Piaget's theory of developmental stages and Werner's orthogenetic principle suggest the need for students to recognize and resolve discrepancies.
Factors Influencing Thinking

Thinking does not just emerge and function, but develops under the influence of three conditions relevant for education: students' developmental levels, their social-emotional status, and their cultural milieu (including the school as well as the broader society).

Developmental level considerations.

Piaget (1950) showed that the child is an active construing creature inherently predisposed to thinking activities. The child by nature is able to assimilate knowledge from experience and to organize this knowledge through a variety of mental operations. The aspects of experience the child will attend to and the ways he or she will organize it will be limited, however, by the child's developmental level. For example, Grennon (pp. 11-16 in this issue) describes a boy named Jeff. In his work with bar graphs, Jeff treats each bar separately. "For Jeff, the graph is not an array which compares each bar separately. "For Jeff, the example, Grennon (pp. 11-16 in this issue) describes a boy named Jeff. In his work with bar graphs, Jeff treats each bar separately. "For Jeff, the graph is not an array which compares each bar separately. For Jeff, the example, Grennon (pp. 11-16 in this issue) describes a boy named Jeff. In his work with bar graphs, Jeff treats each bar separately. "For Jeff, the graph is not an array which compares each bar separately. For Jeff, the example, Grennon (pp. 11-16 in this issue) describes a boy named Jeff. In his work with bar graphs, Jeff treats each bar separately. "For Jeff, the graph is not an array which compares each bar separately. For Jeff, the example, Grennon (pp. 11-16 in this issue) describes a boy named Jeff. In his work with bar graphs, Jeff treats each bar separately. "For Jeff, the graph is not an array which compares each bar separately."

Piaget's notions of stages and Werner's orthogenetic principle complement each other. Piaget describes the logical operations children use at different levels of development. The orthogenetic principle describes the processes the children use in organizing knowledge. For example, in the classification example, from a Piagetian perspective, children might be grouping items in an array on the basis of a single or multiple attribute, thus evidencing different levels of logical thought. Whichever logical strategy children use, they are still differentiating attributes and integrating them. These latter processes are reflections of the orthogenetic principle. Thus, working with a Piagetian stage model and Werner's orthogenetic principle, the teacher can identify two sets of complementary processes, each contributing to children's thinking and problem-solving skills.

Personal-social influences. How we think, what we think about, and how we carry out our thoughts are in part dependent on what kinds of persons we are, our attitudes and feelings about our competence, and whether we are willing to take risks, be flexible, and so on.

All these characteristics affect the thought process, facilitating or inhibiting its effectiveness. Thinking skills depend on these factors. For example, I presented a group of young children with a group of three-dimensional miniatures of farm and zoo animals. I asked the children to separate the assortment of objects into those animals they liked and those they feared. I then asked them to classify the items in the liked and feared groups into smaller groups. Most children had no trouble creating subsets of animals in the liked group, but they tended to leave the feared group as an undifferentiated whole. By asking the children to separate the benign from the threatening, I was asking them to articulate their emotional reactions. Since they created subsets for the benign but not the threatening group, the competence of the children to create groupings was not in question; rather, a negative emotional response blocked their performance in the feared part of the task.

Let us not just think of emotions as having a negative impact on cognitive performance; they can have positive effects as well. Such factors as interest, curiosity, and enthusiasm can influence the quality of thought positively, while text anxiety, fear of failure, and negative attitudes toward the task can...
have adverse effects on the quality of thought.

Cultural factors. Although it is true that humans, by their very biological similarity, can employ a wide array of thinking skills, the use of these skills will vary as a function of cultural milieu. For example, in Western thought, it is common to think in terms of causal connections, of discovering relationships among discrete events, and of placing value on analytic and synthetic activities. These processes, however, may necessarily be employed in non-Western cultures. Cause-effect, for example, is conceptualized to some Eastern cultures as it is among Westerners. Even the notion of an objective reality is not accepted by all cultures.

Comparable differences can be found within our own society. How creationists and evolutionists interpret geological data and draw conclusions about the origin of the human species, for example, is a function not of differential abilities, but of divergent beliefs.

Constructivist Perspective and Distancing Strategies

In view of the influences of developmental level, social-emotional states, and surrounding culture, how are we to think about teaching thinking? How do we go about it? We can begin by recognizing three components as critical to the teaching of thinking: concepts of the child, of the context, and of teaching strategies.

The child as a constructor of knowledge. The constructivist's fundamental assumption about the child is that knowledge is an end product. The child's mind naturally and actively perceives and constructs relationships about surrounding objects, events, and people. In so doing, new knowledge is integrated with previous experience, forming an ever-increasing knowledge base (Copple and others, 1984).

Discrepancy as context. Cognitively, the child develops by recognizing and resolving discrepancies, that is, inconsistencies between what is expected and what actually occurs in the environment (Copple and others, 1984; Sigel and Cocking, 1977). These inconsistencies usually generate tension, which in turn generates activity to resolve the tension. This activity associated with problem solving thus creates the opportunity for new learning.

A discrepancy can only be perceived if the child is at a sufficiently advanced developmental stage to detect the discrepancy. After all, expectations cannot be violated where none exist.

The constructivist perspective, then, assumes that:

1. The individual develops by actively constructing his reality.
2. Development takes place through a process of discrepancy resolutions.
3. Discrepancy perception is limited by the individual's current expectations or knowledge.

Constructions of knowledge are organized into conceptual representations. These concepts are transformed mentally into some type of symbol, perhaps a picture, word, design, or kinesthetic sense. These internal representations, which are products of constructions, are communicated through external representations—words, photographs, music, gestures, maps—each of which presents some inner thought or wish (Sigel, 1978).

The ability to represent, which is called representational competence (Copple and others, 1984), is as peculiar to humans as thinking is. In fact, for Piaget, representation and thinking are similar (Piaget, 1962). My work indicates that the ability to represent, albeit generic, will vary with the quality of the individual's social and cultural experiences, assuming the child is neurologically intact.

Three general developmental principles guide the formation of representational competence:

1. Human beings understand the world through representations of it.
3. Representational competence develops fully only in response to interaction with appropriate physical and social environments.

Distancing Strategies As Teaching Tools. The remainder of my discussion will address this last principle in terms of teaching strategies that promote representational competence. Social encounters which serve this purpose require the child to deal with experiences (objects, events, actions) separate in time or space from the immediate present. Circumstances or behaviors that create such mental demands are called distancing events (Copple and others, 1984).

Distancing strategies can vary in level, form, and content. Some strategies make minimal demands on the child's cognitive ability, like asking the child to label an object; others are more taxing, like asking a child to discover a relationship between events or to construct a class of objects. Distancing strategies provide opportunities for the child to differentiate or integrate or re-integrate experience. Essentially, through distancing strategies, teachers can actualize the orthogenetic principle. By so doing, these same strategies may contribute to stage development in terms of logical-mathematical reasoning. (See Figure 1 for a list of strategies) Research has shown that when parents employ low-level strategies their children are less likely to demonstrate competence in planning, anticipating consequences, and reconstructing past events. Low-level distancing strategies seem to contribute to less effective thinking and problem solving (Sigel and McGillicuddy-DeLisi, 1984). Results from two preschool programs (Copple and others, 1984) indicate that the frequency with which teachers employ higher-level distancing strategies is positively relat-

<table>
<thead>
<tr>
<th>Figure 1. Types of Distancing Strategies.</th>
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<tr>
<td><strong>High-Level Distancing</strong></td>
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<tr>
<td>evaluate consequences</td>
</tr>
<tr>
<td>evaluate competence</td>
</tr>
<tr>
<td>evaluate effort and/or performance</td>
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<tr>
<td>evaluate necessary and/or sufficient</td>
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<tr>
<td>inferencing, for example, causal relations and their effects</td>
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<tr>
<td>generalize plan</td>
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<tr>
<td>confirm a plan</td>
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<td>conclude</td>
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ed to children's performance in tasks requiring reconstructive memory and the ability to predict outcomes (Johnson and Sigel, 1977; Sigel, 1979).

Teaching that enhances representational competence will:

1. Place the cognitive demand on the child. For this purpose, an authentic, carefully worded question is often more effective than a statement.

2. Draw the child's attention to a discrepancy, contradiction, or inconsistency. Inquiry that resolves the illogic and results in a new integration of ideas should follow.

3. Involve the child in mental activity that requires going beyond the obvious concrete event—how far beyond will depend on the child's understanding of the task and what the teacher wants to know about it (Sigel and Saunders, 1983). (This point is consistent with Brooks and Gremmon's Cognitive Matching program.)

The Classroom as a Teaching Environment

The foregoing description of teaching strategies has been described as though the teacher is engaged in a one-to-one interaction with the child. Yet I am actually describing a teaching approach that occurs in a group setting.

Since every teacher is concerned with keeping order in the classroom, eliciting maximum participation of the pupils, and ensuring that all students gain from the classroom experience, inquiry in a group setting raises practical problems. To use inquiry takes time. Not every child can participate, and not every child is interested in listening to peers. Further, other children who have to take tests may question whether this approach will help them do well on tests which are usually objective and ask for recall rather than reasoning.

Do these problems for implementing inquiry teaching rule out for use in ordinary classrooms and suggest that the method is appropriate only for individualized or small group instruction? My answer is an unqualified no. I contend that the type of instructional model advocated in this essay can work in the typical classroom if teachers are trained to be sensitive and skilled in applying distancing strategies.

Other instruction, even though it takes place in a group setting, is in reality one-to-one interaction. The teacher asks a child a question; the child responds, and the teacher goes on to the next child. The rest of the class observes this teacher-pupil interaction. Pupils do not usually interact. Another common instructional strategy is for the teacher to address the whole group, thereby creating another dyadic interaction—teacher vs. group. Neither of these models fosters a classroom climate that yields the greatest opportunity for classroom inquiry and social interaction. Rather, teachers should encourage students to interact with each other—to generate cognitive demands on their fellow students.

By developing skills in group management, teachers can become adept at creating a social climate conducive to the use of inquiry strategies. Otherwise, they will not be able to implement the inquiry strategies to the benefit of the class.

Further, I believe that advocates of teaching through inquiry and discussion must take into account the broader school context with the built-in expectations typical of administrators and parents who are emotionally and intellectually invested in children's performances. All are familiar with the argument that teaching through discussion, while interesting, still provides no guarantee that content to be covered will be completed, and that poses problems for teachers and administrators who rely on so-called objective test scores as the criterion of academic achievement. The educator's double bind for the 80s is the necessity of developing children's representational competence through reflection, discovery, and inquiry, while also producing effective test scores likely to result from didactic teacher-centered strategies.

Let the reader conclude that the computer will somehow magically resolve the dilemma. Let it suffice to point out that the computer is but an instrument that could contribute to the representational competence of children with provocative and insightful software; on the other hand, it could also persist in didactic strategies transferred to the computer from past educational practices.

The choice of how best to teach thinking faces the educational community and the public. Nothing is more basic or deserving of prompt attention and resolution. We can begin by ensuring that future theory underlying methodology is consistent with what we know already about the way children learn.

A more detailed description of the role of inquiry and principles for inquiry are available from the author.

References


