Requirements and Benefits of Effective Interactive Instruction: Learner Control, Self-Regulation, and Continuing Motivation

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While educational technologies provide increasing opportunities for interactive exploration in a learning environment, crucial questions remain: Will learners be able to exercise control and effectively regulate their own learning in flexible learning systems? Will they be motivated enough really to explore? Theory and research suggest that learners can and will, if the instructional systems are well-designed and if the learners are adequately prepared. In this paper, the components of learner control, self-regulated learning, and continuing motivation are examined as possible requirements and benefits of effective interactive instruction. A theoretical framework is advanced which illustrates the interdependence and mutual importance of these three components. Educational research in each of these three areas is analyzed, inconsistencies are discussed, and further support is developed for consideration of these components within an instructional situation. Finally, recommendations are offered for future research, to develop further what we know about what makes instruction effective and learners successful.

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INTRODUCTION

☐ Imagine students who are not only capable of regulating their own learning, but who are so enthusiastic about it that they voluntarily explore new bodies of knowledge. This is one of the dreams of educators and instructional developers both past and present. And while new interactive technologies promise increasingly flexible instructional environments, decades of research on "new" technologies indicate that the availability of technology is not enough to ensure learning.

Significant questions are emerging about the efficacy of interactive instruction. These questions revolve around three basic issues: learner control, self-regulation of learning, and the continuing motivation to learn. For example, given learner control, will students be capable of managing their own learning in an effective and productive way—will the choices they make be good ones? Will they be interested enough in learning really to explore? How can interactive systems be designed to assist students in self-regulation and to enhance their motivation to explore and to learn?

The components of learner control, self-regulation, and the continuing motivation to learn are examined in this paper as possible requirements and benefits of effective instruction. A theoretical framework is developed which demonstrates the interdepend-

ence and mutual importance of these instructional components. Next, the research literature is reviewed from this theoretical perspective, and finally, suggestions are made for future research.

THEORETICAL FOUNDATIONS

For learners to be effective, they must be able to make appropriate instructional choices based on effective learning strategies, and they must be motivated by a desire to learn. The following discussion of relevant learning theory is driven by these assertions.

Learner Control and Self-Regulation of Learning

Interactive instructional systems make it possible to provide learners with control over depth of study, range of content covered, number and type of alternative media selected for presentation, and time spent on learning. With these options, individuals can tailor the learning experience to meet specific needs and interests. The rationale supporting provision of learner control is that each individual will know what is best for him or her and will act on that knowledge (Mager, 1964; Merrill, 1975, 1980).

Researchers and theorists such as Merrill (1975, 1980) assert that learners need to be given instructional control. Exercising control over one's learning can be in itself a valuable educational experience—instructional decisions are made, the results experienced, and the best tactics for different instructional situations can be discovered in the process. In this way, the exercise of learner control can be thought of as a precursor to the development of self-regulation.

To be truly effective, many educators suggest going a step further, by training students in the use of global learning strategies for a variety of instructional situations. This recommendation is based on the belief that learners who command the greatest range and depth of learning skills will be the best equipped to handle learner control and other forms of instructional self-management (Resnick, 1972). From this perspective, skills in self-regulation become essential for the effective use of learner control.

Self-regulation of learning implies a high level of cognitive engagement, including actively receiving and selecting information, making connections with existing knowledge, organizing the approach to learning tasks, and continuously monitoring learning, including rehearsal and self-checking (Corno and Mandinach, 1983). Jacobson and Thompson (1975) suggest a four-stage apprenticeship for students, leading up to the attainment of self-teacher status: (1) adopt rules for making instructional decisions, (2) develop a rationale for the use of specific instructional procedures, (3) generalize to new instructional situations, and (4) adapt strategies to new learning needs.

However, presentation of rules and rationales for various learning strategies and practice in applying and adapting them may not be enough to encourage self-regulated learning. Attitude toward learning may be just as significant as the learning skills themselves—the value that students place on learning for its own sake will determine, in part, the degree to which higher levels of cognitive engagement develop (Brophy, 1983). For this reason, training for improved use of student control should involve attempts to change learner attitudes and orientation toward learning, including an increased commitment to active learning (Baird and White, 1982).

Student Orientations Toward Learning: The Continuing Motivation To Learn

Motivation is suggested here as another important component in the design and utilization of interactive instructional systems. Of the different motivational constructs advanced to date, intrinsic motivation and continuing motivation are among the most significant for instructional theory and research. When an activity is intrinsically motivated,

theorists argue, the primary reward is the activity itself. Individuals are thought to be more self-involved—they may attempt more difficult problems, and when they do, their focus will tend to be on the *way* to solve the problem, rather than finding the correct solution (Condry & Chambers, 1978). Continuing motivation is the type of intrinsic motivation most directly concerned with education. It reflects an individual's willingness to learn (Maehr, 1976). Students display continuing motivation when they return to a learning activity without external pressure to do so, presumably because of an intrinsic interest in the activity.

Engaged and active exploration of an interactive learning environment requires such a motivation to learn on the part of its users. However, with a primary focus on achievement in the schools, continuing motivation is infrequently cultivated as a valuable instructional outcome. According to Bruner (1966), instructional activities in our schools often fail to draw upon the natural energies that can sustain spontaneous learning and thus the will to learn becomes a problem.

What is necessary to encourage and sustain spontaneous and intrinsically motivated learning? Educational theory suggests that a number of instructional components are directly linked to motivational outcomes. Among them are the promise of competence or self-efficacy, the perception of personal control, the perception of relevance, and the stimulation of curiosity (Keller, 1983; Lepper, 1985; Malone, 1981).

Competence/Self-Efficacy

Striving for a feeling of competence or effectance motivation was advanced by White (1959) to be a motive behind exploration and play behaviors. According to Deci (1975), individuals want to feel personally effective in dealing with their environment, and they actively seek out situations in which they can feel competent and self-determining. This has support in the interactionist perspective of Piaget (1951). According to this perspective, children are attracted to situations that are moderately assimilable. These situations match existing cognitive structures in part, but also challenge the child by requiring accommodation, or partial modification of the child's schemata for dealing with the world.

Challenging situations are those which involve meaningful goals whose attainment is somewhat uncertain (Malone, 1981). The degree to which an individual feels effective in managing such challenges determines the effort that will be expended (Bandura, 1982). While neither success nor failure should be predetermined, there should be a reasonable chance for success. Providing the student with opportunities to succeed in moderately challenging instructional situations can promote feelings of self-efficacy and encourage continuing motivation.

Personal Control

An individual's perception of personal control, the second main requirement of intrinsically motivating instruction, is aligned with the concept of self-efficacy in two related theoretical perspectives: the theory of personal causation (deCharms, 1968) and the construct of locus of control (Rotter, 1966). According to the theory of personal causation, "Origins" (individuals who perceive their behavior as stemming from their own choices) tend to value their own behavior more highly and to exhibit more task motivation than do "Pawns" (individuals who feel their behavior is dictated by external forces). Individuals with an internal locus of control believe that personal events and outcomes are contingent on their own behavior. Those with an external locus feel that such events are caused by outside forces beyond their control.

A perception of personal control (an "origin" or internal locus of control perspective) can be thought as a prerequisite for development of feelings of personal causation and competence. However, while an individual must be given instructional control in a learning situation in order to develop perceptions of control, the provision of learner control op-

portunities will not necessarily result in individual perceptions of control. Learners given significant amounts of control, as in an interactive system, should be encouraged to exercise it actively to make instructional decisions (Lepper and Chabay, 1985). In addition, the learning environment must be obviously responsive to learner choices—individuals must perceive that the relevant changes in the instruction are a result of their decisions (Lepper, 1985). Kehoe (1979) proposes that when choices are provided, the degree to which individuals perceive they have a choice (are in control) is related to the level of attractiveness of the choices available. If this is so, then to enhance perceptions of personal control, the choices made available to learners should be attractive ones, with obvious interest or utility.

Relevance

Building revelance to learners can help to ensure that instruction will be motivating. According to Keller (1983), this can be done by relating instruction directly to important needs, motives, or values. Keller goes on to suggest specific strategies for doing this, including instrumental-value and cultural-value strategies. With an instrumental-value strategy, instructional tasks or goals are presented as prerequisites for desired future goals. Relevance and motivation can also be built through cultural-value strategies, such as incorporation of activities that are positively valued by students' cultural reference groups. Besides enhancements made in the design of instructional content, relevance can be strengthened by allowing users to shape the context and form of instruction through exercise of learner control options.

Stimulation of Curiosity

A fourth proposed requirement of intrinsically motivating instruction is the stimulation of curiosity. Curiosity can be considered as a challenge to one's understanding. It can be provoked in sensory ways (through graphics, animation, or music) or in cognitive ways (through conceptual conflict) (Malone, 1981). Surprise, incongruity, and moderate complexity can all serve to stimulate cognitive curiosity, as can novelty, variability, and mild uncertainty (Lepper, 1985). Not only should curiosity be evoked by revealing inconsistencies, curiosity should also be satisfied by helping learners to modify their knowledge structures to reach consistency (Malone, 1981). This cycle of curiosity stimulation and satisfaction can be a significant component of intrinsically motivating instruction.

Summary: Theoretical Underpinnings of Learner Control, Self-Regulated Learning, and Continuing Motivation to Learn

There is considerable overlap in the theoretical foundations of learner control, self-regulated learning, and the continuing motivation to learn. All three are thought to be influential in the effective design and successful utilization of interactive instruction. It may be that enhancement of any one element will strengthen the effects of the other two.

Provision of learner control allows students to tailor their instructional experience to suit personal needs and interests, thus increasing instructional relevance and encouraging continuing motivation. Learner control can assist students in development of self-regulation by providing the opportunity to discover and refine instructional strategies. And when actively exercised in a responsive environment, options for learner control can promote perceptions of personal control and further strengthen continuing motivation.

Skills for self-directed learning are essential learning tools in the flexible interactive environment. Self-regulation of learning is considered by some to be of paramount educational importance, something that should be taught alongside content-specific information and skills. As mentioned previously, self-regulation strategies can also be developed by students themselves through the exercise of learner control. In any case, learner control is required for the successful practice

of self-managed learning. In addition, when an instructional experience is effectively self-managed, it can add to an individual's sense of competence and self-efficacy and result in increased motivation.

Finally, active, involved exploration of an interactive instructional system depends on the existence of a continuing motivation to learn. According to motivation theorists, instruction that is intrinsically motivating is that which produces feelings of competence and self-efficacy (made possible in part by use of effective self-management strategies), perceptions of personal control (strengthened through provision and exercise of learner control options), perceptions of relevance, and stimulation of individual curiosity. In the same way that learner control and self-regulation enhance motivation, the continuing motivation to learn can be thought of as positively affecting the use of both learner control and self-management strategies. This relationship between these components is depicted in Figure 1.

Learner control, self-regulation, and continuing motivation can be argued for as requirements in the effective design of interactive instruction. At the same time, the effective use of instruction which incorporates these elements can theoretically lead to a variety of related benefits. When learner control in an interactive system is exercised, the benefits could be reflected in increased student self-regulation and continuing motivation. When students gain experience in self-regulation, this experience may transfer

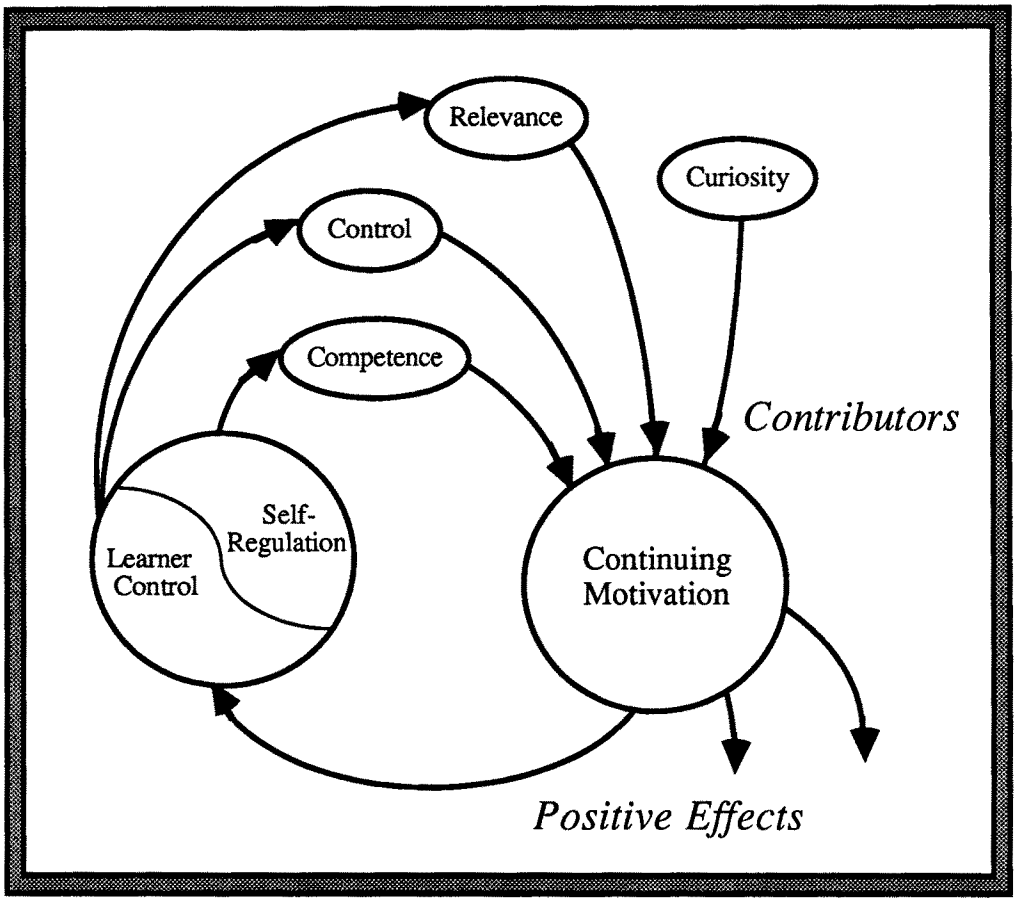

FIGURE 1 □ Contributors to and positive effects of continuing motivation.

to other learner controlled situations, besides promoting an increase in continuing motivation. Similarly, when interactive systems stimulate student motivation, students' excitement and interest in learning can positively influence their desire to exercise control and manage their own learning, as well as having other beneficial effects. The requirement/ benefit relationship of learner control, self-regulation, and continuing motivation to the effective development and use of interactive instruction is depicted in Figure 2.

RESEARCH RESULTS

In this section, research support is outlined for the preceding theoretical exposition. Research is discussed relative to the proposed requirements within interactive instruction for learner control, self-regulation of learning, and continuing motivation.

Learner Control Research

According to learning theorists, learner control can provide a number of positive instructional outcomes: individualizing instruction to accommodate personal needs/interests, assisting in development of instructional strategies, and promoting perceptions of personal control. Elements of instructional control that have been examined in educational research include control over content, sequencing, difficulty, amount of instruction or

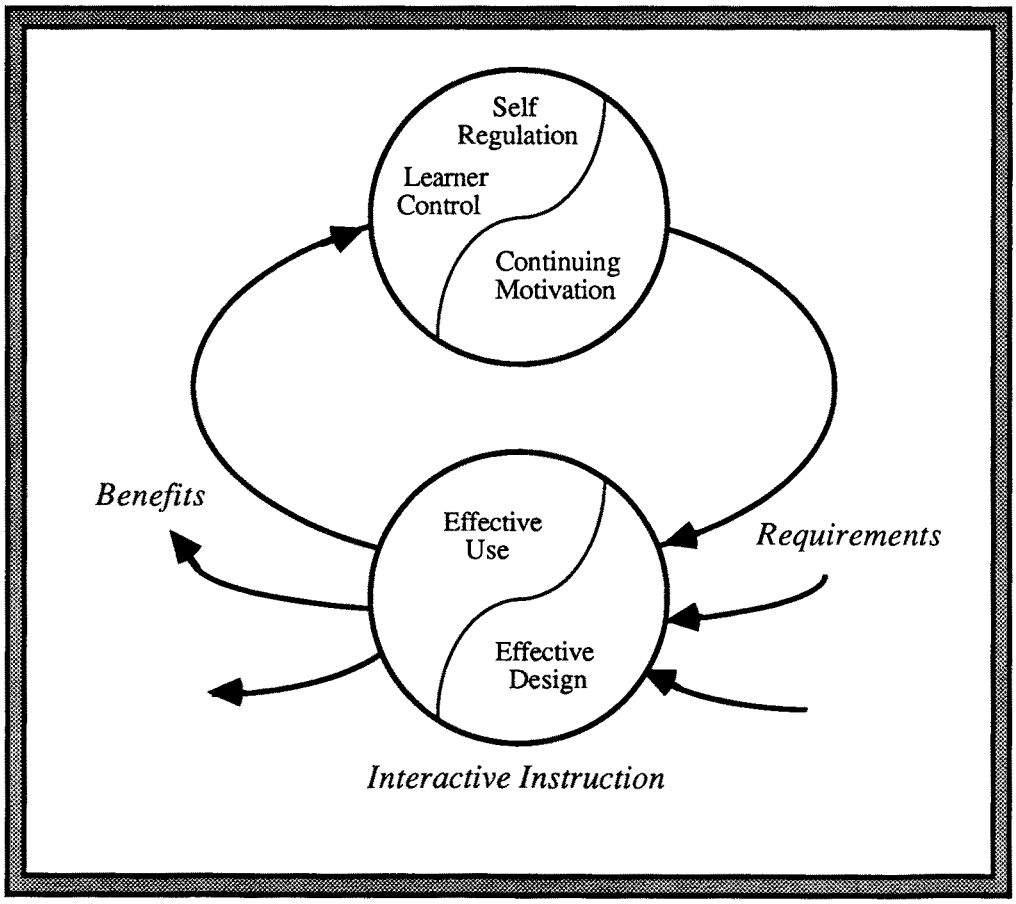

FIGURE 2 □ Requirements and benefits of effective interactive instruction.

practice, and pacing. However, as pointed out by Carrier (1984), students given learner control may not make good choices—the research in this area indicates mixed results in terms of student achievement under learner control.

To begin this discussion of learner control research, three possible reasons for inconsistent benefits from learner control will be outlined: a behaviorist rather than cognitivist orientation, individual student differences, and discomfort/inexperience in exercising control options. Following this discussion, research support for learner control theory will be summarized.

Variable Results from Learner Control: Possible Explanations

BEHAVIORIST VS. COGNITIVE DESIGN. The differential effects of behaviorist versus cognitive design of instruction may be one factor that is overlooked in consideration of the effects of learner control. As outlined by Clark (1984), instruction in a behaviorist design is highly directed, with shorter steps, more practice and feedback, and nearly identical elements in both instruction and testing situations. With such a design, learning is more "near transfer." This is the type of instruction most commonly delivered in our schools; the relevant outcome is achievement. In contrast, Clark continues, instruction based on a cognitive design allows student control over direction and monitoring of the learning process. The instruction tends to be at higher difficulty levels and is presented in larger chunks. Learning here is more "far transfer." For this type of learner-controlled experience, the relevant outcome is long-range achievement and continuing motivation to learn. Considering outcomes, Clark notes that near transfer may be achieved at the expense of far transfer, and vice versa.

The foregoing rationale suggests at least three things. First, while the learner control in cognitively oriented instruction may be effective for promoting the construction of large-scale knowledge structures (as well as promoting self-management of learning and continuing motivation), if outcomes are measured with an achievement test typical of a behaviorist design, no benefit may be indicated for learner control. Second, very structured behaviorally oriented instruction may preclude opportunities to learn at higher levels of cognitive engagement, at least for some students. Moreover, if students are consistently given such highly structured instruction, some may be incapable of managing their own instruction when given the opportunity. Finally, a single-minded instructional emphasis on higher achievement alone may damage students' continuing motivation to learn. In fact, Ames (1987) suggests that factors found to promote achievement may be detrimental to continuing motivation.

INDIVIDUAL DIFFERENCES. A second possible reason for mixed learner control results is the existence of individual differences in student abilities and prior knowledge. These individual differences play a role in how students process information (Salomon & Gardner, 1986) and thus impact the potential effectiveness of learner control. Some research results suggest that control is beneficial for students of higher rather than lower ability (Green, 1976, cited by Snow, 1980) or with higher rather than lower levels of prior subject matter understanding (Gay, 1986). If one assumes that students of higher ability are also more effective at managing their own instruction, and that those with a higher level of understanding already have in place a knowledge structure with which to tie in new information, these results seem like logical outcomes. Results such as these suggest that students should be given the training to become self-managers as well as instructional assistance in self-management, and that those without a strong knowledge base should be assisted in making the links that will help establish the structure for new knowledge.

INEXPERIENCE/DISCOMFORT. Inexperience in use of learner control can negatively influence its effects. Gray (1987) found provision of learner control in instruction on economic policy to promote higher achievement on an

immediate posttest *and* less positive attitudes toward the instruction than linear control. The type of learner control offered in her study involved the ability to flip backwards and forwards to any point in the instructional sequence, a procedure that could have been somewhat foreign and confusing to students. It is this type of problem that may result with the use of some interactive learning systems—learners who follow sometimes obscure links between instructional elements can be confused or get lost before they have a firm grasp of how the system works and how the content itself is structured (Fiderio, 1988). Because inexperienced learners could find such learner control to be confusing, it is critical that instruction include information about learner control options and practice in exercising them.

Discomfort in the exercise of learner control can also negatively impact its effectiveness. In one learner control study, college students were allowed to ask for additional supporting examples within self-paced mathematics instruction, but had to do so in front of two other students in their group (Ross & Rakow, 1981). It is possible that asking for additional examples in front of others might generate embarrassment because of an implied lack of understanding, and dampen students' enthusiasm for exercising control. This possibility underlines the importance of control options being both appealing and non-threatening.

Effectiveness of Learner Control within Instruction

LEARNER CONTROL AND THE INDIVIDUALIZATION OF INSTRUCTION. Ross and Morrison (1989) suggest that learner control over the *contextual* properties of instruction will allow students to tailor according to their personal interests and performances. For example, when undergraduate nursing and education majors were allowed to select the themes used for explanations and problems in statistics instruction, their performance was found to improve (Ross, McCormick,& Krisak, 1986). White (1974, reported by Perlmuter & Monty, 1977) found that when fifth-grade students were allowed to choose which four stories they would read during a reading comprehension test, these students performed significantly better than those who could not choose. Even the latitude to select one of the four stories elevated students' performance in White's study.

Besides selection of thematic settings for instruction, learners may also benefit from control over other contextual factors, such as text density and instructional medium. When undergraduate education students were allowed to select the text densities (high or low) and medium (print or computer) for their instruction, their achievement was significantly higher than that of students who had only been able to select text density (Ross, Morrison, & O'Dell, 1988). Results of a study conducted by Pascal (1971) indicate that providing college students with their choice of medium for a semester's psychology instruction (independent study, lecture, and lecture and discussion) can result in more positive student attitudes toward the instruction than if students are assigned their second or third choices. And as will be discussed later on, exercise of this type of control may serve to make instruction more motivating by increasing personal relevance.

LEARNER CONTROL AND THE PROVISION OF ADVISEMENT. Some learner control research, such as that conducted by Carrier and Williams (1988) suggests that learners can make effective use of learner control, performing as well as or better than those under external control. However, a critical factor in the effective use of learner control appears to be the provision of advisement—suggestions on how to exercise learner control successfully or when to do it. Advice such as this has included the optimal amount of practice needed (based on sophisticated models), how a student's performance compares to program criteria, and how and when to use learner control (based on general suggestions).

The Minnesota Adaptive Instructional System (MAIS), developed by Tennyson and Rothen (1979), is an adaptive model for determining the optimal amount of practice. It

is based on prior knowledge, a criterion level of performance, and a "Loss Ratio" reflecting losses associated with advancing a learner whose true level of functioning is below the criterion and retaining a learner whose true level exceeds the criterion. The model is continuously updated with each student response. It can be used to determine the amount of practice an individual receives (adaptive control) or to advise the learner, who has control over amount of practice, on how best to achieve the objectives. Application of this model for instruction in psychology (college students) and physics (high school and college students) suggests that provision of such advisement is a critical factor in effective use of learner control over amount of practice (Tennyson, 1980, 1981; Tennyson and Buttrey, 1980).

In studies examining control over content review (Campanizzi, 1978; Kinzie, Sullivan, & Berdel, 1988), advice was based on student performance relative to program criteria and was provided along with the option to review related content. While students exercising this control selected fewer reviews than those automatically assigned reviews, they achieved a higher performance on the posttest than those who had not been given control.

Advice in the form of general encouragements to select learner control options has been found to lead to more active exercise of learner control. Carrier, Davidson, Williams, and Kalweit (1986) provided sixth-grade students with optional instructional elaborations in computer-based instruction on advertising techniques. Some students were given encouragement to select the instructional options: two-thirds of the screens displaying option opportunities also included encouragement to do so: "Try another practice; more practice may help you learn better" (p.225). While no differences resulted in posttest achievement, students receiving encouragement selected significantly more instructional options than those receiving no such encouragement.

These studies suggest that learner control can be exercised in instructionally effective ways when advice is provided. Milheim and Azbell (1988) suggest that when advising the learner to choose particular instructional options, a rationale should also be provided as to why these particular choices should be made. Presentation of such advice, along with the option to discard the advice if it seems inappropriate, can provide the means for learners to effectively individualize their own instruction, by making informed instructional selections in a supportive and empowering environment.

LEARNER CONTROL AND THE DEVELOPMENT OF INSTRUCTIONAL STRATEGIES. Results of a study conducted by Newman (1957) suggest that learners can develop effective learning strategies on their own, when given learner control. In this study, the study strategies that military trainees developed on their own for learning electrical symbols proved to be more effective than those developed by instructional experts.

Adaptive, learner controlled, and randomly determined study sequence strategies were compared by Atkinson (1972) in the presentation of German vocabulary words to college students. After administering a delayed posttest, Atkinson concluded that students can be very effective in determining the optimal study sequence (a 53% gain over random presentation), but not as effective as an adaptive teaching system based on students' prior responses to items of unequal difficulty (a 108% gain over random presentation). Given the effectiveness demonstrated for advisement in the paragraphs above, one wonders if providing advisement based on this adaptive method would further enhance the effectiveness of learner control.

LEARNER CONTROL AND THE ENHANCEMENT OF ATTITUDES AND MOTIVATION. Research indicates that students are motivated to control their own learning and that learner control can result in more positive student attitudes, less anxiety, and higher levels of student engagement. There is also research support for the notion that the exercise of learner control can produce greater perceptions of personal control and, consequently, a stronger motivation to learn.

Results of two studies with high-school students and computer-assisted science instruction suggest that students want to exercise learner control. In a free-choice situation, students in these studies overwhelmingly elected to return to instruction in which content review was learner controlled rather than program controlled (Kinzie & Sullivan, 1989a, 1989b). In addition, the exercise of control options in an instructional situation has resulted in more positive student attitudes toward the instruction. Similar to the results obtained by Pascal (1971, described above), the findings of Hurlock, Lahey, and McCann (1974) suggest that when military trainees are allowed to choose among training topics within CAI on electronics, they develop more positive attitudes toward the instruction than when they are branched to topics on the basis of their pretest scores.

Learner control has also been linked to reduced levels of student anxiety. In a study conducted by Hansen (1974), anxiety in college (as measured by a state-anxiety scale) was aroused when the students were informed that their performance on some computer-assisted instruction was indicative of their intelligence and that they would be compared to other college students. Students given learner control over receipt of feedback within the instruction experienced significantly greater decreases in anxiety than those provided routinely with feedback. Students provided with no feedback remained highly anxious throughout the instruction. Comparable findings were reported by Stotland and Blumenthal (1964). Students were told they would be completing ability tests highly predictive of success in life. Students who were told they must follow a prescribed order in completion of the tests experienced a significant increase in anxiety (as indicated by a measure of palmar sweat); those who chose the order of test completion experienced no such increase. Related research in social psychology suggests the positive effects of provision of control in situations involving negative environmental stimuli (Sherrod, Hage, Halpern, & Moore, 1977; Rodin, Solomon, & Metcalf, 1978) and in the lives of the elderly (Langer & Rodin, 1976; Rodin & Langer, 1977; Schulz, 1976, Schulz & Hanusa, 1977).

Provision of control options has also been linked to higher levels of student engagement. When middle-school students were given a choice over the difficulty level and amount of practice in arithmetic, observation and categorization of student behaviors across 15 days indicated that while these students completed fewer problems, they were more engaged in the instruction than those who were given problems of identical difficulty and who spent the same amount of time on the activity (Fisher, Blackwell, Garcia, & Greene, 1975). Instructional engagement can be a positive learning outcome, and when students exercise learner control options by making conscious choices, they will tend to be more engaged and to invest more in the learning activity. Similar results have been obtained from the encouragement of student elaboration in learning. An ultimate result has been better performance (cf., Bobrow & Bower, 1969).

Theory suggests that provision of learner control can produce greater perceptions of personal control and, as a result, more intrinsic motivation for the instructional activity. Support for the connection between learner control and perceptions of control has been provided by Arlin and Whitley (1978), who found that the perceptions of control held by fifth- through seventh-grade students were directly related to the number of opportunities the students were given to control their own learning. Control has also been directly linked with motivational outcomes, as will be documented in the following section on self-regulated learning research.

Research on Self-Regulated Learning

Effective use of interactive instruction requires learners to be self-directed and self-regulated, but some investigators note that students may lack the appropriate skills. A significant body of research suggests, however, that self-regulation strategies can be learned and used by students, though the extent to which these skills will be transferred to novel situations remains unclear.

This research will be described in the paragraphs which follow.

Training in Student Self-Management

Wang (1983) noted that students highly developed in self-management tend to use previously learned concepts and to be persistent in seeking out new information, but that students low in self-management skills have a tendency to adopt problem-solving strategies regardless of their effectiveness. A similar observation was made by McCombs (1982-3): many individuals have trouble adjusting to self-directed learning—they lack effective study strategies and skills as well as basic personal responsibility skills related to self management and the motivation to learn. Recognizing that many individuals may not be equipped with effective learning strategies, or that they may use strategies ineffectively, a number of researchers have turned their attention to the teaching of strategies and how to use them.

Research indicates that students can be successfully taught to use specific learning strategies. Gray (1982, cited by Corno & Mandinach, 1983) was successfully able to train less able students to use organizing processes in their note-taking, something they neither spontaneously did nor were effective at previously. Moreover, students will use organizational/memory tools to modify and improve their own learning strategies when not required to do so (Steinberg, Baskin, and Hofer, 1986). Providing strategy value information can help ensure continued strategy use. Schunk and Rice (1987) suggest that students can be encouraged to use a strategy simply by being informed that use of the strategy can improve performance.

In the self-schedule system developed by Wang (1983), students are taught the skills required to assume responsibility for planning and carrying out instructional activities. At the same time, teachers are trained in techniques to maximize the use of school time for instruction. Students are then allowed to schedule their own learning activities but must budget their time to complete all assignments as well as a number of exploratory learning tasks of their own choice within a set amount of time. Results of studies examining the effects of the self-schedule system suggest that as students learn self-management, they become more independent, purposeful, and attentive, and they exhibit higher rates of on-task behavior than students in traditionally managed classrooms (Wang, 1983). In addition, several of these studies indicate higher task completion rates under the self-schedule system.

Once students gain experience in regulating their own learning, research suggests that the degree to which they effectively self-regulate will increase. In a study conducted by Armstrong (1989), third-, fifth-, and eighth-grade students developed their own strategies for two sets of increasingly complex tasks. For each task, they also had to "teach" a computer to complete the task. In the process, students increasingly demonstrated the ability to analyze and adapt their strategies to arrive at computer task completion; they also applied strategies they had developed to new task situations. Over the two-week period, questioning by the students also indicated increased self-reliance. During initial sessions, students were most concerned with whether they had the right answer. In contrast, students in final sessions asked purposeful, information-gathering questions directed to assist them in devising appropriate strategies.

Self-Regulated Learning and Learning Control

Theory suggests that self-management is an important complement in the exercise of learner control, and research supports this contention—self-management can make the provision of learner control more effective. Greiner & Karoly (1976) found that providing undergraduate psychology students with instruction in self-monitoring, self-reward, and planning skills along with learner control resulted in greater mastery of study skills knowledge than did four other treatments including control alone. Campbell (1964) found that "coached practice" on the use of learn-

ing strategies was a significant addition to self-directed learning techniques used by ninth-grade mathematics students. In his study, coached practice was provided to one-half of the students in both self-directed and linear learning groups. The practice involved an initial discussion session on self-directed or linear learning and three additional hour-long sessions in which students studied but were interrupted once or twice to critically evaluate their study procedures. After eight class periods, the self-directed students outperformed those in the linear instruction group but only when they had received coached practice.

At the same time that self-regulated learning skills can enhance the effectiveness of learner controlled instruction, students must have some degree of control to be able to regulate their own learning. Results from a series of studies conducted by McCombs (summarized in McCombs, 1984) suggest that effective training in self-management strategies should also include opportunities for individuals to take responsibility and control of their learning. Ross and Zimiles (1974, cited by Wang, 1983) found that when instruction incorporated learner-controlled features, students were more autonomous, asked more questions, and participated in more conceptually based information exchanges than students in traditional classrooms.

Self-Regulated Learning and Continuing Motivation

Research indicates that self-regulated learning methods can result in greater continuing motivation to learn. After a year-long course in geography for fourth- and fifth-grade students, Campbell and Chapman (1967) found that students who had directed their own study reported a significantly greater gain in motivation for learning about geography and directing their own course of study than did students in fixed linear instruction who depended on the teacher for direction. Training in motivational skills and learning strategies (both important components of self-regulated learning) prior to entering a technical course was found by McCombs (1984) to result in higher levels of both motivation and performance.

In addition, the enhancement of feelings of personal control (one of the requirements proposed for motivating instructional situations) is one of the outcomes noted in research on self-regulated learning. In their application of the self-schedule system, Wang and Stiles (1976) gave second-grade students control over the order in which they completed their assignments in class and the time they would spend on each. The students reported greater perceptions of self-responsibility and completed a significantly higher proportion of the assignments than when the teacher exercised this control.

Research on Continuing Motivation

Theorists suggest that intrinsically motivating instruction is associated with feelings of competence and self-efficacy, perceptions of personal control, perceptions of relevance, and stimulation of individual curiosity. Little research has been conducted, however, examining the links between these components and continuing motivation. Several studies investigating the relationship between student perceptions of control and motivation are described below, as is a study which begins to explore the connection between relevance and motivation.

Perceptions of Control and Motivation

Locus of control, which indicates the degree to which individuals believe that events and outcomes are a result of their own behavior, is one measure which has been used in the study of continuing motivation. Crandall, Katkovsky, and Preston (1962) found a positive relationship between boys' responsibility for achievement outcomes (measured by a locus of control questionnaire) and their intrinsic motivation to learn, as expressed by reported time spent in achievement-related, free-play activities. In an observational study by Stephens (1971, cited by Wang, 1983), students with an internal locus of control were found to be active and assertive learners who

were excited about learning, whereas students classified as externals were relatively passive, inattentive, and non-exploratory.

Harter & Connell (1984) found students' perceived control to be the critical variable at the beginning of a predictive chain involving both achievement and motivation. In their study of 785 elementary and junior-high-school students, the students' perceptions of control, defined as the degree to which they felt responsible for their academic experiences, directly influenced academic achievement. Achievement in turn affected the students' feelings of competence, and competence affected motivational orientation. The results of numerous studies indicate significant positive relationships between an internal locus of control and achievement (see Findley & Cooper, 1983; or Stipek & Weisz, 1981; for reviews).

Perceptions of Relevance and Motivation

Research cited previously suggests that allowing students to select the themes, topics, and medium used within instruction will result in improved performance and attitudes. The effects of this practice on student motivation have not been explored, however. It can be argued that when students exercise such contextual control, they are making the instruction more personally relevant and thus more intrinsically motivating. Results from a study conducted by Herndon (1987) lend support to this argument. In his study, examples in logic instruction for high-school seniors were based on their responses to an interest inventory, making the instruction more relevant to the students. Greater levels of continuing motivation for the instruction were found when such interests were incorporated than when they were not.

Summary: Research on Learner Control, Self-Regulated Learning, and the Continuing Motivation to Learn

In the research conducted on learner control, student control over the contextual properties of instruction (thematic setting, medium, text density, etc.) has resulted in improved achievement, attitudes, and motivation. For the effective use of other types of control, the provision of advisement appears to be a significant factor. Limited research has been conducted on the specific effects of learner control options on the development of instructional strategies; better support for strategy development is provided by research on self-regulated learning. Individuals do seem to be motivated to select learner-controlled instructional materials, and learner control has been linked with a variety of positive affective outcomes. Research support has also been provided for the connection between provision of learner control and individual perceptions of control (theorized to be a requirement for continuing motivation).

While students may lack skills in self-regulation, research suggests that these management skills can be taught. Related interventions have resulted in ability to use learning strategies and in the use of the strategies when not required to do so, as well as in a range of positive behaviors including an increase in independence, attention, engagement, and higher rates of task completion. Self-regulated learning has also been linked to greater student motivation for learning. And just as provision of learner control has been linked to greater perceptions of personal control, the promotion of self-regulated learning has been linked to higher levels of personal responsibility for learning.

Of the components proposed by theorists for intrinsically motivating instruction, research has been conducted only on the perceptions of control and relevance. Students with an internal locus of control (a perception that instructional outcomes are a result of their own behavior) have been found to be intrinsically more motivated to learn. Perceived control has also been suggested in the research literature as a precursor to both achievement and motivation. Initial research on the connections between relevance and motivation suggest that when instructional examples are based on student interests, increased continuing motivation may be among the positive outcomes.

RECOMMENDATIONS FOR FUTURE RESEARCH

Research and theory suggest that the elements of learner control, self-regulation, and continuing motivation can be mutually supporting, while all three have been shown to be effective for promoting a variety of positive instructional outcomes. How can the potential of these instructional elements be realized and the outcomes of learner self-direction and motivation be encouraged? The issues described below will be of specific interest as research in this area continues.

Learner Control Research

To begin with, some of the benefits of learner control within instruction may be apparent from a cognitive rather than a behaviorist perspective. Because of this, outcomes considered within learner control research should include the development of effective learning strategies, the continuing motivation to learn, and long-range achievement.

Secondly, researchers examining learner control should continue to explore ways in which advisement can be offered to assist individuals in use of learner-controlled features and regulation of their own learning. In this exploration, outcomes such as development and use of effective learning strategies and continuing motivation should be examined as a function of both the opportunity for learner control and the provision of advisement.

Thirdly, the relationship between the provision of learner control and student perceptions of control within instruction should be considered. As pointed out earlier, provision of learner control does not necessarily result in perceptions of control for the learners. How can the link between learner control opportunities and a student's perception of control be strengthened, thus capitalizing on the potential for positive motivational effects?

Research on Self-Regulated Learning

Many questions remain on how best to train students in self-management. While research suggests that self-regulated learning strategies can be taught and will be adopted, what can be done to ensure these strategies will be effectively used in the same or novel situations? How can we guide students to become self-teachers (Jacobson & Thompson, 1975)? And like the relationship between learner control opportunities and perceived control, the relationship between self-regulation strategies and personal responsibility for learning is worthy of continued examination.

Research on Continuing Motivation

Will instruction that promotes feelings of competence and self-efficacy, personal control, relevance, and curiosity result in higher levels of continuing motivation than instruction that does not? A few studies have been conducted to date involving personal control and relevance that suggest positive motivational effects. More research is needed on these elements and their relationship to continuing motivation.

Research on This Interactive Instructional Perspective

Theory and research provide support for the components of the perspective presented here. Future research must examine larger portions of the framework advanced to determine its appropriateness in the design and use of interactive instruction. Besides providing support or dictating revisions, research in this area can serve to expand the foundations to define more inclusively what makes interactive instruction effective. For example, it is conceivable that instruction might incorporate all of the components suggested here and still be ineffective. How do other critical components dovetail with those discussed?

Finally, of particular interest will be determinations of how to effectively *use* well-designed interactive systems so that potential benefits are realized. For instance, how can we best prepare learners for this instructional experience? What follow-up methods will assist in transfer of knowledge and skills to new

learning situations? Through pursuit of these and other research questions, we will be able to further develop what we know about what makes instruction effective and learners successful.

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