex-

ample, the study showed that, at Level 1, which extended from 9 to 14 months of age, every element of an offer must be visibly present on the nonverbal level and the child's attention must be focused on the visual representation in order to give a comprehending response. As a hypothetical example, "Do you want a banana?" is a verbal offer of an object. If it is presented in this way to a Level 1 baby, there will be no specific response to the offer. What is required in addition is a complete nonverbal representation of the offer: a real banana must be offered by means of the appropriate gesture in the baby's usual location for eating, and the infant's attention must be focused on what is being offered. Once all these elements are present, a meaningful response in the form of an acknowledgment is possible. Such an acknowledgment may take the form of either a rejection (such as pushing away the banana) or an acceptance (such as opening the mouth to receive the banana). In the case of either positive or negative acknowledgment, the point is that effective communication of the offer has taken place and this has occurred through the use of a nonverbal scaffold. The example, "D'ya wan call Daddy?" illustrates the necessity of a complete nonverbal scaffold at Level 1 with an actual example from our data.

At Level 1, in short, a child is capable of responding to an offer sequence when all the relevant contextual and semantic information is present and attended to on the sensorimotor level. The responsibility for providing the elements and ensuring the child's attention rests with the mother. Note that successful activity offers require a demonstration of the activity, as well as the presence of the necessary objects and persons. Interactions that do not fulfill these requirements are not successful for the Level 1 child, who requires a complete nonverbal translation of the offer, that is, scaffolding to the maximum extent possible.

At the point where the child lacks the linguistic skills necessary to comprehend a given message, the scaffold is nonverbal. The mother presents word and sentence meanings that can be seen. This process gives the child an opportunity to learn new linguistic meanings which can then be internalized in the movement from inter- to intraindividual meaning.

At the stage of language development represented by the telephone example, the linguistic representation is irrelevant for communication, because the process is basically one of nonverbal com-

munication. If this is the case, in what sense is it meaningful to speak of the mother's nonverbal representation as a scaffold for the successful accomplishment of linguistic communication? Looking at the situation from the adult's point of view, the mother may view herself as primarily attempting to communicate a linguistic message. So she may view the nonverbal representation as "cues" to the decoding of her linguistic message. This seems a particularly likely interpretation of the mother's point of view in those situations where a verbal offer is presented first and nonverbal elements are added only later when the verbal message fails to communicate. This is the situation in the telephone example.

More essential to the nature of the scaffold, however, is the situation from the child's point of view. I would argue that, at Level 1, the linguistic message is irrelevant to successful communication. It is not, however, irrelevant to *language learning*. Indeed, just because the nonverbal message is self-sufficient without language, it provides an opportunity to learn the meaning of the linguistic representation, which was heretofore an unknown quantity. The hypothesis is that the presence of both verbal and nonverbal representations provides an opportunity for a Level 1 child to form associations between words or phrases and their concrete referents. Thus, the nonverbal representation is a scaffold for the verbal in the sense that the former helps the child to learn the latter.

Developments in foreign language teaching utilize a nonverbal scaffold to "translate" or make manifest the meaning of unknown messages. For example, Kuniyara and Asher (1965) found that methods involving the acting out of meanings by the teacher are more effective in teaching Japanese as a foreign language than are other methods of instruction involving hearing or seeing a verbal translation.

At this point, the analogy between informal learning and the scaffold breaks down, for the carpenter does not learn from his or her scaffold, but the informal learner does. That is, the scaffold not only helps successfully to accomplish the current task but also provides information which, as it becomes internalized, gradually eliminates the learner's need for the scaffold itself. A better analogy in this respect might be the labels on a typewriter keyboard. They provide a support for accurate typing while letter positions are being learned. However, in the acquisition of touch typing, the visual information provided by the keyboard ultimately becomes

internalized, gradually eliminating the learner's very need for a visually labeled keyboard.

Evidence for this hypothetical process comes from the finding that children at the second linguistic level of the one-word period (between 15 and 17 months of age in our sample) need less scaffolding in the form of nonverbal representation in order to respond to verbally presented object offers. This developmental change suggests—although only longitudinal data can prove—that the means used to gain comprehension at Level 1 succeeded in teaching the child certain word or phrase meanings, and that at Level 2 the association between word and nonverbal referent has now been internalized so that the referent is no longer necessary for comprehension to occur.

Consider this example of comprehension by a Level 2 child in the absence of the referent: The mother and child are in the bedroom when the mother asks, "You wan some juice?" The child responds by leaving the room and running down the hall into the kitchen where the juice is kept. This mother's offer is presented on a purely linguistic level; that is, there is no object, gesture, or appropriate location to serve as a nonverbal scaffold. Yet the offer elicits a meaningful response. This older, more linguistically advanced child (although still in the one-word period) does not always need the nonverbal cues required by the less linguistically advanced and younger children. Because of its cross-sectional design, the language development study cannot prove that input at Level 1 caused improved linguistic comprehension at Level 2. However, it strongly suggests that the external scaffold used by the Level 1 child has now been internalized: the Level 2 child does not always need an externally situated translation of the verbal offer. He or she can perform the needed translation internally, representing the meaning of the utterance—the offer plus the specific object—in his or her mind.

The number of nonverbal cues required for meaningful response to a given type of offer substantially decreases as language level and age increase. At Level 1, offers are successful only if all elements are dramatized nonverbally, such as the objects or the activity being offered. At Level 2, in contrast, there are a number of examples of successfully communicated offers in which nonverbal dramatization is incomplete.

Whereas the mother of the Level 1 child constructs the referen-

tial meaning of her linguistic message for her child, the Level 2 child constructs the meaning for himself or herself. This developmental sequence toward comprehension of a linguistic message illustrates Vygotsky's (1978) idea that skills originate as interindividual collaborations which then become internalized, resulting in the intraindividual form, the capacity for independent accomplishment of the skill in question. This process of internalization also shifts the zone of proximal development, as yesterday's nascent skill becomes today's actual one. Thus, the mother or adult teacher is in the position of having to follow a moving zone of proximal development.

Mothers are sensitive to the match, for the input they provide correlates with the child's different needs at different points in development. For example, the modalities through which the mothers initiate their offers change with the child's development. The frequency of purely linguistic initiation, such as asking, "Do you want X?" without an accompanying initiation on the nonverbal level, increases steadily between Level 1 and Level 3 children. At Level 1, only 8% of all offers are initiated on the linguistic level alone. At Level 2, the percentage is 67%. At Level 3 it rises slightly to 75%.

Another aspect of this scaffolding process is that within a given language level more scaffolding is needed for a more difficult task. For example, children at Level 2, who can comprehend the absent object in a verbal object offer, as in the juice example, still invariably need an external representation of the activity in the more complex activity offers. An example of just such a complex activity offer follows.

The mother says, "Do ya wanna comb the baby's hair?" At that moment, several referential elements are missing on the sensorimotor level: the proper configuration, the objects, and the activity. Although one object, the doll, is visible, neither the comb nor the doll is in the child's possession. Without the necessary objects, no demonstration is possible. The mother then provides the objects and a demonstration of the specific activity. At this point the child acknowledges the offer by taking the doll, ultimately enacting the offer by combing the doll's hair.

The examples illustrate the symbolization capabilities of children at Level 2 and display the requirements for comprehension. At this level children are apparently able to represent symbolically the referent of a concrete noun, such as *juice* in the case where the child

runs into the kitchen where the juice is kept. However, there is no evidence that the children are able internally to represent the referent of a verb or any linguistic representation of an entire complex activity. Thus, the mother of the Level 2 child has to demonstrate the activity of combing before her offer achieves communicative success.

These examples show that at Level 2 the child is now a more active participant in supplying the contextual and referential information. At Level 1, the mother is the sole provider of the structure, whereas at Level 2, the child assumes part of the responsibility, albeit enactively. Instances include the occasion when the child picks up the doll (object) in order to comb its hair, and the time when the child runs into the kitchen (location) for the juice (object). The fact that these children can supply missing sensorimotor contextual and referential information is evidence that at Level 2 children have at least partially internalized the sensorimotor structure of an offer sequence, the referential structure of a linguistic offer. Internalization of linguistic offers is complete at Level 3.

There is also a shaping aspect to the mother's developmentally graduated communication. Mothers not only make a given task easier by their collaborative intervention but also select simpler tasks. The ratio of the more complex activity offers to the simpler object offers rises steadily from Level 1 to Level 3. Thus, task difficulty as well as type of intervention is adjusted to the child's current level of development.

#### *Other Examples of Movement from Interindividual to Intraindividual Activity in Language Acquisition*

The research just described relates to development in the child's comprehension of linguistic messages. There is also a passage from interindividual to intraindividual forms on the production side of language development. A longitudinal study of productions from one-word utterances to early combinatorial speech traced most of the first two-word utterances independently produced by the children back to earlier dialogic forms (Greenfield & Smith, 1976). For example, Nicky, one of the children in the study, produced *want* plus an object for his first two-word sentences at 19 months, 27 days. One such example was "awada cacao" (want record), uttered while the record player was turned off. About three weeks earlier,

at 19 months, 4 days, similar linguistic propositions were produced cooperatively in question-answer dialogue with his mother. In these examples, the notion of 'want' is contained in the mother's question, while the object of 'want' is contained in Nicky's response.

*Mother:* What do you want?

*Nicky:* Showel (shovel).

In this question-answer sequence, the child makes use of a word, *want*, in his mother's question to convey the message 'want shovel.' Her question thus provides a scaffold for his message. Three weeks later, the scaffold has been internalized: the child can now provide both message elements himself, as in "awada cacao" (want record).

Nicky's next step in syntactic development was the two-word pattern, no plus an object. This pattern could also be traced back to a dialogic form. Sometimes there was even microgenesis, or short-term development, from the interindividual to intraindividual forms within a given observation period. For example, Nicky's mother asked, "Do you want the dance record?" and Nicky answered, "No!" A few minutes later, his mother asked, "Do you want to listen to it?" referring to a record, and Nicky responded, "No record." His two-word utterance combines a propositional element, *record*, from his mother's earlier question, with his previous response, *no*. These examples strongly suggest a process in which both people's roles in the question-answer routine become internalized by the child, helping him progress from single-word utterances to two-word sentences.

Ochs, Schieffelin, and Platt (1979) provided other examples of a linguistic function being achieved interactionally in dialogue before being expressed syntactically by the child alone. Hatch, Peck, and Wagner-Gough (1979) have made parallel observations indicating that the internalization of dialogue plays a role in the second language acquisition of older children. Thus, the conversational partner provides a scaffold for the language learner's emerging capabilities.

#### *Learning to Weave in Zinacantan, Chiapas, Mexico*

The role of scaffolding in informal instruction was also illustrated in weaving in Zinacantan (Childs & Greenfield, 1980). Weaving is a

skill that is not nearly as universal as talking, but it is nevertheless fundamental in the Zinacanteco culture. The Zinacantecos have a subsistence culture in the highlands of Chiapas in southern Mexico. Their native language is not Spanish but Tzotzil.

Fourteen girls were taped at various levels of learning to weave. Weaving level was measured by the amount of previous weaving experience, as shown by the number of articles woven. The girls ranged from first-time weavers to experts. They were videotaped in the most natural situation possible. At least one teacher was always present, except for the expert weavers. This teacher was always a close relative, usually the mother. The social situation was thus quite parallel to the situation of learning to talk. Unlike the middle-class California mothers, however, none of the weaving teachers (and only one of the learners) had any formal schooling at all. Another difference was that the principal teacher in the weaving situation was often aided by other closely related female onlookers.

The tapes were coded by means of a number of categories of action and interaction. As in the language study, the focus was on both verbal and nonverbal means of instruction.

Scaffolding was again an important theme of the results. First-time beginners produced woven material that was, to the eyes of the researchers, indistinguishable from that produced by the more experienced and expert weavers. This was made possible by the collaborative efforts of the teacher, who sensitively aided the learner wherever necessary to complete the task. First-time weavers clearly could not complete a piece of woven material on their own, yet they did so with the help of the teacher. By making this accomplishment possible through joint action, the teachers operated above what Vygotsky (1974) called the actual developmental level, in the learners' zone of proximal development.

For first-time beginners, the teachers' nonverbal involvement consisted primarily of taking over the weaving at the more technically difficult parts of the process. Thus, during two segments that were difficult because they involved a new process — selvaging and the first cycle of weaving — teachers took over the weaving 53% of the time. The teacher's heavy involvement at the more difficult parts of the process functions as a scaffold in making it possible for the learner to complete the piece of woven cloth. At the same time, this form of intervention provides a model for observation, thus supplying an opportunity for learning and ultimate internalization

of the teacher's skill by the learner. The study indicated that the learners did in fact pay attention when the teachers took over: they watched the model 87% of the time, looking away only 13% of the time.

The basic idea that a scaffold functions to close the gap between learner abilities and task requirements implies that more scaffolding will be used in the harder parts of the task. To test this hypothesis, teacher intervention in the first cycle of weaving was compared with teacher intervention during a later cycle (a cycle consists of adding two weft threads to the weaving, thus passing both over and under every warp thread). The first cycle is intrinsically more difficult, because it constitutes a complete change from what has gone before and because special technical problems are associated with "getting started." For the completely inexperienced weaver the first cycle is also her introduction to weaving.

Comparison of overall teacher intervention in the weaving during the two cycles, excluding cases where there was no intervention during either cycle or where comparative data were not available, showed that every one of the eight teachers intervened more on the first cycle than on the later one. The size of the difference was dramatic: teachers participated in the weaving 65% of the time, on the average, in the first cycle, and only 16% of the time in a later one. This is clearcut evidence of more scaffolding in the harder parts of the task. Thus, the teachers' scaffold is sensitive to the level of task difficulty.

Equally fundamental to the scaffolding concept is sensitivity to the skill level of the learner and the idea that the scaffold supports what the learner can already do. Evidence for this notion was provided by the difference in amount and type of instructional techniques used with learners at different levels of experience. The more experienced the learner, the less frequently the teacher took over the weaving (Table 5.1). Thus, the teacher follows a moving zone of proximal development. The amount of time spent weaving independently also increased with experience (Table 5.1). This trend indicates that weaving knowledge is gradually being internalized by the learners.

Another change in type of teacher intervention as the learner's skill level increased was revealed by an analysis of teacher verbalization. The teacher's verbal aid, like her nonverbal aid, was graded according to the level of the weaver. Thus, beginners received

Table 5.1. Time teacher takes over weaving, works cooperatively with learner, and lets weaver work independently (%).

Teacher's degree of intervention	Previous weaving experience			
	None (n = 2)	1 piece of cloth (n = 2)	2-4 pieces of cloth (n = 3)	Expert (n = 1)
Teacher takes over	61	33	14	0
Teacher and learner work cooperatively	32	15	28	0
Weaver works independently of teacher	7	52	58	100
Total	100	100	100	100

mostly commands, the most direct form of verbal aid. As weaving experience increased, teachers used a higher proportion of statements, which are a more indirect form of verbal aid. Initially, commands constituted 91% of all verbalizations from teacher to learner, while statements constituted only 4%. By the time learners had from two to four woven articles behind them, teachers used commands only 53% of the time, while statements made up 40% of their verbalizations. This trend provides additional evidence of the internalization of the teacher's role. The decline of commands implies that the learners are becoming increasingly self-regulated with the development of skill. Extrapolation from Vygotsky's (1962) framework suggests that the teacher's overt command has been transformed into inner speech in the process of internalization.

Closely related is the finding that the frequency of multimodal instruction—verbal combined with nonverbal—declined as weaving experience increased. For the least experienced learners, the majority of the teacher-initiated interactions (68.4%) combined verbal and nonverbal elements. This figure declined steadily with increasing experience, reaching 33.6% for the girls who had previously woven from two to four articles. In a multimodal message, the nonverbal elements can provide cues as to the intended mean-

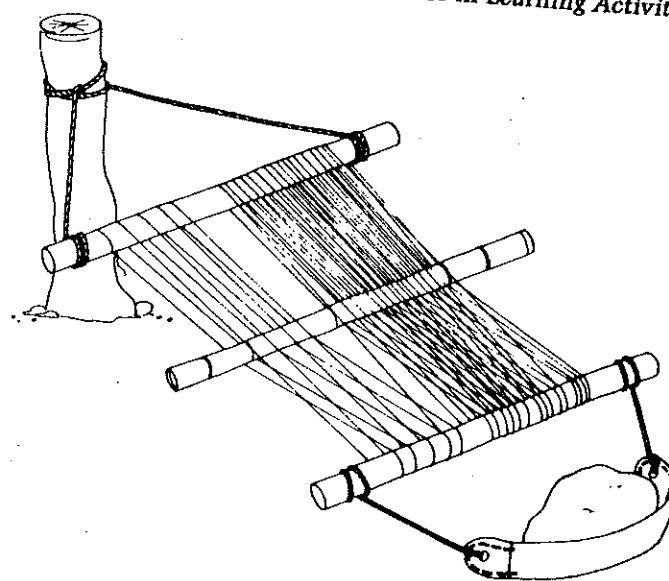


Fig. 5.1. Backstrap loom.

ing of the linguistic message, in weaving just as in learning to talk. Corresponding to this decrease in teachers' multimodal instructions was a steady increase in purely verbal messages as weavers became more skilled (from 17.4% among the rank beginners to 40.1% among the girls with two to four articles behind them). There is an interesting commonality here with the language learning process: the use of multiple and potentially redundant communication channels also decreased as the learner became competent in going from words to meaning.

As in the case of language learning, shaping has a role in weaving education. Girls with little weaving experience are given smaller items to weave. Smaller size makes the task easier by requiring less strength to maintain the tension in backstrap looms; in the actual situation a weaver leaning back would take the place of the rock pictured (Figure 5-1). Thus, shaping is integrated with scaffolding in the informal teaching of weaving in Zinacantan.

#### Comparison Between the Two Learning Situations

The main difference between language learning in Los Angeles and learning to weave in Zinacantan is that there are more failure

experiences in the language learning situation. The Los Angeles mothers did not provide the necessary scaffold in about 15% of the offers, and there the communication failed. In contrast, no weaving failures, or even microfailures, were observed at any level of knowledge. This is because, in weaving instruction, the mother jumps in as soon as she perceives the learner to have the slightest problem, actual or potential. Errors may also be more difficult to control between one and two years of age, the age of learning language, than in middle or late childhood, the age of learning to weave. Thus, age differences may contribute to this contrast.

There was an almost trial-and-error approach to the scaffolding itself in the language learning situation, where a large class of communications fell into the "eventually successful" category. In these cases, the mother did not immediately provide all the scaffolding required for successful communication. She added piece by piece in an almost trial-and-error way. She seemed, though not consciously, to provide the absolute minimum information necessary for success, but was perhaps not quite sure what that minimum was. In contrast, there was no evidence of this kind of trial-and-error scaffolding process in Zinacantan. The teachers seemed to provide exactly what was required from the very beginning. Consequently there were no observable weaving errors on the learner's part in Zinacantan. From the learner's point of view, a trial-and-error approach contrasts with scaffolding because a scaffold, designed for the current level of the learner, prevents error during the course of learning a new skill.

In addition, as Barbara Rogoff pointed out, a teacher may find it harder to prevent errors in a mental skill like language than in a physical task like weaving, and harder to make a match between the scaffold and the skill level of the learner. If so, the language teacher would have a more challenging task than the weaving teacher. This task difference is a possible explanation of the fact that learning to weave in Zinacantan seems relatively error-free in comparison with learning to understand language in Los Angeles, California.

Errors can be constructive in showing the limits of one's skill, as Jean Lave has noted. However, this useful type of error mainly occurs in a context where the teacher wants the learner's skill to generalize to new situations never before encountered and the learner has made an incorrect generalization. Such a context violates the Zinacanteco view of weaving. Zinacantecos want girls to learn to weave a small set of specific patterns, not to transfer their

weaving skill to a wide variety of new patterns. This view serves the larger cultural goal of preserving tradition (Greenfield & Lave, 1982).

In the language learning situation, in contrast, generalization would have a definite value, for it enables the child to acquire linguistic knowledge that is not bound to the context in which the original learning took place. School learning also has generalization as an important goal. Hence, the use of error to show the limits in generality of current skills, thereby aiding the generalization process, can also contribute to an explanation of why errors would be more encouraged in school than out, more tolerated in learning to talk in general than in learning to weave in Zinacantan. Generalization is more valued and necessary in speech and schooling than in Zinacanteco weaving. Thus, task differences, age differences, and value differences are all possible factors in explaining the greater prevalence of error in the language learning situation than in the weaving situation.

Perhaps more interesting than the differences are the similarities across the two informal learning situations:

1. A scaffold adapted to the level of the learner in both cases ensures success at a task the child cannot do on his or her own.
2. The amount of scaffolding needed and provided decreases as the skill level of the learner increases. The teacher thus follows a moving zone of proximal development.
3. Ultimately, the scaffold becomes internalized, enabling independent accomplishment of the skill by the learner.
4. For a learner at a given level of skill, a greater scaffold is provided as task difficulty increases.
5. Scaffolding is integrated with shaping, the technique in which task difficulty is also varied as a function of learner skill.
6. In both situations, teachers appear unconscious of their methods or of the fact of teaching. For example, a Zinacanteco woman, interviewed about how girls learn to weave, said that they learn by themselves. The common belief in Western culture is that children also learn to talk by themselves (Chomsky, 1965).

### Conclusions

In a general way this picture of the development of interaction in informal learning situations illustrates

given activity is mastered interindividually before it is mastered intraindividually, that is, the learner first carries out an activity in cooperation with the teacher. The teacher's role is eventually internalized, and the child then proceeds on his or her own. These two very different examples of informal learning show that the phenomenon of scaffolding is a very general one that can illuminate instructional interaction in a wide range of learning situations.

The findings presented in this chapter touch base at several points with the other chapters in this book that deal with processes of informal instruction. One important commonality concerns the communication techniques used by mothers in informal learning situations. Rogoff and Gardner's results support ours in pointing to the use of high-redundancy messages early in an informal learning process, with a gradual reduction in redundancy as the task structure is internalized by the child. Rogoff and Gardner also found that the child's errors become a signal to the adult to upgrade the scaffolding. In early language learning, additional nonverbal cues, which are "redundant" from the adult's point of view but not from the child's, are provided when the child makes the "error" of not comprehending. In the case of learning to weave, the additional scaffolding placed at particularly difficult junctures in the task seems to *anticipate* rather than *respond* to errors, yielding a relatively error-free performance. Thus, while the frequency of observable errors may be quite different in the two situations, the underlying function of errors to guide instruction is the same. Errors, either anticipated or actual, are used as a signal to upgrade the scaffold, transferring responsibility from the learner to the teacher.

In comparison with out-of-school learning, in-school learning, where there is greater emphasis on independent work and trial-and-error learning, seems to apply the scaffolding principle less frequently. Teachers more than parents allow children to work independently, learning from their own mistakes. Scaffolding, in contrast, leads to relatively errorless learning because, in principle, just the right type and amount of help are provided at each point for the pupil to succeed. However, this distinction between home and school is certainly not absolute. Indeed, Mehan (1979) provided a few examples of verbal scaffolding by a teacher in a teacher-student dialogue in an elementary school classroom.

One reason why trial-and-error learning may be more prevalent at school and scaffolded learning at home is a difference of emphasis

on learning versus getting the task done (Wertsch, this volume). School specializes in learning; outside-of-school activities usually give at least equal, if not greater importance to finishing the job. In the two learning studies the tasks were communication of an offer and weaving. In both cases the successful completion of the task at hand has a value in itself, independent of what the child learns from the process. An arithmetic problem, for example, does not have this same kind of intrinsic value. In the case of weaving, the cost of errors or failure is quite high in economic terms, for the Zinacantecos, a subsistence culture with scarce resources, cannot afford to waste weaving materials. Thus, the value of task accomplishment per se may explain why scaffolding is less prevalent in school than out, while the immediate cost of errors may explain why scaffolded interaction controls errors more in some learning situations than in others. For example, the high economic cost of errors in weaving versus the absence of a concretely apparent cost to communication failures in language learning may explain, to some extent, why error is more carefully controlled in the former situation than in the latter. An unanswered question is the extent to which school instruction could be improved by greater use of the principle of scaffolding, thus putting more emphasis on cooperative success in the early stages of learning and less emphasis on independent discovery through a process of trial-and-error.

Scaffolding is also related to the concept of cooperation. It can be conceived as an asymmetric type of cooperation where one person takes greater responsibility than the other for the successful accomplishment of a task by compensating for the other person's weaknesses. In a seminar, John Whiting and Beatrice Whiting pointed out that cooperation among pupils in school is called cheating. This observation illustrates the point that, in general, school traditionally values independent rather than cooperative learning. This contrast between the role of peer cooperation in and out of school is supported by Newman, Griffin, and Cole's observation (this volume) that cognitive tasks carried out individually in the classroom are often divided up among different children and approached cooperatively in the informal context of an afterschool club.

This concept of scaffolding and its potentially broad applicability to situations of everyday learning raises questions as to the cognitive skills required of the teacher. Usually the focus is on the

cognitive development of the learner. Perhaps more important in real life is the cognitive development which allows a person to become an effective teacher. What are the cognitive skills involved in scaffolding? In England important individual differences were found in mothers' ability to use the technique of scaffolding (Wood, Wood & Middleton, 1978). What experiences or abilities produce these differences among mothers? What are the developmental stages which lead to a mastery of scaffolding? What are the component processes of scaffolding? These questions concerning the cognitive processes of the teacher would be interesting to pursue in the continuing investigation of learning experiences in the everyday world.

## 6. Skiing as a Model of Instruction

*Richard R. Burton*

*John Seely Brown*

*Gerhard Fischer*

While some work has gone into developing specific learning environments, little has gone into clarifying the general issues that affect the acquisition of a complex skill, especially in a naturalistic setting. A study was made of an extremely complex skill, skiing, to determine why it has become so easy to learn. The goal was to analyze the features of a highly successful learning environment in order to articulate a general theory of learning environments.

Learning environments can be examined in terms of a paradigm called "increasingly complex microworlds" (ICM). In this paradigm, the student is exposed to a sequence of environments (microworlds) in which his tasks become increasingly complex. The purpose of an individual microworld is to provide the student with a task that he can perform successfully using a simplified version of the final skill that is the goal. This allows the student to focus on and master one aspect of the skill in a context that requires related subskills. As a result, the student learns when to use the skill as well as how to use it. The purpose of the sequence is to evolve the simplified skills toward the goal skill. The ICM framework focuses both on what is learned in any particular microworld and on how to choose the next microworld in the sequence.

A microworld is created by manipulating three elements: the equipment used in executing the skill, the physical setting in which the skill is executed, and the task specifications for the given equipment and physical setting. These manipulations allow the student to focus on the factors that are fundamental to learning a skill, rather than on factors that are not immediately relevant. A critical factor in determining appropriate microworlds is the pro-