Learning from Programmed Instruction: Examining Implications for Modern Instructional Technology

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This article reports a theoretical examination of several parallels between contemporary instructional technology (as manifest in one of its most current manifestations, online learning) and one of its direct predecessors, programmed instruction. We place particular focus on the underlying assumptions of the two movements. Our analysis suggests that four assumptions that contributed to the historical demise of programmed instruction—(a) ontological determinism, (b) materialism, (c) social efficiency, and (d) technological determinism—also underlie contemporary instructional technology theory and practice and threaten its long-term viability as an educational resource. Based on this examination, we offer several recommendations for practicing instructional technologists and make a call for innovative assumptions and theories not widely visible in the field of instructional technology.

☐ Theorists have recently called for a critical examination of the foundations of instructional technology, including philosophical assumptions not typically acknowledged or scrutinized (e.g., Koetting, 1996; Spector, 2001). Examining assumptions is important, as these theorists have argued, because they heavily influence the manner in which instructional problems and solutions are conceptualized. This article is an attempt to shed light on some of the foundations of contemporary instructional technology by examining parallels between one of its most current manifestations, online learning, and one of its direct precursors, programmed instruction. As our analysis will suggest, several historical assumptions that contributed to the demise of programmed instruction can also be seen in the theory and applications of contemporary instructional technology as expressed in online learning. Based on this analysis, we offer several recommendations for practicing instructional technologists, and argue that an adequate foundation for the field requires innovative assumptions and theories not widely visible in education and psychology.

HISTORICAL DEVELOPMENT OF PROGRAMMED INSTRUCTION

Early Efforts

Although efforts at automating instruction date back to the early 19th century (Mellan, 1936/1960), the work of Sidney Pressey (1927/1960a) has been widely credited as the

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first formal attempt at what became known as programmed instruction (Lumsdaine, 1960). Pressey (1927/1960a, p. 42) sought to free teachers "of much of [their] burdensome routine so that [they] could do more real teaching." His solution was to automate some teaching tasks by developing a device that administered and scored tests. Pressey also included a feature that he thought changed his device from an automatic *testing* machine to an automatic *teaching* machine. A small switch could be set so that the device would not move from the current question until the student answered correctly. When explaining how his machine taught as well as tested, Pressey suggested a number of themes that would resurface in later programmed instruction, including immediate feedback and efficient learning with little teacher intervention. Although convinced of the importance of his work, Pressey ended his research in 1932 because of a lack of acceptance by educators and others, as well as the economic effects of the Great Depression (Pressey, 1932/1960b). During the next 20 years, he and others tried to revive his early work (Pressey, 1950/1960c; Stephens, 1953/1960), while other researchers made similar investigations independently (Burton, Moore, & Magliaro, 1996; Dale, 1967). But despite their best efforts to promote their innovations, no substantive programmed instruction movement materialized.

The Contribution of B. F. Skinner

Educators in the early 1950s became concerned with the mounting pressure on an already overtaxed educational system. For example, there was a growing dissatisfaction with the progressive educational movement (Dewey, 1916), which had gained the reputation of sacrificing educational rigor in an attempt to make education less authoritarian and controlling (Schramm, 1962). The public worried that their children were not being prepared to become world leaders in technology and science (Casas, 1997). Other commentators thought that the infrastructure and human resources of the educational system could not cope with the growing population (e.g., Stolurow, 1961) and that the traditional educational establishment had never served some people well, which contradicted the American ideal of providing high-quality education to all people (Hines, 1965). Finally, institutions such as the military saw the need to train large numbers of people in a short period of time (Osguthorpe & Zhou, 1989).

One person who attempted to remedy these problems was B. F. Skinner, who had pioneered the principles of operant conditioning in the training of animals. *Operant conditioning,* as Skinner (1986) described it, was a method of conditioning that reinforced an organism's spontaneous, natural behavior when it approximated a desired terminal behavior. With continued conditioning the organism would eventually display the desired behavior consistently. Skinner became convinced that operant conditioning could be as effective when teaching human beings as it had been in the training of animals (Skinner, 1968). As Skinner observed teachers using ineffective methods of class management and failing to provide rapid feedback to students, however, he concluded that the traditional classroom actively worked against the principles of operant conditioning. Moreover, he observed that teachers presented large quantities of material at once, expecting students to make unreasonably large behavior changes at one time (Skinner, 1968). Also problematic to Skinner was the fact that too often learning goals were not carefully explicated in specific terminal behaviors (Skinner, 1965).

Skinner's solution to these problems was the teaching machine (1954/1960). He described how a mechanical device could apply the principles of operant conditioning so that reinforcement was immediate, able to occupy a student for a specified period of learning, and able to lead students to near perfect performances. These principles of conditioning, embodied in a machine technology, provided the scientific basis of programmed instruction. Despite the misunderstandings and controversy that would emerge over both his theory and how it was put into practice, for the rest of his career Skinner believed that these methods of instruction could solve the country's most serious educational problems (Skinner, 1986).

Other researchers (e.g., Gagné, 1965; Markle, 1969; Stolurow, 1961) contributed to the development of programmed instruction as the field stimulated a discernable movement in American education. Early research on the effectiveness of programmed instruction was very encouraging to its promoters. One researcher reviewed more than 150 studies and concluded that there was "no doubt" that students learned from programmed instruction (Schramm, 1964a, p. 3). In nearly all of the studies reviewed by Schramm, students using programmed instruction performed as well as or better than students using other methods. With this initial success, educators and developers began to produce programmed instructional materials at a high rate (Holland, 1962).

THE ASSUMPTIONS OF PROGRAMMED INSTRUCTION

The early success of programmed instruction seemed to suggest that machine technology and behaviorist principles were an effective combination. Although programmed instruction eventually declined as a substantive movement in American education, it provided much of the groundwork for contemporary instructional technology (e.g., Jonassen, 1991). What were the assumptions underlying this early instructional technology that produced such promising initial results?

We begin our examination of this movement with its behaviorist underpinnings. Behaviorism is perhaps best known for Watson's statement: "Psychology, as the behaviorist views it, is a purely objective, experimental branch of natural science which needs introspection as little as do the sciences of chemistry and physics. It is granted that the behavior of animals can be investigated without appeal to consciousness" (1913, p. 176). Although Skinner's later and more influential form of behaviorism differed from Watson's in important respects, their programs were based on similar assumptions at the basic levels of *ontology* and *epistemology*. As areas of philosophical discourse, ontology refers to the collection of entities and processes assumed to actually exist, and epistemology refers to the nature of knowledge—what it is, how it is attained, how people know when they have it, and so on. Within the scope of ontology, the behaviorist underpinnings of programmed instruction invoked two basic assumptions. The first assumption, *ontological determinism,* held that human and animal behavior is governed by natural laws, and thus there is no such thing as free will or volition in human behavior. The second ontological assumption, *materialism,* held that reality is composed only of physical matter; thus concepts such as mind and memory could be viewed only as empty abstractions. Within the scope of epistemology, the behaviorist underpinnings of programmed instruction invoked a basic position known as *empiricism,* which held that there are not innate mental precepts or ideas and that knowledge or behavioral repertoires are gradually constructed through sensory experience of physical matter. These two categories of assumption—ontological and epistemological—formed the basic foundation on which the more explicit aspects of behaviorism and programmed instruction rested. The following discussion clarifies how these assumptions informed programmed instruction.

Ontological Determinism

The assumption of ontological determinism was evident in the writings of early programmed instruction theorists. For example, Skinner stated plainly that teaching machines were "a technology based on a deterministic science of human behavior" (1968, p. 170; see also Delprato & Midgely, 1992). Markle stated that "the student learns only what he has been led to do" (1969, p. 6). And Post wrote:

> The most important long-run contribution of [programmed instruction] . . . will probably turn out to be the assumption that learning is the responsibility of the materials, that the author can, to a great extent, control and engineer quality and quantity of learning and is, by extension, accountable for the results. (1972, p. 14)

These quotes should not surprise students of the history of psychology. The general philosophical and scientific tenor of the era was dominated by a sort of positivism and mechanism that viewed all human phenomena as the necessary effect of natural laws (see, e.g., Polkinghorne, 1983). Although educators using such programmed instruction may not have endorsed, or been aware of, the assumption of determinism, the machines used were based on it and thus so was the instruction when left unmodified.

Ontological determinism manifested in programmed instruction as programmers gave students little if any responsibility for learning. Programmers thought that because learning was a technical activity, students could not learn without the influence of some external, determining force such as a programmer's instruction. Of course, if the assumption of determinism is true, then the programmer could be no more responsible for his performance (qua determined teacher) than was the student (qua determined learner). Indeed, as theorists have argued, the very idea of responsibility under such determinism becomes meaningless (e.g., Slife, Yanchar, & Williams, 1999). Nonetheless, the belief that student learning and behavior could be determined by well-developed programmed instruction was a major guiding principle of the movement.

Materialism

Because the assumption of materialism logically implies empiricism (and vice versa; see Robinson, 1985), we will consider these two assumptions together, focusing primarily on materialism. Proponents of behaviorism and programmed instruction tended to accept the position that there was no more to knowledge and learning than physical events such as observable behaviors (Delprato & Midgely, 1992; Glaser, 1964). Others tempered this extreme position by stating that even if there were other factors involved in knowledge (such as a mind), they could not be studied and were fundamentally unimportant to an understanding of learning (Driscoll, 2000). In both cases, scientific and practical validity were granted only to a material reality (see, e.g., Mechner, 1967; Skinner, 1960) and only observable behavior changes counted as evidence of learning (Glaser). Materialism appeared in the language of researchers who translated human phenomena such as creativity, complex problem solving, ethics, thinking, motivation, and self-control into explicitly behavioral terms (e.g., Schramm, 1964a; Skinner, 1959, 1968). For example, in this language children unable to read were children who had not received the right reinforcement, or the proper initiating stimulus events, to shape the next appropriate reading behavior.

Social Efficiency

Programmed instruction was also informed by assumptions only indirectly associated with behaviorism such as *social efficiency* and *technological determinism.* Social efficiency, which suggested that it was imperative for schools to eliminate all unnecessary costs (De Vaney & Butler, 1996), became a sort of educational efficiency. Supporters of educational reform turned to the developing field of scientific management to find methods of improving such efficiency (Niemiec & Walberg, 1989), which became another variable to be controlled in the process of education (Lumsdaine, 1965). The importance of this goal to programmed instruction cannot be overstated. The founders of programmed instruction were convinced that in order to succeed they must find ways to teach more in less time (e.g., Dale, 1967; Skinner, 1968).

The assumptions of social efficiency and ontological determinism, taken together, informed the processes used by programmers to create instructional materials. These processes specified how programmers should translate the general principles of operant conditioning into standardized rules that would produce consistent results. Every input and output had to be defined as precisely as possible (Green, 1967). The process of programming then became a simple matter of putting all the determining factors (e.g., learning materials, questions, feedback) together in the right way (Schramm, 1964b). Programmers believed that an effective instructional product was the sum of its constituent parts, and that if all of the factors were presented in the correct order, students would succeed (Lysaught & Williams, 1963).

Technological Determinism

The assumption of technological determinism, which holds that technology is the most important force in creating social change (Misa, 2003), also heavily influenced the development of programmed instruction. As with social efficiency, the importance of machines to the history of programmed instruction cannot be overstated. As one technologist said "[some people think] that machines are merely aids to teaching. . . . Our thesis is quite the opposite. These machines, when they work, are a theory of teaching" (Galanter, 1959, p. 1). Although some theorists advocated the pre-eminence of learning techniques over the media used (Plattor, 1965; Schramm, 1964b), others thought that separating the machine from the instructional method narrowed the possibilities of what programmed instruction could accomplish (Gotkin & McSweeney, 1967). According to one researcher, programmed instruction had the "ability to *guarantee high achievement*" in students (Padwa, 1962/1964, p. 273, emphasis in original). The power inherent in teaching machines and programmed instruction, as they viewed it, prompted some advocates to claim that, "even a bad program is a pretty good teacher" (Schramm, 1962, pp. 11–12).

THE DECLINE OF PROGRAMMED INSTRUCTION

During the 1960s, critics attacked the methods of programmed instruction for a variety of reasons (Saettler, 1990). As the decade progressed, fewer studies demonstrated the superiority of programmed instruction over other methods. More damaging were studies demonstrating that the principles of operant conditioning were not as important to student success as originally thought (e.g., Kulik, 1982; Lublin, 1965), as well as studies that favored traditional methods over programmed instruction (Kulik, Cohen, & Ebeling, 1980). Research in real educational settings suggested that the success or failure of programmed instruction depended also on the teacher's attitude toward the materials (Casas, 1997). This created a problem since many teachers felt threatened that programmed instruction was, in a sense, competing for their jobs (Heinich, 1995; Nordberg, 1965). Although programmers claimed that they wanted to free teachers to perform more meaningful tasks (e.g., Fry, 1963; Skinner, 1968), this message seemed to get lost in the rhetoric of the instructional inadequacies of the teacher. Additionally, some students experienced frustration when they could not keep up the same instructional pace as their peers. For these children, the pressure to succeed became a hindrance to learning (Casas, 1997).

It was also apparent during this time that programmed instruction was rigid and resistant to adaptation. This rigidity was a result of several historical factors, including the assumptions of efficiency and ontological determinism. The standardized content of programmed instruction, and the teaching machines themselves, were expensive and time consuming to create. To recover their investment, any organization that adopted programmed instruction felt pressure to use the material unaltered for as long as possible (Nordberg, 1965), and any change in content threatened to make the package obsolete (Saettler, 1990). Programmers encouraged this view by claiming that behavioral technology, which was thought to enable the prediction and control of learning based on the assumption of ontological determinism, would provide the optimal way to teach a given subject matter (Klaus, 1961/1964). Program alteration would thus be rarely required.

However, these standardized packages could attempt to handle only situations predicted in advance (Stolurow, 1961), and thus failed to accommodate unique problems and student needs. Researchers discovered that some of the most successful implementations occurred when teachers used programmed instruction in conjunction with other teaching methods, modified the materials, or switched to another method of instruction as needed. Many schools that rigidly implemented programmed instruction experienced problems because the materials could not be tailored to meet student needs (Edling et al., 1964). In this sense, programmed instruction was most effective when its principles and procedures were adapted by the teachers actually using it.

The assumptions of materialism and technological determinism also created difficulty as programmers attempted to define all instructional problems in terms of observable behaviors trainable via a machine technology. If programmers wanted to teach a topic that did not entail a set of observable terminal behaviors, they redefined it into something that did (Gagné, 1965). In this sense, the nature of the subject matter to be taught was itself brought into conformity with the programmed instruction technology available. In redefining the topic, programmers often altered its original meaning into something trite, and tended to constrain student learning (Tanner, 1957/1964). Prepackaged sources of information and conditioning often failed to foster intrinsic motivation and genuine exploration (Garner, 1966). Moreover, the reduction of complex activities to a list of simple behaviors prevented teachers and students from exploring subject matter in ways that may have been more suitable to the particular needs of that group (MacDonald-Ross, 1973). And as programmers reduced complex learning activities to sets of behavioral responses, they had a tendency to be more concerned with the outward form of their materials than with the learning outcomes (Markle, 1967), often gearing material "to the lowest common denominator" (Garner, p. 11). Little consideration was typically given to whether or not students actually needed instruction to learn this type of material.

Perhaps the best example of the oversimplification of learning has come to be known as *overprompting,* which occurred when programmers attempted to increase student motivation by ensuring that students were successful as often as possible. The need for overprompting follows logically from the behaviorist assumption that student learning is determined by operant conditioning or similar principles harnessed by a programmer. From this perspective, the obvious solution to learning problems would be to provide more effective shaping of the desired behaviors—that is, to provide more structure in learning by reinforcing smaller changes in behavior that progressively approximated the target behavior. This meant that learning would occur in small increments with ample rewards, typically producing a correct answer to every question. However, despite Skinner's claim that a correct answer was enough to keep a student engaged (1954/1960), later research has found that such overprompting often led students to pay less attention to the instruction, realizing that the program would compensate for them (Holliday, 1983). Overprompting also resulted in students who were bored and unmotivated. While some students reported that they enjoyed completing programmed materials, most of the historical record indicates that students quickly tired of, and eventually came to dislike, programmed instruction (e.g., Casas, 1997; Post, 1972; Saettler, 1990).

LEARNING FROM PROGRAMMED INSTRUCTION

Against this historical backdrop observers can see an early form of many of the more recent advancements in instructional technology. By using the computer technology developed since the 1960s, developers of instructional materials could, if they so desired, reproduce many, if not all, of the critical features of the teaching machine. Indeed, Skinner himself hoped that computer technology would be used in this way (1986). Furthermore, at least some surface features of contemporary instructional technology, such as computer-based instruction, interactive video technologies, and online learning bear a resemblance to much of the programmed instructional materials developed 40 years ago. The field has undergone several theoretical shifts during this time period, as well. But as argued by several commentators, these new advancements have not substantially altered the nature of extant instructional technology (e.g., Jonassen, 1991; Winn & Snyder, 1996). We propose that instructional technology today can benefit from an examination of how it has been influenced by the same assumptions that led to programmed instruction, and consider how the field can avoid the problems encountered by the users of programmed instruction.

Consider the case of online learning, which is illustrative of many of the current trends in instructional technology. Comparing online learning with programmed instruction reveals a number of interesting parallels. One similarity between programmed instruction and contemporary online learning concerns the assumption of technological determinism. Advocates of online learning seem to be as enthusiastic about the power of Internet technology to cause positive change as the previous generation was about teaching machines. As one technology advocate asserted: "[Internet] technology itself both mandates and assists active learning" (Crane, 2000, p. 10). This author seems to be arguing that technological innovation is the driving force behind effective learning and instruction, a sentiment also expressed by theorists from the programmed instruction era who made statements such as: "These machines are a theory of teaching" (Galanter, 1959, p. 1). Another contemporary author claimed, without supporting evidence, that: "the Net *is* the future. . . . Kids learn to ask better questions, to make better arguments, and to present themselves more positively over the Net" (Ellsworth, 1994, p. 5). Still another claimed that: "online education is much more humane and personal than most forms of classroom instruction" (Kearsley, 2000, p. 11).

Such claims seem to place an unrealistic faith in technology without considering other factors crucial to learning. The danger of this course is that the administrators of online learning approaches may assume that adding technology is enough, and neglect other factors that are necessary for learning to take place (see Feenberg, 1999). It is an often-repeated maxim that developers of instruction should consider the needs of the student above the abilities of a technology, but this message bears repeating. When developers of instruction choose a technology, they should also have a ready explanation as to how or why that technology actually contributes to meeting the needs of the situation. It is not a stretch to imagine some promoter of online learning modifying the claim made of programmed instruction, "even a bad [online course] is a pretty good teacher" (Schramm, 1962, pp. 11–12). Such a technologically deterministic mindset is what has driven some away from online learning (and instructional technology as a whole) (e.g. Smith, 1999; Stoll, 1999). A more tempered approach to the use of technology could help some feel more comfortable with methods such as online learning.

Another similarity between online learning and programmed instruction concerns the assumption of efficiency. Contemporary designers and technologists, seeking to maximize the efficiency of their products, have come to rely on standardized approaches to solving instructional problems, much like the well-defined guidelines of programmed instruction. A host of checklists have appeared specifying the characteristics that must be included in a good online course. One Website on developing effective online courses prescribes two or three methods for each type of instructional problem, such as, "attitudinal changes *require* role play and situational practice" (*Principles of online design: Instructional design,* n.d., emphasis added). Another common guideline directs course writers to keep text to a bare minimum, using only bold headings and bullet points of text if possible (e.g., Nielsen, 2000). Regardless of how beneficial these and similar guidelines may be when reasonably applied, history suggests that their pat and uncritical use as the basis of all instruction is likely to create ineffective products (see Wilson, 1997). As was evident in the programmed instruction movement, rigidly standardized instruction—a one size fits all approach to education—loses its personality and closes off alternative, possibly fruitful perspectives on a given subject matter.

Although many online courses will inevitably utilize some predetermined learning templates or sequences, they may be improved—made more human-oriented, flexible, and innovative—through continued examination and reformulation of the fundamental assumptions upon which they are based. In practical terms, this would take place as online course developers paid more attention to why they make the choices they make. Considering whether or not a certain guideline is being followed because it really is the best choice given the situation, and not simply because it is common practice (or the cheapest, or the most efficient, option), may seem like a burdensome task to some. But the alternative is to risk becoming so entrenched in a certain set of assumptions that those assumptions can no longer be questioned (see Alvesson, 2002). Indeed, the history of programmed instruction suggests that taking for granted a set of assumptions will have substantial impact on future development and innovation in a field.

A third similarity between programmed instruction and much of contemporary online learning concerns mechanistic undergirdings that, like behaviorism, attempt to shift the responsibility for learning to instructional materials (see, e.g., Bork & Gunnarsdottir, 2001). Although instructional designers and technologists have embraced the cognitive revolution (e.g., Winn & Snyder, 1996), which is often thought to restore the active mind to psychology and education (e.g., Ashcraft, 1998), some have observed that cognitive theories differ from their behavioristic predecessors chiefly in their willingness to address complex mental phenomena (e.g., Williams, 1987). In most fundamental respects, however, cognitivism and behaviorism are virtually indistinguishable—they are both rooted in a deterministic (mechanistic) ontology that views human action and learning as the necessary output of environmental inputs and biological conditions; and both are based on an empiricist epistemology that views the mind—including behavioral repertoires, schemas, mental models, and so on—as gradually constructed over time through the mechanistic processing of sensory impressions (e.g., Rychlak, 1991; Slife, 1993; Slife & Williams, 1995; Williams, 1987).

It is not entirely surprising that a psychological theory based on a machine metaphor would render mechanistic accounts, but it is noteworthy that instructional designs and technologies that borrow from this metaphor have faced similar problems as behaviorist-oriented programmed instruction, including rigid instructional sequences that treat learning as a mechanical process (Mayer, 2001; Navarro, 2000; Niemiec & Walberg, 1989; Osguthorpe, Osguthorpe, Jacob, & Davies, 2002; Saettler, 1990; Stoll, 1999). The common historical factor is that both conceptual frameworks—cognitivism and behaviorism—were drawn by instructional theorists from mainstream psychology, which has long privileged mechanistic theorizing of one sort or another. Although early cognitive theorists sought to restore mental processes to psychology, they were still wedded to a mechanistic conception of human existence (Green, 2000). Thus, the fundamentally mechanistic orientation toward learning is never questioned, only the details of whatever manifestation is most current.

Given the mechanistic nature of cognitive theorizing, it is worthwhile to inquire into what is meant by the phrase *active processing.* Although cognitive models introduce vocabulary and concepts not seen in behaviorism, the active processing that follows from their mechanistic assumptions can, under a careful analysis, be "active" only in the way that a literal machine such as a computer could be active—namely, functioning in a manner that is consistent with factors such as past programming, structural design, environmental inputs, and so on. It is not clear how mechanistic sequences of processing can account for essential aspects of human learning and motivation such as interest and engagement, challenge, curiosity, learning from error, dialectical reasoning, moral purpose, autonomy, relatedness and community, and the flexibility to learn in many ways. Thus, although cognitive models have opened the possibility of moving beyond purely behavioral theories of learning, they have not rejected the mechanistic thrust of behaviorism, and continue the project of manipulating instructional variables in order to optimize learning outcomes (i.e., produce desired output).

Moreover, it is important to note that although the behavioral sciences have long privileged deterministic theories, such conceptions create various theoretical and practical problems in the human realm. As William James (1897/1956) argued more than 100 years ago, ontological determinism (when taken to its logical conclusion) results in a debilitating pessimism, necessary error, and fatalistic passivity. More recently, critics in psychology (e.g., Williams, 1992) have argued that ontological determinism ushers in a form of nihilism, wherein meaningful human activity is reduced to the mechanistic or necessary functioning of mere matter-in-motion, such as gears and sprockets in a machine or a stone tumbling down a hillside. Learning, from such a perspective, entails none of the human meaning and possibility that makes it a challenging, worthwhile, or noble endeavor in the first place; it is, rather, the necessary reaction to necessary environmental input or conditions. Some designers and theorists may balk at these provocative implications, suggesting that machine and connectionist models in cognitive psychology provide only metaphors that enable the generation of useful theories, research questions, and technologies. However, such a position fails to recognize that any metaphor will necessarily rule out, as well as enable, certain theoretical possibilities, thus acting as a set of theoretical blinders. Instruction and technology based on mechanistic theorizing, then, will be informed by the constructs that fit within such a perspective. In the case of the machine metaphor, it is clear that many aspects of human action and learning, such as creativity, freedom, and responsibility do not fit theoretically and thus will not easily find their way into educational applications.

Continued theoretical exploration and development in instructional technology will then need to address these types of issues. While the trend over the last decade toward constructivist approaches (e.g., Duffy & Cunningham, 1996; Jonassen, 1991) provides a different point of departure and holds promise in loosening up instructional applications that are in need of more flexible and collaborative learning environments, no theoretical perspective offers an educational panacea. The much-debated shortcomings of behaviorism, cognitivism, and constructivism suggest that continued theoretical exploration and research will be required if the demands and challenges of the future are to be adequately met.

An alternative approach is to describe instruction and learning from an agentic perspective that assumes learner freedom and responsibility. Agentic theories differ from their deterministic counterparts by emphasizing the human experience of freedom and meaningful action (see Howard & Conway, 1986; Rychlak, 1979; Sappington, 1990; Wescott, 1988; Williams, 1992). Such theories assume that mechanistic accounts necessarily omit crucial aspects of human existence and, indeed, render human life essentially meaningless or absurd (James, 1897/1956; Williams, 1992). The assumption of agency, on the other hand, suggests that human life is (or can be) purposive, meaningful, and filled with possibility.

Although agentic approaches are not common in mainstream psychology and education, several theories that may usefully inform instructional applications, such as online learning, have been advanced in the literature. Consider two well-developed examples:

Logical learning theory. First, logical learning theory (LLT; Rychlak, 1994), which draws on the rationalist-Kantian tradition, has been supported by considerable empirical research and theoretical argumentation. LLT theorizes that people are motivated by their emotive or affective assessment of a subject, and learn in an inherently oppositional fashion, flexibly apprehending concepts by virtue of what they are and are not, learning from error, exploring the meaning of subject matter, and so on. Because of oppositional reasoning, agents possess an innate mental ability to generate alternatives and to think or act otherwise than can be predicted from the present environment and past informational inputs.

From the perspective of LLT, it is important to realize that neither instructors nor instructional technology can control learning or shape and direct the learner's behavior in the manner specified by more deterministically-oriented theories. As Rychlak has stated, "the learner is an organizer, evaluator, and meaning extender rather than an informational inputter, storer, and retriever" (1994, p. 296). For this reason, instruction is an opportunity for personal transformation that requires learner responsibility in conjunction with appropriate instructional design. More specifically, according to this agentic perspective, learners must play an active role in organizing the material to be learned, and the instruction must facilitate this process. This is not meant to suggest the need for unstructured-discovery learning environments, but rather for structured learning environments that enable the processes of student conceptualization and analysis. For instance, learners may be asked to rephrase the material to be learned, to think critically about it, to comment on its meaning from a personal standpoint, to teach it to someone else, to assess it according to what they like and dislike, and other related activities. Ultimately, the learner must actively conceptualize the material rather than passively receive it.

Other implications of LLT for educational practice can also be extended to online learning. For example, LLT postulates that courses that expose students to alternative ways of viewing a subject, giving them opportunity to criticize the strengths and weaknesses of each approach, lead to learning that is more meaningful and useful. Rychlak (1994) was careful to point out that this does not mean giving students the impression that all alternatives are equally viable or useful. Rather, the teacher or designer is responsible for helping students develop "reasoned opinions and sound rationales for selecting among such alternatives" (p. 293). Given that the design of some online courses encourages a deterministic approach to the subject by focusing on the completion of rote assignments rather than on meaningful learning (Davies, 2003), online learning environments should incorporate opportunities for students to experience alternatives, along with appropriate support to help them take an informed and defensible position.

Self-determination theory. Second, work in the area of self-determination theory (SDT; Ryan & Deci, 2000) has empirically demonstrated that human learning and intrinsic motivation are optimized when persons experience a sense of autonomy, competence, and relatedness in their activity. Self-determination theorists have also studied factors that tend to occlude healthy functioning and motivation, including, among others, controlling environments, rewards contingent on task performance, the lack of secure connection and care by teachers, and situations that do not promote curiosity and challenge (Ryan & Deci). Moreover, these researchers have discussed processes that allow persons to engage in nonintrinsically motivating activities in self-determining and meaningful ways (Ryan & Deci).

The SDT research of Deci, Ryan, and their collaborators (Deci, Vallerand, Pelletier, & Ryan, 1991; Ryan & Deci, 2000) could be extended to the development of online learning in many different ways. Although individual designers would need to adapt these ideas to their own projects and instructional areas, we can thematize a few general guidelines suggested by this agentive approach. From the perspective of SDT, learning environments should, to the extent possible, support learners' natural sense of autonomy and self-expression as they pursue competence in a given subject. Ryan and Deci suggested that learners are more likely to make good decisions and learn purposefully if they do not feel as if they are being coerced throughout the learning activity. As opposed to the programmed instruction approach—which routinely led students to the one correct answer and caused them to lose interest and motivation along the way—developers of contemporary online learning should adopt styles (in writing, visual presentation, organization of material, etc.) that respect the students' ability to make decisions about learning. As Ryan and Powelson (1991) pointed out, such a learning environment need not come at the expense of all extant curricula and content, but rather involves a variation in the context that situates the curricula and content—one that emphasizes active student participation, autonomy, and appropriate support rather than the control of learner behavior.

More specifically, such an approach could be adapted to online learning environments by allowing for learner choice in how material is presented, organized, and studied; by emphasizing active participation in problem solving (with guidance available as needed); by asking questions that foster the examination of concepts, facts, and principles from a variety of perspectives; by providing exercises that help students actively compare and contrast facts and concepts; and by providing learners with appropriate learning challenges (e.g., projects, problems, questions, writing assignments, etc.) that require creative student involvement, accompanied by appropriate performance feedback.

Learner relatedness is also a relevant concern from the perspective of SDT, suggesting that the current emphasis on learner collaboration and dialogue within instructional development scholarship is an important step toward more optimal online learning environments. At bottom, from the perspective of SDT, designers should recognize that an adequate learning experience is multidimensional, and that measurable gains in cognitive outcomes (e.g., fact accumulation, standardized testing scores) provide a relatively narrow way of thinking about the highest goals education. As Ryan and Powelson (1991; see also Deci et al., 1991) persuasively argued, the outcomes of an effective education surely must also include enthusiasm about the subject matter, heightened self-worth and confidence, feelings of social connectedness and responsibility, and a sense of personal autonomy, creativity, and competence in decision making and problem solving.

The advantage of these and other agentic approaches (for reviews, see Sappington, 1990; Wescott, 1988; Williams, 1992) is that they are sensitive to essential aspects of human learning and existence not captured by deterministic theories, although being scientifically and practically defensible. Crucial work in the area of instructional theory remains, of course, such as extrapolating more specific applications from these alternative theoretical perspectives to technologies such as online learning. Moreover, continued theorizing and research is needed to determine if specific principles and applications from behaviorism and cognitivism can be applied in conjunction with principles from these alternative theories, and whether or not such traditionally deterministic conceptions can be reframed in ways that make them cohere with agentic frameworks.

Flexible Instructional Design and Technology

The argument presented in this article has been that instructional technology as a field is not likely to benefit from rigid adherence to a process, theory, or method of delivery. Our position is that to avoid the same fate as programmed instruction, developers of instructional technology, particularly online learning, should pursue flexible solutions and be more sensitive to specific learning contexts. Some recent examinations of online learning investigate these possibilities by incorporating multiple instructional strategies into learning environments or by attempting to understand self-organized learning systems (Levin, Levin, & Waddoups, 1999; Wiley & Edwards, 2002). To help instructional technologists avoid rigidity, we present a short list of questions that developers can ask about their products (Table 1). These questions follow from the assumptions of programmed instruction. We recommend this list to any who are interested in examining how their assumptions may be affecting the instructional products they create.

In conclusion, we call for contemporary instructional technologists to be more broad-minded about what constitutes an effective instructional experience, and to seek continual feedback regarding their created instruction. For each of the many alternatives available (only some of which have been discussed in this article), instructional technologists must be willing to examine all of the evidence as to each alternative's potential (and actual) effectiveness. By examining all of the evidence, they may come to discover that powerful instructional techniques can be found in more places than originally thought. And if they accept evidence that suggests that inflexible instructional solutions do not allow individuals to achieve their highest potential, instructional technologists must then be willing to adopt assumptions that foster flexibility in the types of solutions they consider. But as the history of programmed instruction has suggested, the failure to consider alternative approaches narrows the range of viable instructional possibilities, and ultimately jeopardizes an instructional technology's ability to succeed. □

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Table 1 □ Questions for online course developers relating to the assumptions of programmed instruction.

Question	*Assumption*	*Implication*
Does your online course attempt to remove responsibility from the students for their learning?	Determinism	Overly standardized content
Does your online course cater to the "lowest common denominator" that students may bring to the situation? Does it suffer from the problem of over-prompting, or similar problems that indicate it does not appropriately challenge students?	Efficiency and Determinism	Elevation of process over outcomes
Do you think your online course offers the one optimal path to master the particular subject being taught?	Materialism and Empiricism	Overly standardized content
Do your online courses reflect a wide variety of methodologies, depending on the characteristics of the students and the subjects being taught? Or, are almost identical forms and methods used for all?	Efficiency	Elevation of process over outcomes
Do the objectives and content of your online courses reflect the reality of the subject being taught, or do your courses define all objectives in terms that are easy to observe, teach, or test?	Materialism and Empiricism	Cumbersome and impractical applications
Do your online courses rely on the underlying technology to make up for shortcomings in other aspects of the instructional solution?	Technological Determinism	Overly standardized content; elevation of process over outcomes
Do you judge your online courses based primarily on such factors as how closely a development process was adhered to, or how strictly they conform to a template, or do you judge them according to their success with students?	Efficiency	Elevation of process over outcomes

REFERENCES

Alvesson, M. (2002). *Understanding organizational culture.* London: Sage Publications Ltd.

Ashcraft, M. H. (1998). *Fundamentals of cognition.* New York: Longman.

Bork, A., & Gunnarsdottir, S. (2001). *Tutorial distance learning: Rebuilding our educational system.* New York: Kluwer Academic/Plenum Publishers.

Burton, J. K., Moore, D. M., & Magliaro, S. G. (1996). Behaviorism and instructional technology. In D. H. Jonassen (Ed.), *Handbook of research for educational communications and technology* (pp. 46–73). New York: Simon & Schuster Macmillan.

Casas, M. (1997). *The history surrounding the use of Skinnerian teaching machines and programmed instruction (1960–1970).* Unpublished Dissertation, Harvard University, Boston.

Crane, B. E. (2000). *Teaching with the Internet: Strategies and models for K-12 curricula.* New York: Neal-Schuman Publishers, Inc.

Dale, E. (1967). Historical setting of programed instruction. In P. C. Lange (Ed.), *Programed instruction: The sixty-sixth yearbook of the national society for the study of education, part II* (pp. 28–54). Chicago: The University of Chicago Press.

Davies, R. S. (2003). Learner intent and online courses. *Journal of Interactive Online Learning, 2(1).* Retrieved February 25, 2004, from http://www.ncolr.org/jiol/archives/2003/summer/4/index.asp

Deci, E. L., Vallerand, R. J., Pelletier, L. G., Ryan, R. M. (1991). Motivation and education: The self-determination perspective. *Educational Psychologist, 26,* 325–346.

Delprato, D. J., & Midgely, B. D. (1992). Some fundamentals of B. F. Skinner's behaviorism. *American Psychologist, 47,* 1507–1520.

De Vaney, A., & Butler, R. P. (1996). Voices of the founders: Early discourse in educational technology. In D. H. Jonassen (Ed.), *Handbook of research for educational communications and technology* (pp. 3–45). New York: Simon & Schuster Macmillan.

Dewey, J. (1916). *Democracy and education: An introduction to the philosophy of education.* New York: The Macmillan Company.

Driscoll, M. P. (2000). *Psychology of learning for instruction* (2nd ed.). Needham Heights, MA: Allyn & Bacon.

Duffy, T. M., & Cunningham, D. J. (1996). Constructivism: Implications for the design and delivery of instruction. In D. H. Jonassen (Ed.), *Handbook of research for educational communications and technology* (pp. 170–198). New York: Simon & Schuster MacMillan.

Edling, J. V., Foshay, A. W., Ginther, J. R., Herbert, J., Schramm, W., & Thelen, H. (1964). *Four case studies of programmed instruction.* New York: Fund for the Advancement of Education.

Ellsworth, J. H. (1994). *Education on the Internet: A hands-on book of ideas, resources, projects, and advice.* Indianapolis: SAMS Publishing.

Feenberg, A. (1999). *Distance learning: Promise or threat?* Retrieved December 11, 2002, from http://www-rohan.sdsu.edu/faculty/feenberg/TELE3.HTM.

Fry, E. B. (1963). *Teaching machines and programmed instruction: An introduction.* New York: McGraw-Hill Book Company, Inc.

Gagné, R. M. (1965). The analysis of instructional objectives for the design of instruction. In R. Glaser (Ed.), *Teaching machines and programmed learning II: Data and directions* (pp. 21–65). Washington, DC: National Education Association of the United States.

Galanter, E. (1959). The ideal teacher. In E. Galanter (Ed.), *Automatic teaching: The state of the art* (pp. 1–11). New York: John Wiley & Sons, Inc.

Garner, W. L. (1966). *Programed instruction.* New York: The Center for Applied Research in Education, Inc.

Glaser, R. (1964). Programed instruction: A behavioral view. In D. A. Sohn (Ed.), *Programs, teachers, and machines* (pp. 86–99). New York: Bantam Books.

Gotkin, L. G., & McSweeney, J. (1967). Learning from teaching machines. In P. C. Lange (Ed.), *Programed instruction: The sixty-sixth yearbook of the national society for the study of education, part II* (pp. 255–283). Chicago: The University of Chicago Press.

Green, C. D. (2000). Dispelling the "mystery" of computational cognitive science. *History of Psychology, 3,* 62–66.

Green, E. J. (1967). The process of instructional programing. In P. C. Lange (Ed.), *Programed instruction: The sixty-sixth yearbook of the national society for the study of education, part II* (pp. 61–80). Chicago: The University of Chicago Press.

Heinich, R. (1995). The proper study of instructional technology. In G. J. Anglin (Ed.), *Instructional technology: Past, present, and future* (pp. 61–83). Englewood, CO: Libraries Unlimited, Inc.

Hines, R. H. (1965). Automation and culturally deprived children. In J. S. Roucek (Ed.), *Programmed teaching: A symposium on automation in education* (pp. 115–132). New York: Philosophical Library.

Holland, J. G. (1962). New directions in teaching-machine research. In J. E. Coulson (Ed.), *Programmed learning and computer-based instruction* (pp. 46–57). New York: John Wiley and Sons, Inc.

Holliday, W. G. (1983). Overprompting science students using adjunct study questions. *Journal of Research in Science Teaching, 20*(3), 195–201.

Howard, G. S., & Conway, C. G. (1986). Can there be an empirical science of volitional action? *American Psychologist, 41,* 1241–1251.

James, W. (1956). The dilemma of determinism (pp. 145–183). In W. James (Ed.), *The will to believe and other essays in popular philosophy* (pp. 145–183). New York: Dover Publications. (original work published 1897)

Jonassen, D. H. (1991). Objectivism versus constructivism: Do we need a new philosophical paradigm? *Educational Technology, Research and Development, 39*(3), 5–14.

Kearsley, G. (2000). *Online education: Learning and teaching in cyberspace.* Belmont, CA: Wadsworth.

Klaus, D. J. (1964). Programing: A re-emphasis on the tutorial approach. In A. de Grazia & D. A. Sohn (Eds.), *Programs, teachers, and machines* (pp. 137–145). New York: Bantam Books. (original work published 1961)

Koetting, J. R. (1996). Philosophy, research, and education. In D. H. Jonassen (Ed.), *Handbook of research for educational communications and technology* (pp. 1137–1147). New York: Simon & Schuster MacMillan.

Kulik, J. A. (1982). Individualized systems of instruction. In H. E. Mitzel (Ed.), *Encyclopedia of educational research* (5th ed., pp. 851–858). New York: Macmillan.

Kulik, J. A., Cohen, P. A., & Ebeling, B. J. (1980). Effectiveness of programmed instruction in higher education: A meta-analysis of findings. *Educational Evaluation and Policy Analysis, 2*(6), 51–64.

Levin, J., Levin, S. R., & Waddoups, G. (1999). Multiplicity in learning and teaching: A framework for developing innovative online education. *Journal of Research in Computing in Education, 32,* 256–269.

Lublin, S. C. (1965). Reinforcement schedules, scholastic aptitude, autonomy need, and achievement in a programed course. *Journal of Educational Psychology, 56*(6), 295–302.

Lumsdaine, A. A. (1960). Teaching machines: An introductory overview. In A. A. Lumsdaine & R. Glaser (Eds.), *Teaching machines and programmed learning: A source book* (pp. 5–22). Washington, DC: National Education Association of the United States.

Lumsdaine, A. A. (1965). Assessing the effectiveness of instructional programs. In R. Glaser (Ed.), *Teaching machines and programmed learning II: Data and directions* (pp. 267–320). Washington, DC: National Education Association of the United States.

Lysaught, J. P., & Williams, C. M. (1963). *A guide to programmed instruction.* New York: John Wiley and Sons, Inc.

MacDonald-Ross, M. (1973). Behavioural objectives-A critical review. *Instructional Science, 2,* 1–52.

Markle, S. M. (1967). Empirical testing of programs. In P. C. Lange (Ed.), *Programed instruction: The sixty-sixth yearbook of the national society for the study of education, part II* (pp. 104–138). Chicago: The University of Chicago Press.

Markle, S. M. (1969). *Good frames and bad: A grammar of frame writing* (2nd ed.). New York: John Wiley & Sons, Inc.

Mayer, R. E. (2001). *Multimedia learning.* New York: Cambridge University Press.

Mechner, F. (1967). Behavioral analysis and instructional sequencing. In P. C. Lange (Ed.), *Programed instruction: The sixty-sixth yearbook of the national society for the study of education, part II* (pp. 81–103). Chicago: The University of Chicago Press.

Mellan, I. (1960). Teaching and educational innovations. In A. A. Lumsdaine & R. Glaser (Eds.), *Teaching machines and programmed learning: A source book* (pp. 265–274). Washington, DC: National Education Association of the United States. (original work published 1936)

Misa, T. J. (2003). The compelling tangle of modernity and technology. In T. J. Misa, P. Brey & A. Feenberg (Eds.), *Modernity and technology* (pp. 1–30). Cambridge, MA: MIT Press.

Navarro, P. (2000). The promise-and potential pitfalls-of cyberlearning. In R. A. Cole (Ed.), *Issues in Web-based pedagogy* (pp. 281–296). Westport, CN: Greenwood Press.

Nielsen, J. (2000). *Designing Web usability.* Indianapolis: New Riders Publishing.

Niemiec, R. P., & Walberg, H. J. (1989). From teaching machines to microcomputers: Some milestones in the history of computer-based instruction. *Journal of Research on Computing in Education, 21*(3), 263–276.

Nordberg, R. B. (1965). Teaching machines-six dangers and one advantage. In J. S. Roucek (Ed.), *Programmed teaching: A symposium on automation in education* (pp. 1–8). New York: Philosophical Library.

Osguthorpe, R. T., Osguthorpe, R. D., Jacob, W. J., & Davies, R. S. (2002). *The moral dimensions of instructional design.* Paper presented at the the annual meeting of the American Educational Research Association, New Orleans, LA.

Osguthorpe, R. T., & Zhou, L. (1989). Instructional science: What is it and where did it come from? *Educational Technology, 29*(6), 7–17.

Padwa, D. J. (1964). Dimensions of the need. In A. de Grazia & D. A. Sohn (Eds.), *Programs, teachers, and machines* (pp. 271–273). New York: Bantam Books. (original work published 1962)

Plattor, E. E. (1965). Teacher education and teaching machines. In J. S. Roucek (Ed.), *Programmed teaching: A symposium on automation in education* (pp. 23–39). New York: Philosophical Library.

Polkinghorne, D. (1983). *Methodology for the human sciences: Systems of inquiry.* Albany: SUNY Press.

Post, D. (1972). Up the programmer: How to stop PI from boring learners and strangling results. *Educational Technology, 12*(8), 14–17.

Pressey, S. L. (1960a). A machine for automatic teaching of drill material. In A. A. Lumsdaine & R. Glaser (Eds.), *Teaching machines and programmed learning: A source book* (pp. 42–46). Washington, DC: National Education Association of the United States. (original work published 1927)

Pressey, S. L. (1960b). A third and fourth contribution toward the coming "industrial revolution" in education. In A. A. Lumsdaine & R. Glaser (Eds.), *Teaching machines and programmed learning: A source book* (pp. 47–51). Washington, DC: National Education Association of the United States. (original work published 1932)

Pressey, S. L. (1960c). Development and appraisal of devices providing immediate automatic scoring of objective tests and concomitant self-instruction. In A. A. Lumsdaine & R. Glaser (Eds.), *Teaching machines and programmed learning: A source book* (pp. 69–88). Washington, DC: National Education Association of the United States. (original work published 1950)

Principles of online design: Instructional design. (n.d.). Retrieved March 20, 2003, from http://www.fgcu.edu/onlinedesign/designdev.html.

Robinson, D. N. (1985). *Philosophy of psychology.* New York: Columbia University Press.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55,* 68–78.

Ryan, R. M., & Powelson, C. L. (1991). Autonomy and relatedness as fundamental to motivation and education. *Journal of Experimental Education, 60,* 49–66.

Rychlak, J. F. (1979). *Discovering free will and personal responsibility.* New York: Oxford University Press.

Rychlak, J. F. (1991). *Artificial intelligence and human reason: A teleological critique.* New York: Columbia University Press.

Rychlak, J. F. (1994). *Logical learning theory: A human teleology and its empirical support.* Lincoln: University of Nebraska Press.

Saettler, P. (1990). *The evolution of American educational technology.* Englewood, CO: Libraries Unlimited, Inc.

Sappington, A. A. (1990). Recent approaches to the free will versus determinism issue. Psychological Bulletin, 108, 19–29.

Schramm, W. (1962). *Programed instruction: Today and tomorrow.* The Fund for the Advancement of Education.

Schramm, W. (1964a). *The research on programed instruction: An annotated bibliography* (No. OE-31034). Washington, DC: U.S. Department of Health, Education, and Welfare, Office of Education.

Schramm, W. (1964b). *What is programed instruction? An introduction for the layman.* Palo Alto: Stanford Institute for Communication Research.

Skinner, B. F. (1959). The programming of verbal knowledge. In E. Galanter (Ed.), *Automatic teaching: The state of the art* (63–68). New York: John Wiley & Sons.

Skinner, B. F. (1960). The science of learning and the art of teaching. In A. A. Lumsdaine & R. Glaser (Eds.), *Teaching machines and programmed learning: A source book* (pp. 99–113). Washington, DC: National Education Association of the United States. (original work published 1954)

Skinner, B. F. (1965). Reflections on a decade of teaching machines. In R. Glaser (Ed.), *Teaching machines and programmed learning II: Data and directions* (pp. 5–

20). Washington, DC: National Education Association of the United States.

Skinner, B. F. (1968). *The technology of teaching.* New York: Meredith Corporation.

Skinner, B. F. (1986, October). Programmed instruction revisited. *Phi Delta Kappan, 68,* 103–110.

Slife, B. D. (1993). *Time and psychological explanation.* Albany: SUNY Press.

Slife, B. D., Yanchar, S. C., & Williams, B. (1999). Conceptions of determinism in radical behaviorism: A taxonomy. *Behavior and Philosophy, 27,* 75–96.

Slife, B. D., & Williams, R. N. (1995). *What's behind the research: Discovering hidden assumptions in the behavioral sciences.* Thousand Oaks, CA: Sage Publications.

Smith, F. (1999). When irresistible technology meets irreplaceable teachers. *Language Arts,* 76(5), 5–99, 414–421.

Spector, J. M. (2001). Philosophical implications for the design of instruction. *Instructional Science, 29,* 381–402.

Stephens, A. L. (1960). Certain special factors involved in the law of effect. In A. A. Lumsdaine & R. Glaser (Eds.), *Teaching machines and programmed learning: A source book* (pp. 89–93). Washington, DC: National Education Association of the United States. (original work published 1953)

Stoll, C. (1999). *High-tech heretic: Why computers don't belong in the classroom and other reflections by a computer contrarian.* New York: Doubleday.

Stolurow, L. M. (1961). *Teaching by machine* (No. OE-34010). Washington, DC: U.S. Department of Health, Education, and Welfare, Office of Education.

Tanner, D. (1964). The machine teacher and the human learner. In A. de Grazia & D. A. Sohn (Eds.), *Programs, teachers, and machines* (pp. 300–309). New York: Bantam Books. (original work published 1957)

Watson, J. T. (1913). Psychology as the behaviorist views it. *The Psychological Review, 20,* 158–177.

Wescott, M. (1988). *The psychology of human freedom: A human science perspective and critique.* New York: Springer-Verlag.

Wiley, D. A., & Edwards, E. K. (2002). Online self-organizing social systems: The decentralized future of online learning. *The Quarterly Review of Distance Education, 31*(1), 33–46.

Williams, R. N. (1987). Can cognitive psychology offer a meaningful account of meaningful human action? *The Journal of Mind and Behavior, 8,* 209–222.

Williams, R. N. (1992). The human context of agency. *American Psychologist, 47,* 752–760.

Wilson, B. G. (1997). *The postmodern paradigm.* Retrieved March 31, 2003, from http://carbon.cudenver.edu/bwilson/postmodern.html.

Winn, W., & Snyder, D. (1996). Cognitive perspectives in psychology. In D. H. Jonassen (Ed.), *Handbook of research for educational communications and technology* (pp. 112–142). New York: Simon & Schuster MacMillan.