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ABSTRACT

Three perspectives of instruction that reflect applications of cognitive theory are transportation of knowledge, application of algorithms, and transfer of responsibility. To determine what kind of instructional theory is appropriate for vocational education in a rapidly changing, technological, and increasingly complex society and what contributions cognitive theory can make to this instructional theory, each perspective may be examined in terms of Goodnow's (1980) dimensions and in terms of what the perspective has brought to and how it has been modified by application of cognitive theory. A critique of the perspectives of instruction in relation to societal conditions and to educational purposes also helps to answer the questions. Four interrelated conclusions can be drawn: (1) instructional perspectives influence how cognitive theory is applied; (2) the potential of cognitive theory is most fully realized within the perspective of transfer of responsibility; (3) this perspective provides an overarching instructional framework that addresses needs implied by societal conditions and educational aims they warrant and within which multiple educational aims can be addressed; and (4) cognitive theory can help vocational educators clarify and strengthen their transfer of responsibility orientation to instruction. (Contains 133 references.) (YLB)

National Center for Research in Vocational Education

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PREFACE

This document is part of the National Center for Research in Vocational Education's (NCRVE's) continuing effort to understand and improve vocational curriculum and instruction. It is one in a series of documents concerning teaching and learning. This document examines instructional perspectives reflected in education and their relationship to cognitive theory. It provides an organizing framework for other documents in this series which report research on instruction in vocational and technical education and for thinking about instructional practices in all areas of education. It is hoped that this document will stimulate thinking and discussion concerning future directions for education. It should be of special interest to researchers, practitioners, teacher educators, and policymakers concerned with integrating vocational and academic education and with renewal and revitalization of American education in general.

EXECUTIVE SUMMARY

As the United States moves into the twenty-first century, new challenges are confronting its educational systems. The viability and relevance of American education is being questioned. These challenges are stimulating thinking about changes that may be needed in educational practice and in the assumptions underlying present educational approaches. There are calls not only for new approaches to educating but also for new conceptualizations of teaching and learning. It has been suggested that cognitive theory, a rapidly growing area of educational psychology, can help educators, researchers, and policymakers better understand and evaluate such criticisms and improve education in ways that address justifiable criticisms, build on its strengths, and enhance its relevance within a twenty-first century context.

Cognitive theory rests on assumptions about the nature of learning that differ in several respects from those underlying instructional theories familiar to most educators. According to cognitive theory, learning is a process of knowledge construction rather than knowledge absorption and storage; people use what they already know in constructing new knowledge; and learning is closely related to the context in which it takes place. Even though assumptions underlying cognitive theory differ from those underlying some familiar views of instruction, because people use what they already know in learning something new, applications of cognitive theory to instruction reflect the familiar views. In addition, some instructional views do not adequately address changing societal conditions. Application of cognitive theory to instruction is likely to be more coherent if there is awareness of how existing views of instruction fit with cognitive theory assumptions, with changing societal conditions, and with educational aims such conditions warrant.

The purpose of this document is to address two questions: (1) What kind of instructional theory is appropriate for vocational education in a rapidly changing, technological, and increasingly complex society? and (2) What contributions can cognitive theory make to this instructional theory? To answer these questions, three perspectives of instruction which applications of cognitive theory have reflected are outlined. The three perspectives include (1) transportation of knowledge, (2) application of algorithms, and (3) transfer of responsibility. Each perspective is examined in terms of the following: underlying metaphors; view of the nature of knowledge; what is perceived as valuable to learn and as benefiting from teaching; what is perceived as learning, development, and

progress; who should teach; what is involved in teaching and learning; instructional design metaphors and models; methods considered feasible and proper for assessing progress; and what the perspective has brought to and how it has been modified by cognitive theory. A critique of the three perspectives of instruction in relation to societal conditions and educational purposes is then provided. The critique is followed by conclusions and recommendations regarding cognitive theory and instructional perspectives.

Perspective I: Instruction as Transportation of Knowledge

Among the three instructional perspectives, instruction as transporting knowledge has the longest history in formal, school-based education. It is widely reflected in current educational practice. The underlying metaphor in this view of instruction is physical movement of knowledge from one place to another as through a pipeline. Knowledge is viewed as a commodity that can be passed from one person to another. Learning, development, and progress are viewed as accumulation of culturally valued knowledge. Experts who possess this knowledge are seen as qualified to teach. Teaching entails direct communication of knowledge through telling, showing, and writing. Learning entails receiving directly communicated knowledge through reading, listening, and watching and storing it in memory. Instructional design is content-focused and involves selecting, organizing, and sequencing content. The degree to which learners can recall knowledge that has been communicated is the major approach to assessing development and progress. Although assumptions underlying this view of instruction are least compatible with cognitive theory assumptions, it is reflected in some applications of cognitive theory to instruction. These applications have focused on how oral, written, and graphic communication should be configured to make it easier for learners to focus their attention on and accurately comprehend the meanings intended by the author or speaker.

Perspective II: Instruction as Application of Algorithms

Instruction as application of algorithms focuses on acquisition of skills and related knowledge with the intent to improve learners' performances in areas that have value in the culture. Sometimes described as a scientific approach to instruction, algorithm-oriented instruction seeks to control the learning process so that intended learning occurs. Algorithms enable control, standardization, efficiency, and predictability by outlining a

completely guided, strictly directed process which, if repeated by any person, will lead to identical results. This kind of instruction prescribes a system of operations and procedures for carrying processes out in order to achieve specified kinds of learning for specified kinds of learners. Knowledge is seen as decomposable into small, elementary elements which can be learned in isolation and then combined to produce the desired performance. Learning, development, and progress are viewed as the ability to produce error-free, uniform performances that conform to specified standards.

Those who teach must be able to apply the instructional prescriptions provided by the instructional developer and manage the instructional system. The process of imparting knowledge and its assimilation by learners is controlled and regulated automatically or semi-automatically by teaching materials and equipment. Learner activity focuses on following instructions, responding to directions, and practicing prescribed actions until the actions and their products conform to a given model and standard. Design of instruction involves analysis of component operations involved in desired performance, and prescription of instruction that will produce in learners the ability to perform the operations. Application of cognitive theory within this view of instruction has focused on developing more adequate and precise understanding of thought processes and knowledge underlying desired performance and of how these can be developed.

Perspective III: Instruction as Transfer of Responsibility

The roots of the transfer of responsibility instructional perspective are in apprenticeship and other real-world experience-based learning. In formal education, this instructional perspective has been known by such labels as experiential learning, inquiry or discovery learning, and cooperative education. The ultimate aim in this perspective is that the learner is able to assume independent responsibility for an area of practice in the real world. Independent responsibility involves identifying problems; making decisions about what is appropriate to do, what will be done, and how it will be done; determining what knowledge is needed and where and how it will be obtained; monitoring one's own actions; and assessing the consequences of one's decisions and actions. Instruction within this perspective provides a structure that enables learners to engage in these activities beyond their present capacities to do so. By engaging in the activities, capacities underlying them are learned, developed, and extended. It is possible for learners to engage in activities for

which they have not yet developed the needed capacities because the teacher or specially adapted materials and equipment provide supportive assistance. This assistance is like a scaffold which extends the learner's capacities and involvement in an activity. As learners' capacities develop, the support is gradually reduced.

Knowledge is viewed as constructed by individuals as a result of their interactions with the world in ways that reflect their prior knowledge and experience and of the contexts in which experience occurs. Teaching guides learners toward directing their own learning and finding their own meanings and requires a deep understanding of broad principles and concepts underlying an area of practice, an intense interest in learners and their development, and the ability to join with them in a supportive learning partnership. Progress in learning is indicated by learners' increased capacities to independently assume responsibility for the conduct of activity. When learners can do an activity without the scaffolds that have been provided, the capacity has been fully developed and the responsibility for its enactment fully transferred to learners.

Instructional design involves identifying and understanding conditions that foster or support the activities of interest and the capacities they require. These conditions provide the basis for creating a learning environment and the kinds of scaffolds that will be used. The learning environment and the scaffolds are continually modified as learners develop so that learners receive continually and gradually changing amounts and kinds of support and challenge as their capabilities develop. Apprenticeships, some simulations, and certain kinds of projects are examples of transfer of responsibility instruction. Structures within which transfer of responsibility instruction occurs have in common incorporation of features of real-world contexts, learner-directed activity, frequent interaction with a teacher or other mentor who guides and supports the learning process, and tailoring of activity to each learner's level by introducing the appropriate amount of challenge or assistance throughout the learning process. Application of cognitive theory within this view has focused on gaining a deeper and more explicit understanding of the nature of real-world problems and of how people deal cognitively with them. This understanding has been used to develop learning environments which reflect contextual aspects of real-world activities and which support learners in developing cognitive capacities relevant to them.

Critique of Instructional Perspectives and Implications for Vocational Education

Societal Conditions

The twentieth century is drawing to a close having increased the rate of societal change and complexity that characterized its onset. These conditions have confronted organizations with new challenges. As a result, problem solving and other reasoning capacities have become increasingly important at all organizational levels. A growing realization that multiple perspectives are valuable in understanding and responding to complex problems has led to work team structures which can effectively use the varied knowledge that is distributed among people. As a result, social abilities to work with others are becoming more important. There is growing realization that workplace and personal life are interdependent and that changes in the family as a consumer of goods and services and supplier of labor and capital affect the workplace and vice versa.

As the nature and structure of the workplace and the family have changed and as roles have become less well-defined, the specific knowledge and skills people need for the future have become less predictable. Future conditions in an era of rapid change will inevitably present learners with problems their education has not "covered." In dealing with such problems, learners will need to find their own meanings and fill in gaps in their knowledge and reorganize what they know on their own.

Critique of Instructional Perspectives in Relation to Societal Conditions

Each of the perspectives is useful for some purposes. Some, however, are more responsive to societal conditions outlined above than others. For example, the knowledge transportation instructional perspective does not acknowledge that in a rapidly changing world with unknown, unpredictable tomorrows, all kinds of people—not only experts—need to be prepared to reconstruct, elaborate, and extend what they already know. In addition, the focus in this view on knowledge storage and recall is too limited in a world which demands flexible knowledge and complex mental capabilities. Because the algorithmic model of instruction can only be applied to known performances that already exist, societal conditions of rapid change and unpredictability also pose difficulties for this perspective. The algorithmic view of instruction is also limited in helping learners develop complex mental capacities because these capacities are not governed by specific rules.

Because the transfer of responsibility perspective of instruction supports learners' self-directed learning and is not dependent on highly specific description and prescription, this perspective appears to be more responsive and to offer more possibilities than the other two views for education in a societal context like that outlined earlier. It supports learners in developing complex cognitive processes by giving them opportunities to identify problems, construct relevant knowledge, create solutions, and make choices. In addition, because learners are engaged in joint action with others, it provides opportunities to develop social capacities that are relevant to working with others.

Educational Aims

Purposes of education have historically reflected economic, social, and political aims as well as educational ones. For example, purposes of vocational education connected with preparation for employment, personal development, and manpower and economic development reflect contrasting views of educational aims which have surrounded vocational education since its inception. These contrasting views of educational aims might be characterized as socialization on the one hand and as individual and cultural development on the other. Socialization involves adoption of prevailing meanings in the culture that reflect the culture's view of the world and which are seen as correct, right, appropriate, and best. Education based on socialization aims seeks to prepare learners for living effectively in their culture as it is. In contrast, individual and cultural development aims of education are focused on cultural change. Education based on individual and cultural development aims seeks to create opportunities for individuals to develop as unique persons rather than in prescribed ways. A society of such individuals is seen as benefiting from the rich array of talents and capacities of its members and as being changed by their working together to improve it.

Historically, socialization aims have been prominent in education. Criticisms of education for lack of emphasis on helping citizens, the workforce, and families to affect and deal with changing conditions have increased in recent years. Societal conditions suggest that individual and cultural development are educational aims whose time to play a more significant role in the character of American education has come. Some might argue that although worthy, individual and cultural development purposes are the responsibility of other areas of education. Others have contended that there is a need and a responsibility in all subjects to provide opportunities for students to question, to create and invent, and to know themselves and what they think and why they think it because each subject involves

seeing differently. Consequently, there is a need in all subjects to emphasize real-life problems which have important consequences and no easy, obvious answers. Students should experience the constraints that context imposes on such problems and the realization that the knowledge needed to resolve them has to be developed and figured out, not just looked up.

Critique of Instructional Perspectives in Relation to Educational Aims

The emphasis in the knowledge transportation instructional perspective on culturally valued knowledge reflects socialization as an aim. In the same vein, with its focus on culturally valued performances that conform to specified standards, algorithmic instruction also reflects socialization as an aim. In the transfer of responsibility perspective, while the current society and current ways of doing things are not ignored, neither are they assumed to be a model of what should be. The transfer of responsibility perspective of instruction incorporates the present in ways that help learners extract deep, full, varied, and personal meanings from it and that are potentially relevant to an unknown future. The present serves as a vehicle for developing general capacities that remain relevant when the present no longer exists. The opportunities the transfer of responsibility perspective can provide for learners to direct their own learning, to explore and examine diverse ideas, and to work together in identifying and solving meaningful, real-life problems reflect individual and cultural development aims relevant to the kind of world described. Because the transfer of responsibility perspective enables learners to understand their culture as it is without being limited by it, it addresses a multiplicity of educational aims.

Conclusions

- *Instructional perspectives influence how cognitive theory is applied.*
  Application of cognitive theory has occurred within well-established modes of instruction. These modes or perspectives of instruction are reflected in how cognitive theory has been applied. Depending on the instructional perspective reflected, cognitive theory has been used to serve socialization aims as well as individual and cultural development aims. That is, some applications of cognitive theory have had as a primary aim improvement in student learning of knowledge and skills associated with specific roles reflected in the present culture, while other applications have emphasized helping students become independent, self-directed

learners and thinkers. Some applications of cognitive theory have simultaneously addressed all of these aims because the instructional perspective within which they have occurred has encompassed a multiplicity of educational aims.

- *The potential of cognitive theory is most fully realized within the transfer of responsibility instructional perspective.*

  The three instructional perspectives are not equal with respect to their compatibility with cognitive theory assumptions. Assumptions underlying the knowledge transportation perspective are least compatible with those of cognitive theory. Nevertheless, some applications of cognitive theory have been influenced by this perspective. Cognitive theory applications influenced by an algorithm perspective go further in reflecting cognitive theory assumptions. Considerable attention is paid to the nature of learners' prior understanding, and a richer variety of means are incorporated to help learners construct prescribed meanings. Assumptions underlying the transfer of responsibility-perspective are the most fully compatible with those of cognitive theory. This is because this perspective gives learners roles that enable them to direct their own learning; it allows for construction by learners of what are truly their own meanings, and it is attentive to several aspects of context in the development of learning environments.

- *The transfer of responsibility perspective provides an overarching instructional framework that addresses needs implied by societal conditions and the educational aims they warrant and within which other instructional perspectives can play a part and multiple educational aims can be addressed.*

  The transfer of responsibility perspective offers a better fit with societal conditions and with educational aims deemed appropriate in such conditions than do either of the other two instructional perspectives. Because of its responsiveness to societal conditions, and the relevance of its assumptions for a democratic society, transfer of responsibility instruction is broadly applicable throughout education in a wide range of vocational and academic subjects and across educational levels. As an overarching instructional framework, the transfer of responsibility instructional perspective allows incorporation of other instructional perspectives and a multiplicity of educational aims. Because the transfer of responsibility perspective places a larger realm—a meaningful context—around specific knowledge and skills that gives them meaning and because control of the learning process is shared with

students, using the other perspectives within the transfer of responsibility perspective reduces their limitations. Used within the transfer of responsibility perspective as accompaniments for selected aspects of learning, the knowledge-transportation and algorithmic instructional perspectives are more likely to serve an ultimate end of enhancing learners' capacities to exercise their own judgment and their own sense of style and craft and to direct their own learning than if these perspectives are the primary approaches to instruction.

- *Cognitive theory can help vocational educators clarify and strengthen their transfer of responsibility orientation to instruction and its language can help them communicate among themselves and with other educators regarding this kind of teaching.*

  Transfer of responsibility instruction is already established in vocational education. Since its inception, vocational education has been sensitive to the importance of context-embedded knowledge. Vocational educators have actively sought and developed ways of connecting school-based learning and real-world contexts. Supervised work experience, cooperative education, and in-school laboratories intended to simulate critical aspects of real-world activities and their contexts are approaches that have been widely used within vocational education to connect theory and practice.

Recommendations

The following recommendations for educators, researchers, and policymakers are based on the conclusions summarized in the preceding section:

- Develop a better awareness and understanding of how the transfer of responsibility instructional perspective is expressed in educational programs through case-focused research. Extend awareness among the general public, educators in all fields, researchers, and policymakers of how transfer of responsibility instruction provides bridges between school and life. One approach that might be used in this process is to identify educational programs that can serve as models of transfer of responsibility instruction. Encourage and support accessibility of these programs for observation by other educators, researchers, and policymakers. Encourage and

support teachers in these programs in communicating their experience in and understanding of this kind of teaching to other teachers.

- Experiment with transfer of responsibility as an overarching instructional perspective in creating new curricular organizations and structures that help learners connect and integrate their learning. For example, experiment with transfer of responsibility as an overarching instructional perspective in efforts to integrate vocational and academic education.

- Examine cognitive theory for potential contributions it can make to strengthening and further developing transfer of responsibility as an overarching instructional perspective. Use relevant cognitive theory in developing transfer of responsibility learning environments and study these environments for their impact on student learning and development. Examples of this kind of research, of cognitive theory-based transfer of responsibility learning environments and their development using cognitive theory, and of the significant impact of these environments on learning are cited in the paper.

- Examine teacher education programs for the extent to which preservice teachers are exposed to a transfer of responsibility perspective of instruction. Model and teach in such programs approaches to curriculum, instruction, and assessment that support teaching from this perspective and extend these efforts to inservice staff development programs for current teachers.

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PROBLEM AND PURPOSE

As the United States moves into the twenty-first century, new challenges are confronting its educational systems. The viability and relevance of American education is being questioned. These challenges are stimulating thinking about changes that may be needed in educational practice and in the assumptions underlying present educational approaches. There are calls not only for new approaches to educating but also for new conceptualizations of teaching and learning (Carnoy & Levin, 1985; Committee for Economic Development, 1985; National Commission on Excellence in Education, 1983; Sherman, 1983).

Critics of education have charged that schooling is too removed from and unconnected to the real world (Resnick, 1987). For example, critics specifically of vocational education have charged that it replaced an educationally superior apprenticeship system (Gott, 1988) and have called for a reconstructed vocational education (Oakes, 1986b). Some scholars have suggested that cognitive theory, a rapidly growing area of psychology and educational psychology, can help educators, researchers, and policymakers better understand and evaluate such criticisms and improve education in ways that address justifiable criticisms, build on its strengths, and enhance its relevance within a twenty-first century context (Raizen, 1989; Resnick, 1987; Thomas, 1992; Thomas & Litowitz, 1986).

Cognitive theory focuses on the nature of knowledge, thinking, and learning and on origins, conditions, and mechanisms that affect them (Anderson, 1985; Andre & Phye, 1986; Neisser, 1976). It is viewed as having important implications for all areas of education (Anderson, 1985; Lochhead, 1979). Some have characterized the magnitude of change that cognitive theory implies for education as revolutionary (Johnson & Thomas, 1992). Applications of cognitive theory to education may seem revolutionary in that they emphasize understanding rather than low-level basic skills, memorization, and recall of isolated facts. In addition, cognitive theory-based instruction seeks to make information usable by transforming it through thinking and to facilitate independent learning (Idol, Jones, & Mayer 1991; Jones, 1992). Cognitive theory rests on assumptions that differ from those underlying associationist and behaviorist psychologies from which instructional theories familiar to most educators have emerged (Resnick, 1989; Royer, 1986). According to cognitive theory, learning is a process of knowledge construction rather than

knowledge absorption and storage; people use what they already know in constructing new knowledge; and learning is closely related to the context in which it takes place (Resnick, 1989).

Learning as a process of knowledge construction means that learners construct their own understanding. Human beings are seen as active meaning-makers who learn because they actively try to understand by making their own sense of knowledge and experience (Andre & Phye, 1986; Lochhead, 1979). Such learning is believed to be facilitated by teachers who help students become aware of multiple sources of knowledge and manage their own learning activities and thinking (Jones, 1992). As active meaning-makers, people use what they already know in constructing new understanding (Andre & Phye, 1986; Lochhead, 1979). This prior knowledge is itself revised in the process of using it in understanding something new. Cognitive theory-based instruction emphasizes enhancing students' opportunities to link new information to prior knowledge, to connect school learning to significant real-world tasks and issues, and to engage actively with content by questioning its premises and applying it to problems and situations (Jones, 1992).

Finally, the assumption that learning is closely related to the context in which it takes place is based on evidence that the environment in which learning occurs influences the nature of both thinking and of what is learned (Lochhead, 1979; Rogoff & Lave, 1984). Learning is seen as embedded in contexts that have physical, conceptual, and social aspects. These contexts or environments that influence learning include the broader culture, people's immediate or near environments (i.e., the workplace, the family, the community, the neighborhood, the school, and the classroom), and specific activities and situations. The role of context in learning implies that learning may be more context-specific and less generalizable than has been previously realized. It also implies that the physical, conceptual, and social structures reflected in schools, classrooms, laboratories, and learning activities should receive educators' attention as significant factors in learning. Many sources are available which provide extensive discussion of cognitive theory and its relevance to instruction (Baron & Sternberg, 1987; Jones, 1992; Laster, 1985; Lochhead & Clement, 1979; Phye & Andre, 1986; Prawat, 1991; Raizen, 1989; Thomas, 1992; Thomas & Litowitz, 1986).

Even though assumptions underlying cognitive theory differ from those underlying some familiar views of instruction, because people use what they already know in learning

something new, applications of cognitive theory to instruction reflect the familiar views. Because the assumptions underlying some views of instruction are more compatible with cognitive theory assumptions than is the case for other instructional views, cognitive theory is more adequately represented in some instructional applications of it than others. In addition, some instructional views do not adequately address changing societal conditions. Application of cognitive theory to instruction is likely to be more coherent if there is awareness of how existing views of instruction fit with cognitive theory assumptions, with changing societal conditions, and with educational aims such conditions warrant. The purpose of this document is to address two questions: (1) What kind of instructional theory is appropriate for vocational education in a rapidly changing, technological, and increasingly complex society? and (2) What contributions can cognitive theory make to this instructional theory?

Goodnow (1980) suggests that the deeper meanings that underlie and drive the character of instruction can be understood by examining models of instruction along certain dimensions. A model reflects a paradigm, a perspective, a view, a set of assumptions about the fundamental nature of instruction. These terms—model, view, and perspective—are used interchangeably throughout this document. The dimensions of analysis suggested by Goodnow include the following:

- Underlying Metaphors
- View of the Nature of Knowledge
- What Is Perceived as Valuable To Learn and as Benefiting from Teaching
- What Is Perceived as Learning, Development, and Progress
- Who Should Teach
- What Is Involved in Teaching and Learning
- Instructional Design Metaphors and Models
- Methods Considered Feasible and Proper for Assessing Progress

Three perspectives of instruction which applications of cognitive theory to instruction have reflected are outlined in the following sections. The perspectives are broad, overarching world-views of instruction that are reflected in more specific instructional theories. The three perspectives include (1) transportation of knowledge, (2) application of algorithms, and (3) transfer of responsibility. Each perspective is examined in terms of Goodnow's dimensions and in terms of what the perspective has brought to and

how it has been modified by application of cognitive theory. A critique of the perspectives of instruction in relation to societal conditions and to educational purposes is then provided. The critique is followed by conclusions and recommendations regarding cognitive theory and instructional perspectives.

PERSPECTIVE I:
INSTRUCTION AS TRANSPORTATION OF KNOWLEDGE

Instruction as transportation of knowledge has a long history in formal education. It is still widely reflected in current educational practice.

- *Underlying Metaphors*: The underlying metaphor in this view of instruction is physical movement of knowledge from one place to another. In this view, instruction is the transportation system that accomplishes the movement. This basic metaphor is reflected in such images as a pipeline or conduit running between containers (Reddy, 1979) or a pitcher pouring into vessels. Knowledge is moved from the source to receiving receptacles. The transportation system is simple—usually direct flow of explicit information through telling or showing by a teacher, writing by a textbook author, and listening, watching, or reading by learners.

- *View of the Nature of Knowledge*: In this view, knowledge has the character of a commodity—something that has an existence separable from its possessor and which can be passed, intact, from one person to another. Knowledge also has a quantitative dimension in terms of how much is possessed, transported, and acquired.

- *What Is Perceived as Valuable To Learn and as Benefiting from Teaching*: In this view of instruction, knowledge that has value in the culture, as determined by cultural authorities, is seen as important to learn. Learning such knowledge is important to future members of the culture who will maintain the character of the culture and pass on its heritage. Thus, the present culture as it is viewed by cultural authorities benefits from teaching in that it is maintained or reproduced in new members. Learners are also seen as benefiting in that they are given knowledge that will aid their fitting into the current culture. Cultures exist at various levels. Institutions, occupations and professions, communities, regions, ethnic groups, and societies all represent cultures.

- *What Is Perceived as Learning, Development, and Progress*: Learning, development, and progress are viewed as accumulation of knowledge that is valued in a culture and as increasing ability to reproduce (recall) the knowledge when it is called for.

- *Who Should Teach*: Individuals who possess valued knowledge should teach. Disciplinary scholars who develop knowledge and other experts in an area of knowledge are those who are qualified to teach others.

- *What Is Involved in Teaching and Learning*: Teaching and learning involve moving knowledge from those who possess it (teachers and textbook authors) to those who do not (learners). Teaching entails providing knowledge sources as well as providing and controlling a transportation system for conveying the knowledge to learners. Direct communication of knowledge through writing, telling, and showing is the central transportation system and may take the form of books or lectures and demonstrations by the teacher. Learning entails receiving directly communicated knowledge through reading, listening, and watching and storing the information, intact, in memory. Learners' errors are remediable by repeating and reviewing the original communication or by exposure to additional, similar communications. These direct communication methods are used for all topics and all learners. Stages of learning are marked by amount and content of knowledge accumulation and are considered in determining how rapidly and in what sequence knowledge is conveyed.

- *Instructional Design as Content Selection and Organization*: Instructional design is content-focused. Instructional design involves selecting, organizing, and sequencing content to facilitate its transportability, reception, comprehension, and retention by learners. The ways in which knowledge will be transported are assumed to be those described above and are not attended to in great detail (Schwab, 1974). Since organization and sequencing of content are thought to be primary variables in its reception and retention by learners, models of instructional design focus on principles regarding these two variables. Examples of such principles include organizing and sequencing content from the general to the specific, from the specific to the general, from concrete to abstract, and from simple to complex. Instructional design involves determining which organizing principles are relevant and likely to facilitate the transportation, reception, and retention of particular content. Selection of content is done in terms of what learners already know (so as not to unnecessarily repeat or to leave gaps in accumulated knowledge), what is most important

for learners to know, and what knowledge learners are most likely to be receptive to and retain given their stage of development and other relevant characteristics.

- *Methods Considered Feasible and Proper for Assessing Progress*: The degree to which learners can reproduce (recall) knowledge that has been communicated is the major approach to assessing development and progress. This method assesses reception and retention of knowledge and reveals whether or not the transportation system was successful. Knowledge recall is tested orally or through written tests by teacher questioning and learner answering. Learner responses are evaluated in terms of the degree to which they match the original knowledge that was communicated. Close matches are accepted as correct; deviations or incomplete reproductions are viewed as errors.

- *Applications of Cognitive Theory*: As already indicated, a cognitive view of learning is constructive in nature. Learning is seen as involving construction and reconstruction of knowledge by the learner rather than as absorption of intact knowledge from external sources. Understanding what is communicated by someone else involves a search of one's own memory for prior knowledge that can be used to interpret new information or the construction of a new cognitive structure if an existing structure cannot be found. The learner is seen as an active meaning-maker rather than a passive, empty vessel to be filled. Consequently, central tenets of cognitive theory depart in significant ways from a knowledge transportation view of instruction. Despite these differences, when the primary aim of cognitive theory-based instruction is limited to construction by learners of those meanings that cultural authorities wish to convey to learners through written text, oral lecture, or demonstration, the goals of instruction are similar to those of knowledge transportation instruction.

Applications of cognitive theory to instruction influenced by a knowledge transportation view have focused on aspects of cognitive theory especially relevant to reading, listening, observation, memory, and recall. These include attention, encoding, representation, storage, and retrieval of information. Information processing theories of cognition have used the computer as a model of information processing to better understand how people take in, process, and store information (Phillips & Soltis, 1985). Information processing models have provided a basis for determining how text and verbal and graphic communication should be configured to make it easier for learners to focus their attention and find in memory prior knowledge for interpreting it (Campione & Armbruster, 1985;

Grabe, 1986; Kintsch, 1989; Kulhavy, Peterson, & Schwartz, 1986). In text, this is largely accomplished by modifying text organization and providing text-embedded signals such as headings, questions, pictures, and underlining or other forms of highlighting. Context is established by inserting questions within a text, by asking students to read or listen for an assigned perspective or theme, or by introducing the material as connected to earlier material, to an assignment, or to students' interests. These strategies have been shown to be effective in helping learners construct intended meanings.

Even more effective are approaches that teach learners to impose such modifications themselves to aid their own attentional focus and understanding of information presented in text, lectures, and demonstrations (Corno, 1986; Crain, 1988; Palincsar, 1986). Because the central concern in these strategy-focused approaches is teaching learners how to learn, they are more characteristic of the transfer of responsibility instructional perspective outlined later.

PERSPECTIVE II: INSTRUCTION AS APPLICATION OF ALGORITHMS

Instruction as application of algorithms represents an attempt to address problems and limitations associated with instruction as transportation of knowledge. This instructional view focuses on acquisition of skills and related knowledge with the intent to improve learners' performances. Sometimes described as a scientific approach to instruction, algorithm-oriented instruction seeks to control the learning process so that intended learning occurs. This instructional perspective has emerged during the twentieth century as behaviorist psychology—which it draws on—developed.

- *Underlying Metaphors*: The algorithm, a central metaphor underlying this view, is a prescription for carrying out, in a defined sequence, a certain system of operations for the solving of all problems of a given class (Landa, 1974, p. 11). Algorithms are general solution methods directed at solving a class of problems. Instructional algorithms are prescriptions for carrying out a system of operations that result in specified kinds of learning for specified learners.

While the term algorithm is not part of most people's everyday language, the concept underlies many everyday, familiar activities. Arithmetic operations represent algorithms. Certain procedures are followed that, if followed correctly and applied to the intended class of problems, guarantee a correct numerical answer in the form of a sum, a remainder, a product, and so on. An algorithm might be thought of as a formula that provides specific instructions for operating on substances, objects, materials, people, and ideas to transform them in predicted ways. Algorithms enable control, standardization, efficiency, and predictability by outlining a completely guided, strictly directed process which, if repeated by any person, will lead to identical results (Landa, 1974).

According to Landa (1974), "Algorithms can serve as one means of effectively controlling the processes of learning and teaching" (p. 33). A system operator (teacher) performs the specified operations on objects (learners). Each operation accomplishes part of an eventual transition of the learner from one state to another, the final result being that the learner is transformed in some way by the operations: "All of the possible states of the object are considered known, and the exact reactions required of the system operator are specified for each one of them" (p. 20). Because in pedagogy we do not know how to construct algorithms in the precise, mathematical sense of the term, instructional algorithms are actually only quasi-algorithmic prescriptions in which some aspects of the learning problem are sufficiently known to reach the precision of an algorithm but some are not. The algorithmic approach to instruction is frequently associated with the metaphor of an industrial input-output production system.

- *View of the Nature of Knowledge*: Like the transportation of knowledge view of instruction, knowledge is seen in algorithmic instruction as separable from persons. Knowledge can be decomposed into varying levels of smaller, more elementary elements which when recombined equal the original whole.

- *What is Perceived as Valuable To Learn and as Benefiting from Teaching*: What needs to be known and what is valuable to know is the knowledge and skills associated with culturally valued performance. Learners are stated beneficiaries of teaching. In the algorithmic view of instruction, guarantees that learning will occur for all learners in a given category are sometimes stated. Learners who have been unsuccessful in or unreceptive to the knowledge transportation type of instruction are viewed as especially benefiting from instruction generated by this perspective. The decomposability of

knowledge into varying levels of elementariness is viewed as allowing individualization of the learning process and a range of learners at different levels of learning to be served. Other beneficiaries of teaching are institutions, agencies, organizations, and enterprises that are interested in the performance learners can produce.

- *What is Perceived as Learning, Development, and Progress*: Learning, development, and progress are interpreted in this view of instruction as the ability to produce error-free, uniform performances that conform to specified standards in response to increasingly general (less elementary) instructions. Learning is viewed in terms of the level of knowledge decomposition one can understand. An everyday example illustrates this concept. A person left a note for another that said, "There is a casserole in the refrigerator to heat for supper." Upon finding the note, the receiver of the note dutifully removed the casserole and placed it on a burner on the stove, turned the burner on, and went away to do something else. Upon returning to the kitchen, this individual found the contents burned and the casserole dish cracked and separated. The instructions, heat the casserole, were above (were too general for) this individual's level of understanding. More specific instructions that said put the casserole in the oven, set the oven at 350 degrees, turn the oven on, and leave the casserole in the oven for thirty minutes would have been more likely to result in error-free performance. The receiver of the note did not have sufficient understanding of what heating meant under conditions involving a container suited for the oven but not made for more intense, direct heat. As this example illustrates, failure occurs when learners do not meet standards for desired performance under specified conditions.

- *Who Should Teach*: In this view, the teacher is a person who can follow precise instructions carefully and systematically. Teachers apply but usually do not develop instructional algorithms. Instructional algorithms are costly and time consuming to develop. Once instructional prescriptions have been developed, the instructional system can be operated by anyone who can perform the needed operations. Thus, who should teach is the person who can accurately and adequately follow instructional prescriptions provided by the instructional developer and who can manage the instructional system.

- *What is Involved in Teaching and Learning*: Landa (1974) describes a teaching algorithm as a specific program of actions to be carried out by the teacher which is aimed at evoking and regulating specific actions from students. This algorithm ensures automatic (or semi-automatic) control over students' assimilation of knowledge, skills, and habits by

breaking down the teaching process into sufficiently elementary components. Teaching materials and equipment are "devices that control and regulate automatically or semi-automatically the process of learning and teaching. . . . They permit both the imparting of knowledge and the controlling of its assimilation" (p. 65). They enable control over the student's unsupervised work and free the teacher to give more time and attention to the general administration of all educational work. The teacher controls the transformation system, manages and adjusts the variables in the system, and diagnoses and prescribes according to directions of the system developer. In programmed learning, materials and equipment take on several of these functions.

To instruct, the teacher must know the least fragmented (elementary) level of instruction that will produce in learners uniform, error-free performance. Since the level of operations that are elementary is likely to vary within a group of learners and since instruction is often group oriented, group instruction is usually aimed at a level that matches the capability of most of the learners. An advantage claimed for programmed learning and individualized instruction over group instruction is that the learner can begin at his or her individual level of what operations are elementary (Landa, 1974). When learners fail to produce desired performances, they repeat the instructional prescriptions for only the failed components using either the same or similar materials. Requiring repetition of only failed components and only as many repetitions in each component as necessary to acquire the component are viewed as ways of accommodating individual differences in learners.

The role of learners is to acquire prescribed knowledge and skills as quickly and effectively as possible. Learner activity focuses on following instructions, responding to directions, and practicing prescribed actions until the actions and their products conform to a given model and standard. Learners are often described as active in this view and their role is contrasted with the passive role learners have in the transporting knowledge view of instruction.

- *Instructional Design as Engineering*: Design of instruction as an algorithm involves analysis of component operations involved in desired performance and prescription of instructions or rules that will produce in learners the ability to perform the operations. Instructional design involves the creation of teaching algorithms by reducing (through analysis) large scale aims and actions to teachable components.

For instructional algorithm development to be possible, two conditions must be met: (1) clear categorization of learners and (2) isolation and clear indication of the final set of operations used in the instructional system (Landa, 1974). Determining the level of understanding that characterizes various categories of learners requires empirical investigation. This process involves developing instructional prescriptions (algorithms) at a level of elementariness hypothesized to reflect the level of understanding and capability of persons to be taught. If an individual can carry out the instructions uniformly and without error, then a higher level of elementariness is tried until lack of uniformity and errors appear. This type of analysis and experimentation has been applied to intellectual as well as physical tasks. In order to know the degree to which instructions in a prescription should be broken down, one must know which operations a learner can produce (Landa, 1974). Once these levels of operations have been determined and instructional prescriptions have been developed, the instructional system can be operated by anyone who can carry out its requirements.

Gagne's (1974) learning hierarchies (Resnick, 1976) are an example of an engineering type of instructional design model based on algorithmic logic. Gagne's learning hierarchies approach assumes that more complex tasks include simpler (more elementary) tasks and can be learned by accumulated learning of each of the simpler tasks (Resnick, 1976). The model includes developing a description of the state of knowledge to be achieved (final or target performance), a description of the initial state in which the learner begins, specification of actions which can be taken to transform the initial state, assessment of specific instructional effects, and evaluation of generalized learning outcomes (Glaser & Resnick, 1972). In this instructional design model, a domain of tasks relevant to an occupation, an operation, or a goal is selected. For each task, subordinate (more elementary) tasks embodied in it are specified. Learning hierarchies are then constructed by determining the enabling subtasks that contribute to each task component and breaking enabling subtasks into further subcomponents until one has reached a level of components (elementary operations) which learners currently possess. Teaching methods are then designed to enable learners to move from their current level to the next level of subcomponents and on up the hierarchy to mastery of the highest level task. Tasks can reflect either cognitive operations or psychomotor behaviors.

- *Methods Considered Feasible and Proper for Assessing Progress*: Observing learners for demonstration of uniform, error-free performance under specified conditions is

the primary approach to assessing progress. Learner performances are observed for uniformity over time and for conformity to specified performance standards under increasingly varied and challenging conditions. Lack of uniformity and occurrences of nonconformity to standards are perceived as errors.

When instruction fails to produce intended learning, the system operator (the teacher-manager) rather than the algorithm tends to be faulted since, by definition, an algorithm if properly applied always yields the intended result. The way the algorithm was applied rather than the algorithm itself is usually seen as the culprit. This perception is reflected in the following comment: "There are innumerable cases of projects that started life with great promise but later failed to fulfill this promise. As in general only the human elements in an instructional system are variable (the materials stay the same), the reasons for such decline in efficiency must lie with the humans, teachers, possibly students, and definitely managers" (Romiszowski, 1981, p. 16).

- *Applications of Cognitive Theory*: Cognitive theory has modified the instruction as applying algorithms view toward a focus on cognitive performance by making understanding of what is entailed in various kinds of cognitive performance more explicit. The focus on cognitive elements rests on the assumptions, supported by cognitive research, that cognitive components underlie performances and that performance can be enhanced by altering these cognitive components in certain directions. Cognitive theory has enabled extending analysis of overtly observable tasks to analysis of cognitive tasks. Cognitive task analysis involves determining the cognitive components underlying a specified domain of performance (Gott, 1986; Greeno, 1980; Lesgold et al., 1986; Means, Roth, Schlager, & Mumaw, 1989; Mumaw & Means, 1988; Roth, Schlager, & Mumaw, 1989; Schlager, Means, & Roth, 1988).

Application of cognitive theory to instruction as an algorithm provides (1) descriptions and understanding of cognitive states, structures, and processes underlying general levels of performance such as novice and expert (Chase & Simon, 1973; Eylon & Reif, 1984; Rabinowitz & Glaser, 1986); (2) descriptions and understanding of cognitive states, structures, and processes underlying performance within specific domains of knowledge and expertise (Clarkson, 1962; Clement, 1982; De Jong, 1983; Dillard, Bhaskar, & Stephens, 1982; Hauslein & Good, 1989; Johnson, 1988a; Larkin, McDermott, Simon, & Simon, 1980; McKeithen, Reitman, Reuter, & Hirtle, 1981;

Wiedenbeck, 1986); and (3) descriptions and understandings of what brings about advances in these cognitive elements (Bhaskar, Dillard, & Stephens, 1983; Chiesi, Spilich, & Voss, 1979; Reif, 1982).

In applying cognitive theory within an algorithmic perspective of instruction, researchers have sought to develop understandings and descriptions of cognitive states, structures, and processes that are precise enough to serve as end targets of instruction, to categorize learners when instruction begins, and to serve as benchmark targets in between. Cognitive theory concerning what is involved in the transformation of cognitive elements, particularly the transformation from understanding to skill, has been applied to increasing the precision of instructional prescriptions (Pokorny, 1989). In these ways, cognitive theory has supported development of instructional algorithms for areas of performance where they have not previously been possible. A primary contribution of cognitive research to algorithm-oriented instruction is an understanding of models of human information processing at varying stages of learning. Such understanding makes the development of "ideal" prescriptive theoretical models possible by specifying the thought processes and knowledge which underlie desired performance and through which such performance can be effectively achieved. Some theorists have suggested that these kinds of instructional applications of cognitive theory reflect an integration of cognitive theory with behavioral theory (Andre & Phye, 1986).

The language of engineering is apparent in such applications of cognitive theory. For example, Reif (1980, pp. 39, 48; 1987) speaks of "human cognitive engineering," "human knowledge engineering," and an "applied science" of instructional design that yields "well-engineered instructional systems." According to Reif (1987), systematic analysis of instruction requires answers to three fundamental questions: (1) What are the students' underlying thought processes and knowledge in the initial state before instruction? (2) What thought processes and knowledge underlie the desired intellectual performance in the final state desired after instruction? (3) What effective instructional transformation process can be devised to help the student construct the modified knowledge structure leading to the desired final performance? Cognitive theory is used to increase the explicitness and the precision of answers to these questions.

Algorithm-oriented applications of cognitive theory to instruction also assume a constructivist view of learning. Unlike knowledge transportation-oriented applications,

however, algorithmic ones use more varied methods to bring about construction by learners of intended meanings and focus on cognitive skills as well as understanding. Algorithm-oriented, cognitive theory-based instruction also pays considerably more attention to the nature of students' prior knowledge. Prior knowledge is of interest in algorithmic approaches because students can be appropriately categorized according to level of learning. Interest in learners' prior understandings is also reflected in the attention paid to the types of misconceptions learners reflect. The driving interest with respect to students' prior understanding is the degree to which that understanding is like or unlike the understanding that is desired. Context is established by selecting problems for students to work with that reflect features of the target problems of interest.

PERSPECTIVE III: INSTRUCTION AS TRANSFER OF RESPONSIBILITY

The instruction as transfer of responsibility perspective, like the knowledge-transportation perspective, has existed for centuries. Its roots are in apprenticeship and other real-world, experience-based learning. Over the last two centuries, it has been introduced into formal education where it has been known by such labels as experiential learning and inquiry or discovery learning and cooperative education.

- *Underlying Metaphors*: Instruction as transfer of responsibility is concerned with providing a structure that enables the learner to engage in activity that is beyond their present capacities. By engaging in such activity, present capacities are extended and new ones are learned and developed. While metaphors of a journey or an expedition have been used to characterize this perspective in the past, metaphors that have had more recent attention include the microworld or virtual world and the scaffold.

A microworld (Burton, Brown, & Fischer, 1984) is a microcosm, a "little world," an immediate setting that supports action that will take place within it by providing props that suggest possibilities. This microcosm may be a setting within the real world. Often, however, like a stage set, it is a virtual world, one that is reflective enough of the real world to stimulate and accommodate real-world-like activity but more accessible or safer or less costly than the real-world setting it represents. For example, a flight simulator allows

student pilots to "fly" a plane under varying weather conditions in a safer, less costly world than that provided by a real plane.

A scaffold (Greenfield, 1984) is a temporary structure that is used to support people so that they can engage in an activity not otherwise possible. A scaffold augments, extends, and amplifies a person's capabilities beyond their current level in order to meet the demands of an activity. A scaffold also may provide props or supports that make an activity easier to do. Finally, a scaffold removes or reduces barriers to engaging in an activity. Training wheels on a bike and a net stretched underneath a trapeze apparatus are examples of scaffolds. Training wheels keep the bike upright so that the rider can learn the art of balancing the two-wheeler. The net allows the trapeze performer to develop and work out new routines and practice them by reducing the threat of injury should a fall occur.

Microworlds and scaffolds make it possible for the learner to engage in activities for which their capacities are not yet developed. Microworlds provide a setting, stimulation, and possibilities for activities of interest. Scaffolds provide unobtrusive support. Neither completely defines the possibilities for what might occur.

- *View of the Nature of Knowledge*: Knowledge in this view of instruction is constructed by individuals as a result of their interactions with the world and with each other. Because knowledge is uniquely constructed by each person in ways that reflect their prior knowledge and experience, knowledge does not exist separate from persons. A person's knowledge is a part of the person's individuality, uniqueness, and nature. Knowledge is not a commodity that can be taken from one place and put in another. It is a living, changing part of a person. For example, an artisan contributes special, unique qualities to their work that mark it as their own. Further, the nature of knowledge is related to the contexts in which it is experienced. Knowledge exists embedded in a context—not as a free-standing, self-contained entity. Finally, knowledge is socially influenced, constructed through interaction of people with their social context.

- *What is Perceived as Valuable To Learn and as Benefiting from Teaching*: Hodgkin (1985) speaks of a constructive balance between openness to environment and the internalizing of rule-governed patterns from the environment. Different views are valuable to learn—including past and present culturally embedded meanings; one's own personal

meanings; other peoples' personal meanings; and new, as yet undetermined meanings. Such learning is aided by teaching but is not solely dependent on teaching. While teaching is perceived as making learning easier and allowing learning to go faster and further, it is also recognized that some kinds of teaching can impede learning. Because this instructional perspective seeks eventual independence of the learner from the teacher and functioning by the learner at levels equal to and beyond those of the teacher, transfer of responsibility to learners for guiding their own learning processes is an implicit, if not always explicit aim in this instructional perspective. Consequently, learning processes and learners' own patterns of learning are perceived as valuable to learn. Teaching that guides learners toward directing their own learning is viewed as benefiting learners by preparing them to continue learning on their own when the teacher is no longer present.

- *What is Perceived as Learning, Development, and Progress*: Increased assumption of responsibility on the part of learners for the conduct of activity, for conceptualizing and deciding on the character and course of action, for monitoring themselves and an activity, and for evaluating consequences of an activity and their actions within it are seen as learning, development, and progress in this view. The deliberate intent of instruction is to transfer to learners what begins as shared responsibility between teacher and learners: directing learning and development, self-control, and initiating, controlling and monitoring activity.

Stages of learning are described in terms of broad, general developmental characteristics. Learners' patterns are anticipated, on the one hand, to be unique and to reflect expression of individual nature and interests and, on the other hand, to reflect general, universal, increasingly complete, encompassing, and complex levels of development. In contrast to algorithmic instruction, learners at different, rather than similar stages of learning are grouped together in transfer of responsibility instruction.

- *Who Should Teach*: Those who can join with learners in joint inquiry, who can assume roles in a learning partnership that are supportive rather than controlling, should teach. This includes learners joining with other learners as well as teachers. Teachers must have a deep rather than surface understanding of broad principles and concepts in their field and an intense interest in learners and their development. Highly controlling individuals are likely to have difficulty releasing sufficient control to the learner and are likely to be a director in the learning process rather than a supportive partner.

- *What is Involved in Teaching and Learning*: Teaching in this perspective does not interfere with or overly control the learner's activity or distort the character of real-world activity. Tasks and activities are not reduced to components; rather, they are left intact. Teaching expands the degree to which learners are able to be active in, have responsibility for, control over, and initiative and freedom in a task or activity by providing nonintrusive support that is highly tailored to each learner's capacities. No more and no less support than the learner needs is provided. As learners' capacities develop, the teacher's support is gradually reduced until learners have complete responsibility for the tasks or activities of interest.

According to Hodgkin (1985), teachers and learners jointly create a "space," or learning environment, that allows learners to fail—but not disastrously; to explore the as yet unknown; and to return to more familiar, secure territory—to explore a small world and be helped by someone else. The teacher's role in this view of instruction is to sustain and enrich the space for learning subject to feedback from the learners and to be a fellow learner. The teacher introduces into the learner's space appropriate structural elements which reflect the surrounding culture. Hodgkin refers to "instruction" as progressively structured experience occurring with the help of another person who makes appropriate representations of the world (microworlds) available and constantly monitors their appropriateness with input from learners. Instruction is not directly communicating to learners what they lack. Instead, it is getting learners to act—to "do knowing," to engage in activity through which learners discover or construct meaning. Instruction involves bringing learners to their learning frontier where they begin to generate interesting questions and hypotheses, develop potential answers, create models or views, and test out their claims.

This view of instruction assumes that, within their developmental limits, learners are capable of controlling and directing their own activity and their own learning and of contributing to that of others. Learners share control of the learning process and stimulate each others' exploring, questioning, hypothesis-making, hypothesis-testing, and meaning-seeking (Hodgkin, 1985). By doing more than they are presently capable of doing with the assistance of the scaffolds that a teacher, more advanced peers, or the physical surroundings and materials provide, learners reconstruct their present understandings and meanings.

The teacher follows learners' development, supporting its movement from where it is to where it can go rather than prescribing ahead of time where it should be. Learners' ideas and actions and those of teachers and others that may be introduced into the learning environment are dealt with as stimulation for thought and exploration. Rather than being viewed as simply correct or incorrect, learners' ideas and actions are viewed by the teacher as interesting in their diversity and origins and as reflecting varying experiences on the journey of learning. The methods of learning determined by the teacher and learner together are chosen to fit the experiences and goals of the learner and the nature of the learning problem.

- *Instructional Design as Stage-Setting*: Instructional design compatible with a transfer of responsibility view of instruction might be viewed as stage-setting—as setting the stage for learners to assume responsibilities of interest, including responsibility for their own learning. The stage is set to support learners in their task of learning. This approach to instructional design emphasizes the learning environment as a place where learners come to engage in activities that interest them and to discover. Objects, social interaction, and problems related to real-world activities are all considered in creating the learning environment.

Instructional design as stage-setting involves identification of activities of interest and general characteristics or capacities they entail. These serve as the aims of instruction and are often determined jointly by teachers and learners. Conditions that foster or support the activities and the capacities they require are then identified. These provide the basis for determining and outlining the "staging"—the nature of the microworld and the kinds of scaffolds that will be used. Types of scaffolding include but are not limited to joint action by teacher and students; joint action by students at different levels of development with respect to the capacities of interest; environmental props and arrangements; the structuring of experiences and questions in ways that make particular features more apparent, meanings more evident, and contradictions more perceptible; and providing learners with opportunities to process, reflect on, and question their experiences. In contrast to the algorithmic view of instruction in which an activity is decomposed into understandable, doable, component parts, instruction as transfer of responsibility leaves the task as it is and provides scaffolding to assist the learner in doing it.

Although the general parameters and nature of the microworld and the scaffolds are planned ahead of time, they also have a dynamic aspect in that they are continually modified, refined, and adjusted as learners develop so that learners receive gradually changing amounts and kinds of support as their capabilities develop. Activities are often larger scale endeavors that span days, weeks, and months rather than lessons of an hour or two duration and that entail many different tasks which require varying levels of capacity development. Such activities are used to provide avenues for learners with differing capacities to engage in joint action in ways that challenge the particular level of development of each. Thus, instructional design occurs both before instruction begins and during instruction. It is a spiral rather than linear process, always circling back and being refined or revised based on feedback from learners and increasingly adequate understandings of learners' capacities and changes in those capacities.

Apprenticeships represent an example of instruction as transfer of responsibility. Apprenticeship places learners in a learning environment, usually some environment in the real world, where they observe and engage in joint action with and "do knowing" under the guidance of mentors experienced in areas where learning is desired. Apprentices usually have real responsibilities. How the responsibilities are carried out have real consequences not only for the apprentice but also for the mentor, the establishment, and its clients. Interpersonal exchange and engagement in real-world activities relevant to the area of learning are central aspects of learning. The goals and priorities of the context are part of what is experienced and learned. Giving apprentices easier tasks in the beginning and more guidance from the mentor reflects scaffolding and tailoring of instruction to the learner's level of development. As learning proceeds, this tailoring is reflected in the gradual assignment of more difficult, complex tasks and in the gradual fading of the mentor's involvement in the apprentice's activity.

Other experiences that may have some similar features include internships, field experiences, and practicums. These often differ from apprenticeships, however, in that they come near the end of an educational program and are seen as following and applying learning that has occurred in earlier, more formal phases of a program. Learning and application are assumed to be two different phases in contrast to the transfer of responsibility perspective in which they are seen as intertwined and simultaneous. It is in the doing, the applying, the engagement in activity that learning, even at early stages, occurs. In vocational education, supervised work experience, cooperative education, and

in-school laboratories intended to simulate critical aspects of real-world activities and their contexts are widely used approaches to instruction that reflect a transfer of responsibility perspective. These approaches, in contrast to many internships, field experiences, and practicum experiences, occur simultaneously and in conjunction with rather than only at the end of classroom instruction.

Simulations provide opportunities to immerse learners in experiences that are characteristic of real life. For example, simulations can expose learners to various aspects of experience (e.g., cognitive, affective, and psychomotor aspects) as they occur in real life—simultaneously and interactively. Simulations can also be set up to reflect critical aspects of real-world contexts—for example, the priorities and goals that are represented in and that shape real-life situations. While simulations are thus capable of exposing learners to the complexities of real situations, they can at the same time make tasks easier for learners by reducing risk and providing other scaffolds appropriate to learners' developing capacities.

Projects are sometimes but not always an example of instruction as transfer of responsibility. Projects that involve joint action by teacher and students or among students at different levels of development; that engage learners in exploratory experiences with an environment; and that engage learners in identifying problems, creating and critiquing ways to deal with them, and monitoring themselves exemplify transfer of responsibility. Likewise, laboratory work can potentially exemplify transfer of responsibility if it is not only a matter of following directions so an experiment or product comes out in a prespecified way.

All of the structures within which transfer of responsibility instruction occurs have in common incorporation of features of real-world contexts, learner-directed activity, frequent interaction with a teacher or other mentor who guides and supports the learning process, and tailoring of activity to each learner's level by introducing the appropriate amount of challenge or assistance throughout the learning process. Researchers' observations of vocational programs, and interviews with teachers and students in them, have reflected various aspects of a transfer of responsibility perspective (Copa et al., 1986; Stasz, McArthur, Lewis, & Ramsey, 1990). The following sampling from interviews with teachers in secondary programs across several areas of vocational education is illustrative (Copa et al., 1986):

Graphic arts teacher reflecting *tailoring of activity to individual learners' levels of development*: "If it is a rough printing job, then I will give the job to a kid that has had . . . more experience. I try to gear the job to the level of the student that I'm giving the job to. If the job needs to get out and I know it has to get done, I'll give it to the student that can do it. . . . They can do problem solving and get it going correctly before having to come and get me." (p. 110)

Vocational teacher of an advanced class reflecting *learner responsibility for learning*: "I see my role here is to be very laid back and let them make the choices. These are advanced students, students that have gone through all the basics. So in this fourth and fifth hour, I like to take a secondary role and let them pass or fail on their own. Let them see . . . if it works out, how it works out. Is it satisfactory to their kind of thing? And also let them fail, as well. Indeed, not if it's going to cause harm to anybody else, but I like to take a secondary role and let them make the choices." (p. 113)

Vocational teacher reflecting the infusion of *real-world context* into instruction: "I try to . . . let them become independent, doing their things on their own and letting them see the results of their independence, . . . as well. Be it good or be it bad. But giving them that freedom as if I were an employer and would you get paid for that kind of activity? 'What you've done in the last two hours—would an employer pay you?' And I often ask them those questions at the end of the hour. . . . I try to let them realize that an employer is going to expect productivity." (p. 113)

Agriculture teacher describing a *simulation*: "I've got seniors out here who say, 'Yeah, my grandpa has a farm, and I'm going to take over and farm it.' I say, 'Okay. Let's have the PCA (Production Credit Association) guy come down here and get close to your records. What do you think it will take for next year? We will have you put together an application for PCA.' And out of the eighteen kids in that class, every single one of them was rejected." (p.115)

Business and office education student reflecting *joint action*: "In this class, you feel more like a family. You work together. In other classes, you aren't a family; you get treated like a kid." (p. 122)

Industrial education student reflecting *learning in activity*: "Ya, it's the way you learn. It's that exactly. Here you learn by hands on." (p. 122)

Home economics family life class student reflecting the role of the class in *making particular features more apparent, meanings more evident, and contradictions more perceptible*: "They always say, 'Senior, you're going to graduate, get married, have kids.' Well, I'm going to school and I think that after school my boyfriend and I might get married and so I kind of think this is helping me to look and see. Is he the one I want? Are we going to be able to live together? Is this the right kind of love that we can build a marriage on? That's what I think I'm getting out of it." (pp. 83-84)

Vocational teacher reflecting priority on *helping learners develop broad capacities*: "[The purpose of vocational education is] teaching them some

reasoning skills because they are going to be changing jobs so often it appears that the specific job skill isn't as important as the work ethic, the reasoning skills, the ability to think, and the ability to learn." (p. 51)

Vocational teacher reflecting *transfer of what begins as shared responsibility between teacher and learners to learners*: "Well, when we first started out, it's some book work, but it has changed where now the kids are more responsible for the preparing of the meals and what have you, and the teacher isn't always there saying how to do it, what to do. It's more or less right now the kids are taking over and they're actually managing the food factory. If you really need help, the teacher's there, but you've got to rely on yourself. You have to know what you're doing." (p. 53)

Vocational student describing his computer project that involved *personally meaningful activity*: "On my program, I was making a machinery record file. Everybody else is either making a record for their Christmas cards or birthdays. But I feel this machinery record file is useful not only to me, but maybe if I made enough of other kinds of programs, I could sell a disk. And maybe down the road somebody else will either have use for it or want to buy it. . . . That's tangible and has a use, and it's not just a game." (p. 155)

- *Methods Considered Feasible and Proper for Assessing Progress*: Methods for assessing progress in the transfer of responsibility model of instruction focus on detecting changes in the capacity of learners to assume responsibility for conduct of activity on their own. Since the teacher is often a partner with the learner in joint activity during the learning process, there are opportunities for the teacher to be aware of such changes. Learners are also encouraged to assess and monitor their own development. When learners can do an activity without the scaffolds that have been provided, the capacity has been fully developed and the responsibility for its enactment has been fully transferred to learners. Observation of learners during the learning process and collecting descriptive evidence of what learners can do with and without assistance are primary assessment approaches.

In this view of instruction, assessment is embedded within instruction. Its methods are not different from those used in instruction. For example, like instruction, assessment entails observation of what learners perceive and detect; how they interpret, generate, and elaborate meanings; their ability to organize and integrate knowledge and to connect knowledge and experience; the level of responsibility they are able to assume; and the complexity and difficulty of activities in which they are able to engage. Simulations, teacher-learner interactions, and interviews with learners are sometimes used to provide such observations for assessment purposes. Observations by peers and instructor(s) and self-observations typically occur throughout instruction to enable support of learning. If

recorded, these not only provide a profile that is useful for assessing the status and direction of learners' development over time, but can also contribute to a summative level of assessment.

- *Applications of Cognitive Theory*: The transfer of responsibility view of instruction has traditionally been used in formal education when more complex or less well-understood learning is the goal. Such learning is not suited to algorithmic and knowledge transportation approaches. Because cognitive theory has contributed to understanding of complex cognitive structures and processes, it has modified the transfer of responsibility view of instruction to focus more directly on assumption of responsibility for cognitive activity. "Cognitive apprenticeship" is a term that has been used to reflect this emphasis on transfer of responsibility for the cognitive aspects of activity (Brown, Collins, & Duguid, 1989; Cognition and Technology Group at Vanderbilt, 1990; Collins, Brown, & Newman, 1989; Gott, 1988). Cognitive apprenticeship instruction has been developed in both technical (Gott, 1988; Lajoie & Lesgold, 1989; Lesgold, Lajoie, Bunzo, & Eggan, 1989) and academic areas of learning (Palincsar & Brown, 1989; Schoenfeld, 1989).

Cognitive research has provided a deeper and more explicit understanding of the cognitive structures and processes underlying real-world activities of people (Cooke, 1988; Johnson, 1988b; Lajoie, 1986; Luria, 1976; Rogoff & Lave, 1984; Scribner, 1984; Scribner, 1985; Thomas & Englund, 1989; Vygotsky, 1978, 1981, 1986). In contrast to the algorithmic view of instruction where this understanding is used to develop precise and specific descriptions of cognitive processes and algorithms for teaching them, it is used in the transfer of responsibility perspective to develop learning environments which more adequately support learners' engagement in the cognitive aspects of activities of interest (Brown et al., 1989; Gott, 1988; Johnson, Flesher, Ferej, & Jehng, in press; Lajoie & Lesgold, 1989; Lesgold et al., 1988; Lesgold et al., 1989; Thomas, Anderson, Cooke, & Getahun, 1992; Thomas & Englund 1989, 1990). Applications of cognitive theory in transfer of responsibility instruction emphasize embeddedness of knowledge and learning in a sociocultural context by incorporating social interaction among learners and cooperative group structures as means of supporting learning. The most comprehensive of these applications incorporate physical, conceptual, and social dimensions of the cultural context of interest (e.g., a particular discipline, a particular occupation). This emphasis on cultural context reflects a broader and deeper treatment of context in transfer of responsibility

applications of cognitive theory than the more limited sense of context reflected in knowledge transportation and algorithm-oriented applications of cognitive theory.

Applications of cognitive theory to instruction as transfer of responsibility have produced simulations which reflect the cognitive and contextual aspects of real-world activities. Some simulations have incorporated the computer as the learning environment and as an "other" with whom the learner interacts (Hollan, Hutchins, & Weitzman, 1987; Johnson et al., 1992; Lesgold et al., 1989). Other approaches have emphasized dialectic reasoning by engaging learners in going back and forth between their own interpretations and others' contradictory views or probing questions (Champagne, Klopfer, & Gunstone, 1982; Lochhead, 1985; Paul, 1987; Thomas et al., 1992). Some applications reflect a hybrid of perspectives in which cognitive task analysis (algorithmic orientation) provides a basis for a learning environment design that reflects some transfer of responsibility characteristics.

CRITIQUE OF INSTRUCTIONAL PERSPECTIVES AND IMPLICATIONS FOR VOCATIONAL EDUCATION

This section examines the three instructional perspectives and their cognitive theory-based modifications in relation to societal conditions and educational aims the conditions warrant.

Societal Conditions

The twentieth century is drawing to a close having increased the rate of change and complexity that characterized its onset. While technological development is largely responsible for the increased rate and magnitude of change in the workplace (Goumain, 1989), other factors—including changes in markets, consumer demand, industrial structure, and labor supply—have also contributed (Bailey, 1990). As these changes have occurred, entry-level educational requirements have risen and jobs at all organizational levels have become increasingly demanding both in terms of specialized knowledge and broad understandings and capacities. For example, problem solving, other reasoning capacities, and social skills have become increasingly important in a wide range of job roles

and at varying organizational levels (Allen, 1984; Bailey & Thierry, 1989; Clark, McLoughlin, Rose, & King, 1988). This has occurred as organizations have responded to the challenges of a rapidly changing context by decentralizing decision-making responsibilities. In addition, knowledge needed to accomplish work tasks is so varied and complex that no one person can know it. This has necessitated working in teams, which has made social skills more critical (Allen, 1984; Clark et al., 1988; Morrison & Morrison, 1989; Smith & Stallard, 1984). Similarly, as workplace interactions involving customers and suppliers have become more complex, social skills have become more critical (Bailey, 1990).

Changes in how work is viewed have also been reported (Corson, 1985; Marsick, 1987; Raizen, 1989). These trends include movement away from a hierarchical authority and control systems view to viewing work as under the control of the worker. In addition, a view of work as performance and control of cause-effect actions and as measured by quantifying and criterion-referencing observable behaviors is being replaced by a view of work as intrinsically satisfying, personally meaningful, and a source of learning and development. There is a growing belief that intrinsic motivation in work is enhanced when workers recognize that they are the producers of products or services which enrich or sustain life, when their own purposes and meanings are involved in their work, and when work entails the exercise of judgment and a sense of style and craft. Finally, a compartmentalized view of life in which work, education, and leisure are isolated from each other is being replaced by a view of work as occurring simultaneously with and integral to other aspects of life.

The nature of workplace learning is also changing (Argyris, 1982; Argyris, Putnam, & Smith, 1985; Marsick, 1987; Raizen, 1989). Workplace learning and training systems reflect movement away from viewing people as having deficits which education can fix, from linear and rational problem solving, from formal classroom-based group activity, and from control by those outside the learning system. These views are being replaced by increasing concern for personal identity and development as central in learning; valuing of multiple perspectives as avenues for deepening understanding and contributing to flexibility; emphasis on problem-finding in addition to solution-finding; and emphasis on self-directed learning through apprentice-like observation, involvement in activity, and critical reflection on experience.

These changes are creating diversity that, in turn, is contributing to the growing complexity of the workplace. Complexity increases cognitive demands because it requires attention to large networks of interrelated factors. For example, as the world shrinks to become a community, workers must consider a broadened array of economic, social, and political variables in making decisions. In addition, increased demand for and capacity to provide highly specialized options has led to a broadened array of commodities and services which has increased the complexity of both production and markets (Bailey, 1990; Raizen, 1989).

The family's interaction with markets, both as a consumer of goods and services and as a supplier of labor and capital, links the workplace to the family in an interdependent relationship—and changes in the family are no less dramatic than those in the workplace. For example, previously well-defined familial roles are becoming more ambiguous, family dissolution is at an all time high, and an increasing number of children are growing up under conditions of poverty (Levitan, Belous, & Gallo, 1988). Factors contributing to these changes include shifts in norms and values, shifts in the distribution of wealth in American society, and a changing legal code (Mintz & Kellogg, 1989).

In the past, well-defined roles in the workplace and in families enabled the identification of specific knowledge that people needed in order to function in these contexts as a basis for curriculum and instruction in vocational education. As the nature and structure of the workplace and family have changed, roles have become less well-defined and the specific knowledge and skills people will need for the future have become less predictable. The challenge for educators in such a context is to determine what and how to teach so that what is learned is relevant to an unknown future. Since it is not possible to identify and "cover" the specific knowledge that people will need, learners will need to be able to find their own meanings, to fill in gaps in their knowledge, and to reorganize what they know on their own.

Critique of Instructional Perspectives in Relation to Societal Conditions

While useful for some purposes, the knowledge transportation instructional perspective is of limited help in meeting the challenge of an unpredictable future. Because it focuses on knowledge as extended and reconstructed by disciplinary scholars and then communicated to learners by teachers, it does not acknowledge that in a rapidly changing world with unknown, unpredictable tomorrows, all kinds of people—not only scholars—need to be prepared to reconstruct, elaborate, and extend what they already know (Resnick, 1987). In addition, the focus in this view on knowledge storage and recall is too limited in a world which demands flexible knowledge, complex mental capabilities, confidence, ingenuity, and persistence in figuring things out on one's own. Attempts within this view to teach highly general knowledge that is widely applicable and not quickly outdated have been largely unsuccessful because learners have not transferred it as expected. Applications of cognitive theory that enhance accurate comprehension are important but do not go far enough. Other possibilities offered by cognitive theory that more adequately respond to societal conditions (e.g., constructing one's own meanings, directing one's own learning, sensitivity to sociocultural context) are not realized within this instructional perspective.

Societal conditions of rapid change and growing complexity also pose some difficulties for algorithmic instruction, which has been used successfully for decades to teach specific observable behaviors and mastery of lower-level basic skills and knowledge. The difficulties stem from the requirement in the algorithmic model of instruction that performances of interest be known, that they already exist and can be identified. When situations and problems that will be encountered cannot be identified and understood ahead of time, specific rules or principles for dealing with them cannot be prespecified as the target states to be achieved in learners. In an era of rapid change, by the time a new area of specific performance is identified, there is little time for it to be well-understood and for instructional algorithms that teach it to be developed before the nature of the performance has changed. Even if such instruction could be very rapidly developed, the process of doing so is costly when the useful life span of the instruction is short.

In addition, the algorithmic view of instruction is limited in helping learners develop complex mental capacities. Landa (1974) states that independent activity such as reasoning is neither completely determined nor determined by prescriptions. Problems requiring reasoning are those in which it is impossible to know or foresee all situations and

operations that will be necessary for solving the problem. Many real-world problems have these characteristics. Real-world problems are not described and presented with conditions, needed information, and specified goals. In real-world situations, the bounds of a problem must be defined and prevailing conditions, needed information, and appropriate goals determined with what is often only sketchy information. Because it is impossible to take everything into account beforehand and to foresee everything ahead of time in identifying and solving such problems, it is impossible to precisely and specifically describe the routes to their solution sufficient for algorithmic instruction to be developed. If these characteristics are ignored and such problems are characterized as more predetermined than they are so that instruction can be done in an algorithmic fashion, learners acquire inaccurate and inadequate understandings (Bullough, Goldstein, & Holt, 1984; Korth & Cornbleth, 1982; Wasserman, 1989). The hybrid simulations mentioned earlier that are based on cognitive task analysis of highly complex thinking processes used in real-world technical occupations but that use a more open-ended transfer of responsibility approach in teaching rather than an algorithmic one are a response to these issues.

Because the transfer of responsibility perspective supports learners' self-directed learning, is not dependent on highly specific description and prescription, and assists learners with complexity without oversimplifying it, this perspective appears to be feasible in and well-suited to an unpredictable, complex societal context. Because the transfer of responsibility view of instruction gives learners opportunities to identify problems, construct relevant knowledge, create solutions, and make choices, it helps them form complex problem-solving processes. Cognitive theory contributes deeper and more adequate understandings of these mental processes so that more relevant learning environments can be developed than has been possible in the past. In addition, because the transfer of responsibility view of instruction engages learners in joint action with peers and teachers, it provides opportunities to develop social capacities that are relevant to working with others.

Educational Aims

Purposes of education have historically reflected economic, social, and political aims as well as educational ones. In vocational education, some purposes have been identified as preparation for employment, work, occupations, and jobs (Advisory Council on Vocational Education, 1968; Snedden in Copa et al., 1985; Prosser in Copa et al., 1985; Raizen, 1989), while other purposes have focused on personal development of the individual (Silberman & Dewey in Copa et al., 1985). Still other purposes have focused on manpower development, human capital development, and other kinds of economic development at a societal level (Beck, 1986; Copa et al., 1985; Grubb & Lazerson in Copa et al., 1985; Violas in Copa et al., 1985; Raizen, 1989).

These purposes of vocational education reflect contrasting views of educational aims which have their roots in the history of educational thought. The Greeks saw education as preparing people for their most appropriate, best-fitting role in serving society's needs as a way of achieving a just and harmonious, well-balanced, well-ordered, and smoothly functioning society (Walker & Soltis, 1986). The idea that education should serve individuals, have as its aim individual development, and encourage learners to construct their own view of the world based on their own experience rather than adopt a culturally prescribed view was introduced in Europe approximately two thousand years later.

These two views of educational aims might be characterized as socialization on the one hand and individual and cultural development on the other. Socialization involves adoption of meanings that are shared by members of a culture, meanings that reflect the culture's view of the world and that are seen within the culture as correct, right, appropriate, and best (Bullough et al., 1984). Education based on socialization aims predetermines the meanings that learners will acquire and develops skills that have value within the current culture. This kind of education carries with it the assumption that society remains the same and seeks to reproduce the present culture by preparing learners for living effectively in it as it presently is (Bourdieu & Passeron, 1977; Brim, 1966; Hamilton, 1990). In contrast, individual and cultural development aims of education are focused on cultural change rather than cultural reproduction. Education based on individual and cultural development aims seeks to create opportunities for individuals to develop as unique persons rather than in prescribed ways. A society of such individuals is seen as benefiting

from the rich array of talents and capacities of its members and as being changed by their working together to improve it (Dewey, 1966).

These two major orientations toward educational aims influence educational practice. Each suggests different kinds of educational means, differing views of instruction. On the one hand, the best, the right, the wise, the most appropriate, *the* answer will be taught. Curriculum and instruction will be set up to enable students to learn and reproduce *the* answer. The other view will lead to an intentional search by both teachers and students for a variety of ways of thinking, doing, and acting in a variety of problem situations with numerous possible answers to questions and solutions to problems.

While there are tensions between socialization and individual and cultural development schools of thought, there is also the sense that both are necessary and that a combination of them in some way is both possible and desirable:

> Schools are agencies of evaluation and selection, not only in terms of admission and grading, but also because society expects them to instill in the minds of the young criteria or values by virtue of which they can decide which environmental influences to accept or reject. Education is partly a process of adjusting [socialization], for society does not want maladjusted adults. But education that is nothing more than a process of adjusting is education for slaves, because only a slave has to accept without the responsibility of choosing. (Ulich, 1965, p. 9)

John Dewey (1966) attempted to combine both views in his educational philosophy. He saw the aim of education as attaining a just, democratic society made up of free individuals and believed that freely developing individuals had to learn from their own experiences. Dewey viewed democracy as both a form of government and a way that people live and work together in which freedom of interaction among groups and the widest possible sharing of experiences, interests, and values is encouraged and facilitated. Democracy provides a supportive and nurturing social environment in which individuals can grow and develop. Society should not simply be maintained and reproduced but should progress in its realization of these ideals. Dewey viewed the school as an embryonic social community which encourages students to cooperate, learn from each other as well as from teachers, and create and participate in the social-cultural context rather than simply adopt it.

What educational aims are relevant in a rapidly changing, increasingly complex societal context and to an unpredictable future? The societal conditions discussed earlier call into question the idea that society remains the same. Shifts in the nature and meanings of work, in workplace learning, and in family structures and roles reflect cultural changes that are rapid, dramatic, and far-reaching and that promise to continue. Socialization for a culture as it currently exists as the sole or primary aim of education, including vocational education, is questionable in such a context for several reasons: (1) Socialization requires knowledge of specific roles and contexts for which people are being socialized. In an era of rapid change, roles and contexts change too fast for this knowledge to be immediately available and specifiable. (2) Education that socializes individuals to assume specific roles that have a short life span rapidly becomes irrelevant and neither individuals nor the society are well-served. (3) Socialization aims do not adequately reflect democratic ideals that American society espouses.

American experience with schooling for the masses has suggested that education that serves societal interests without attention to individual interests, personal meanings, or hopes for the future is likely to engender little personal investment and to be ultimately unsuccessful. According to a cognitive theory view of learning which suggests that learners construct their own understandings based on their prior knowledge and experience and on what is personally meaningful, it should be no surprise that education as socialization for a mass culture that considers too little the diversity of individuals and subcultures has tended to be seen as irrelevant by large segments of learners. Such education has also been criticized for contributing to perpetuating rather than to righting social, economic, and political inequities (Oakes, 1986a).

Historically, socialization aims have been prominent in education (Wirth, 1980). Criticisms of education for lack of emphasis on helping citizens, the workforce, and families to affect and deal with changing conditions have increased in recent years (Carnoy & Levin, 1985; Committee for Economic Development, 1985; National Commission on Excellence in Education, 1983; Raizen, 1989; Resnick, 1987; Sherman, 1983; Wirt, 1988; Wirt, Muraskin, Meyer, & Goodwin, 1989). Such criticisms are likely to continue as long as rapid societal change prevails. Bruner (1966) encapsulates the consequences of socialization as a prevailing educational aim as follows: "Children, like adults, need reassurance that it is all right to entertain and express highly subjective ideas, to treat a task

as a problem where you invent an answer rather than finding one out there in the book or on the blackboard" (p. 158).

In considering individual and cultural development as educational aims whose time to play a more significant role in the character of American education may have come, it is important to remember that while development entails change, not all change constitutes development. As Ulich (1965) and Dewey (1963) suggest, the answer does not lie in ignoring present culture in determining educational aims and curriculum and instruction but rather in seeking to go beyond it by becoming aware of its limitations.

Scholars have contended that there is a need and a responsibility in all subjects to provide opportunities for students to question, to create and invent, to know themselves and what they think and why they think it because each subject involves seeing differently (Eisner, 1987; Ulich, 1965). Echoing Deweyan perspectives, Oakes (1986b) contends that because the adult world is a heterogeneous community, living and working in it require working productively and respectfully with the diverse array of others who share that community. Accordingly, instruction for vocational education should emphasize learning processes and values that are consistent with work skills that are valued and life sustaining in such a world: cooperation, team problem finding and problem solving, communication, decision making, commitment, confidence in abilities, and boldness in developing ideas and approaches. According to Oakes, "Learning activities should be presented as real-life problems: full of ambiguity, bound to specific circumstances and constraints, dependent on formal knowledge and creative 'figuring out,' and with important consequences" (p. 69).

Critique of Instructional Perspectives in Relation to Educational Aims

The three instructional perspectives differ in the educational aims they reflect. The emphasis in the knowledge transportation instructional perspective on passive reception and reproduction by learners of culturally valued knowledge reflects socialization as an aim. In the same vein, the focus on culturally valued performances that conform to specified standards in algorithmic instruction also reflects socialization as an aim. Instruction in both perspectives is controlled by cultural authorities. The learner's role is to learn knowledge and complete activities prescribed by someone else whether or not they are personally meaningful.

The controls embedded in algorithmic instruction have been criticized on grounds that while they may achieve prescribed learning, they may also limit other learning. For example, imposing a particular schema or strategy when equally feasible alternatives exist calls attention to only one possibility and may deter learners from noticing other possible, equally valuable meanings and from generating their own ideas (Korth & Cornbleth, 1982; Wasserman, 1989). A closely related concern is that although algorithmic instruction accommodates individual variation in speed and level of learning, it also potentially limits development of learners' unique capacities by applying the same general teaching and learning approach to all learners at a given level and to all topics and by seeking the same performance characteristics for all learners in a category (Bruner, 1979; Bullough et al., 1984; Eisner, 1982, 1987).

Finally, Richard Paul (1984, 1987) raises a different concern but one related to that already outlined concerning the danger of oversimplification in using algorithmic instruction to teach complex processes and concepts. According to Paul, using cognitive research to conceptualize critical thinking as a series of components or steps in which its important dispositional aspects (e.g., commitment to considering and understanding plausible perspectives that are less well-understood and that differ from or contradict one's own) are ignored makes critical thinking a process for learners to conform to. Such a practice does not acknowledge the multiple perspectives that characterize and need to be considered in a democratic society and in reasoning concerning real-life problems.

In the transfer of responsibility perspective, while the current society and current ways of doing things are not ignored, neither are they assumed to be a model of what should be. The transfer of responsibility perspective incorporates the present in ways that help learners extract deep, full, varied, and personal meanings from it that are potentially relevant to an unknown future. Rather than simply using the present as a pattern to follow, contexts and activities that have meaning in the current culture (and to learners) serve as vehicles for developing general capacities that remain relevant when those particular contexts and activities no longer exist. The present culture is thus a means rather than an end of learning, and the need for members of a society to learn values and norms significant in their culture as well as the needs of individuals to find their own meanings and act on them are addressed. The opportunities that the transfer of responsibility perspective provides for learners to direct their own learning, to explore and examine diverse ideas—including their own thoughts—and to work together in identifying and

solving meaningful, real-life problems, reflect individual and cultural development aims. This perspective is consistent with the kind of education described by Dewey and Oakes as appropriate in a democratic society.

CONCLUSIONS

Based on the preceding analyses of the instructional perspectives, societal conditions, and educational aims, four interrelated conclusions are drawn:

1. *Instructional perspectives influence how cognitive theory is applied.*
   As illustrated in this document, application of cognitive theory has reflected well-established modes of instruction. Depending on the instructional perspective reflected, cognitive theory has been used to serve socialization aims as well as individual and cultural development aims. That is, some applications of cognitive theory have had as a primary aim improvement in student learning of knowledge and skills associated with specific roles reflected in the present culture, while other applications have emphasized helping students become independent, self-directed learners and thinkers. Some applications of cognitive theory have simultaneously addressed all of these aims because the instructional perspective within which they have occurred has encompassed a multiplicity of educational aims.

   Reading comprehension, memory, and recall of information encoded from reading text or listening to lectures are major emphases in cognitive theory applications influenced by a knowledge transportation perspective of instruction. These cognitive theory applications have attempted to make construction by students of an author's or teacher's intended meaning easier by adjusting the communication. Cognitive skills and their interaction with knowledge are a primary interest in cognitive theory applications influenced by an algorithmic perspective of instruction. These applications seek to better understand the nature of cognitive skills and what produces change in them so that algorithms can be developed for teaching them. Applications of cognitive theory that reflect a transfer of responsibility perspective incorporate cognitive and other features of real-world contexts, learner-directed activity and thinking, frequent interaction with a teacher or other mentor who guides and supports the learning process, and tailoring of

activity to each learner's level by introducing the appropriate amount of challenge or assistance throughout the learning process.

2. *The potential of cognitive theory is most fully realized within the transfer of responsibility instructional perspective.*

The three instructional perspectives are not equal with respect to their compatibility with cognitive theory assumptions. Assumptions underlying the knowledge transportation perspective are least compatible with those of cognitive theory. Nevertheless, some applications of cognitive theory reflect this perspective. The assumption that knowledge is constructed by learners is reflected to some extent in cognitive theory applications influenced by this perspective. Cognitive theory applications influenced by an algorithm perspective go further in reflecting cognitive theory assumptions. Considerable attention is paid to the nature of learners' prior understanding, and a richer variety of means are incorporated to help learners construct prescribed meanings. Assumptions underlying the transfer of responsibility perspective are the most fully compatible with those of cognitive theory. This is because this perspective gives learners roles that enable them to direct their own learning; it allows for construction by learners of what are truly their own meanings; and it interprets context comprehensively as having a cultural level and as having social as well as physical and conceptual aspects. Because cognitive theory addresses itself to more complex kinds of knowledge, learning, and thinking, it reaches its full potential when applied within an instructional perspective—like the transfer of responsibility perspective, which also focuses on these.

3. *The transfer of responsibility perspective provides an overarching instructional framework that addresses needs implied by societal conditions and educational aims they warrant and within which other instructional perspectives can play a part and multiple educational aims can be addressed.*

It has been argued that the transfer of responsibility perspective is more responsive to societal conditions and educational aims deemed appropriate in such conditions and in a democratic society than is either the knowledge transportation or the algorithmic perspective of instruction. The transfer of responsibility view helps learners gain general capacities that relate to larger classes of activity, gives greater attention to the individual and cultural development of educational aims, and casts

learners in more powerful and varied roles that enable them to further their own development. The transfer of responsibility instructional view helps learners develop a sense of knowledge as possibilities rather than as an exhaustive set of givens and as reconstructible to fit their own real-life problems and situations. Learning resulting from transfer of responsibility instruction is at a deep, personally meaningful level connected to life outside the classroom and seen by the learner as something he or she had a primary role in accomplishing.

Because of its responsiveness to societal conditions, and the relevance of its assumptions for a democratic society, transfer of responsibility instruction is broadly applicable throughout education in a wide range of vocational and academic subjects and across all educational levels. Its use of scaffolding that enables learners to do more than their present capacities allow and its principles of tailoring instruction to the individual learner and grouping students at different stages of learning together (assigning them different tasks that all fit together into the same whole) makes it highly relevant to simultaneously teaching students of many different ability levels.

As an overarching instructional framework, the transfer of responsibility instructional perspective allows incorporation of other instructional perspectives and a multiplicity of educational aims. Instruction as transfer of responsibility is focused on culturally and personally meaningful real-world activities. Multiple educational aims are addressed because the use of activities that are meaningful within the current culture as vehicles for learning enhances learners' understanding of their culture. Activities are chosen for the contextualized knowledge and skills they entail and for the opportunities they provide learners to take on roles and responsibilities that help them develop more general capacities. Because activities require knowledge and skills, these need to be learned and developed. Here the knowledge transportation and algorithmic instructional perspectives might play a role. For example, learners might conduct interviews or read various sources to find out what is known in an area as a starting place for their own deliberations and discoveries. Algorithmic instruction might be the best way to learn to operate a tool or machine or to perform a calculation that creation of a new product design or pursuit of an hypothesis requires. These modes of instruction might also be used by learners after they have developed their own ideas and methods to learn about

alternative ideas and methods that provide a base of comparison for evaluating their own. In addition, algorithmic instruction may be needed for initial involvement by learners in aspects of activities that involve risk of injury and in which the cost of errors is high. Knowledge transportation may be needed to make explicit critical information that is difficult to discover on one's own because it is inaccessible to sensory detection. In addition, some learners seem to be better supported when both experiential learning and direct, explicit teaching are used (Resnick, 1976).

Because the transfer of responsibility perspective places a larger realm—a meaningful context—around specific knowledge and skills that gives them meaning and shares control of the learning process with students, selective use of the other perspectives within the transfer of responsibility perspective reduces their limitations. Used within the transfer of responsibility perspective as accompaniments, the knowledge transportation and algorithmic instructional perspectives are more likely to serve an ultimate end of enhancing learners' capacities to exercise their own judgment and their own sense of style and craft and to direct their own learning than if these perspectives are the primary approaches to instruction.

4. *Cognitive theory can help vocational educators clarify and strengthen their transfer of responsibility orientation to instruction, and its language can help them communicate among themselves and with other educators regarding this kind of teaching.*

Transfer of responsibility instruction is already established in vocational education: Since its inception, vocational education has been sensitive to the importance of context-embedded knowledge. Vocational educators have actively sought and developed ways of connecting school-based learning and real-world contexts, of developing what has been more recently been called bridging apprenticeships (Resnick, 1987). Supervised work experience, cooperative education, and in-school laboratories intended to simulate critical aspects of real-world activities and their contexts are approaches that have been widely used within vocational education to connect theory and practice. They are documented in the vocational education research literature (Copa et al., 1986; Stasz et al., 1990).

While vocational educators already have a long-standing commitment to aspects of a transfer of responsibility perspective, some of them may also have concerns about using this perspective in the overarching way proposed here. Those concerns are likely to center around content coverage, what will happen to specific skills, and how students who experience transfer of responsibility instruction will be received by employers. Because the emphasis in the transfer of responsibility perspective is not on the teacher's explicitly providing a large amount of content, sometimes it is felt that this view "covers" less content than other views. It is true that transfer of responsibility instruction does not emphasize lectures which "give" a lot of content to students in a short time. On the other hand, because of the broad nature of activities entailed in this view, students are involved in learning a wide range of knowledge and skills. Because of this, both the amount and the range of knowledge and skill students learn can be greater than that learned within other instructional perspectives.

Concerns regarding specific skills are likely to emanate from a perception that specific skills will not be learned and that students will not be employable. Rather than ignoring them, the transfer of responsibility perspective places a larger realm around specific skills that gives them purpose and meaning. Because the student's own interests are involved, the purpose and meaning of a skill is clear to learners in their own terms. As a result, students may be motivated to develop their skills further than would otherwise be the case. Regarding concerns about employability, a recent publication pointed to seven areas of learning that employers have identified as important to them: Learning to learn; the three Rs; communication; creative thinking and problem solving; motivation and self-esteem; personal and career development; and interpersonal competence in teamwork, negotiation, and leadership (Carnevale, Gainer, & Meltzner, 1988). These areas are strikingly consistent with the kinds of capacities emphasized in the transfer of responsibility perspective.

RECOMMENDATIONS

The following recommendations for educators, researchers, and policymakers are based on the conclusions summarized in the preceding section:

- Develop a better awareness and understanding of how the transfer of responsibility instructional perspective is expressed in educational programs through case-focused research. Such research, involving in-depth observation of teaching-learning processes and interviews with teachers and students, is reflected in studies by Copa et al. (1986), Stasz et al. (1990), and Dinham (1989). Extend awareness among the general public, educators in all fields, researchers, and policymakers of how transfer of responsibility instruction provides bridges between school and life. One approach that might be used in this process is to identify educational programs that can serve as models of transfer of responsibility instruction. Encourage and support accessibility of these programs for observation by other educators, researchers, and policymakers. Encourage and support teachers in these programs in communicating their experience in and understanding of this kind of teaching to other teachers.

- Experiment with transfer of responsibility as an overarching instructional perspective in creating new curricular organizations and structures that help learners connect and integrate their learning. For example, experiment with transfer of responsibility as an overarching instructional perspective in efforts to integrate vocational and academic education.

- Examine cognitive theory for potential contributions it can make to strengthening and further developing transfer of responsibility as an overarching instructional perspective. Use relevant cognitive theory in developing transfer of responsibility learning environments and study these environments for their impact on student learning and development. Studies by Johnson et al. (1992) and by Thomas et al. (1992) provide examples of this kind of research—of cognitive theory-based transfer of responsibility learning environments and their development using cognitive theory—and document significant impact of these environments on learning.

- Examine teacher education programs for the extent to which preservice teachers are exposed to a transfer of responsibility perspective of instruction. Model and teach in such programs approaches to curriculum, instruction, and assessment that support teaching from this perspective and extend these efforts to inservice staff development programs for current teachers.

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