Instructional Prescriptions for Learner Control

Jaesam Chung and Charles M. Reigeluth

There has been a great deal of research in the area of learner control, which is widely *believed* to be a highly desirable feature of individualized and interactive learning systems because, it is said, this enables learning to be individualized to each person's needs. Learner control of instruction is intuitively appealing, since it is assumed that individuals will be more highly motivated if allowed to control their own learning.

Unfortunately, research findings regarding the effects of learner control have been inconclusive, and, what is more, they have been more frequently *negative* than positive (Carrier, Davidson, and Kalweit, 1986; Steinberg, 1977; Ross and Morrison, 1989; Tennyson, 1980). So, whereas learner control of instructional options has a great deal of intuitive appeal, and an enormous amount of computer-based program design has been carried out, much of the actual research in the field contradicts the theory of unrestricted learner control.

These negative findings may occur because many students, especially low-achievers, lack the knowledge and motivation to make appropriate decisions regarding such conditions as pacing, sequencing of content, use of learning aids, and amount of practice. These negative findings may also exist because most learner-control strategies employed in research have been insufficient or piecemeal.

Teachers may require more systematic guidelines for implementing effective learner control in instructional situations. A comprehensive, integrated, and prescriptive *theory of learner control* that is viable for interactive learning systems may lead to more effective implementation of learner control.

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Questions Addressed

In the process of instructional prescription building—and as a result of it—the following questions are considered in this article:

- What types of learner control are available in learning situations?
- What are the *condition* and *outcome* variables when learner control types are considered as the *method* variable?
- How can educators and instructional designers identify the functional relationships among learner control, learner cognitive development, learning domains, and learner motivation?
- What can be done to ensure that learners will be able to *effectively* control and regulate their own learning in different instructional systems (especially in hypermedia systems)?

The instructional prescriptions constructed in this article are intended to offer teachers guides to help learners make appropriate control decisions or to allow learners to have effective control over learning processes. In order to develop viable instructional prescriptions of learner control, the developer should create a set of effective *instructional actions* that can bring about the learner's desired *learning outcomes*.

We review a variety of literature, both empirical and theoretical, relevant to "learner control." Learner control strategies are analyzed and classified according to the Conditions-Methods-Outcomes [C-M-O] paradigm (Reigeluth, 1983).

In this article, a variety of learner control methods (including content control, sequence control, pace control, display control, internal processing control, and advisement strategy) are identified and integrated. We inductively integrate the current knowledge concerning learner control into a prescriptive form useful to instructional designers and teachers. The article prescribes a *smorgasbord* of individual learner control strategies to cope with individual learning and instructional situations, as does Keller's ARCS model of motivational design (Keller and Kopp, 1987).

Relationship and Prescriptions

Current instructional prescriptions of learner control are composed of: (1) instructional outcomes, (2) instructional conditions, and (3)

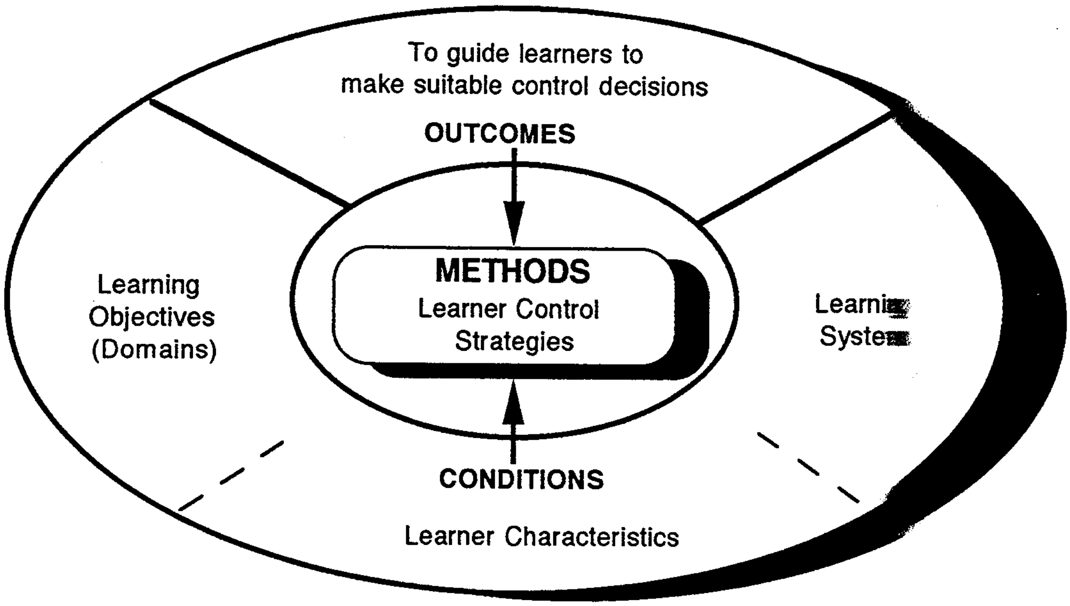

Figure 1. Variables of Learner Control

instructional methods. Figure 1 displays the relationships among these three kinds of learner control variables.

Instructional Outcomes

Reigeluth (1979, 1983) classifies outcomes into three categories: effectiveness, efficiency, and appeal of the instruction. Four important aspects of the effectiveness of instruction are the accuracy (error rate), the speed (performance efficiency), the degree of transfer, and the duration of knowledge retention. The efficiency of instruction is usually measured by the effectiveness divided by student time and the cost of instruction. The appeal of instruction is measured by the learners' appreciation and desire to continue to learn.

Instructional Conditions

The selection of specific learner control strategies is determined by three sets of condition variables: (1) learner characteristics, (2) learning objectives or domains, and (3) learning/instructional systems.

Learner characteristics involve the learner's cognitive developmental stage (readiness), age, motivation, task persistence, aptitude, ability, prior knowledge, and metacognitive skills.

Learning objectives, or domains of learning, are also a crucial condition variable (constraint) of learner control. Gagne (1985) classifies human learning domains into five categories: intellectual skills, verbal information, cognitive strategies, motor skills, and attitudes. Bloom's (1956) three domains (cognitive, affective, and psychomotor) and Merrill's (1983) performance-content matrix (remember, use, and find; fact, concept, procedure, and principle) are good classifications of learning domains. Reigeluth (1989) suggests several types of learning, including memorization, understanding, skills application, generic skills, and affective learning. Both Gagne's and Merrill's classifications have been considered in our current work.

Instructional/learning systems also seem to be an integral part of learner control. These include non-individualized systems, individualized instructional systems (such as traditional CAI, TICCIT), intelligent learning systems (such as ICAI), and multimedia systems. In this article, learning systems are focused mainly on hypermedia systems because basic assumptions of learner control match well with hypermedia in terms of the dynamic, systemic relationship between the learner and the learning environment (Locatis, Letourneau, and Banvard, 1989; Wilson and Jonassen, 1989).

Instructional Methods

Method variables of learner control in current theory include Merrill's (1984) notion of content control, sequence control, pace control, display (strategy) control, internal processing control such as conscious cognition and metacognition, and intelligent advisors (Merrill, Li, and Jones, 1990). In addition, Tennyson *et al.*'s (1985) advisement strategy and Reigeluth's (1979, 1983) notion of macro-level control (such as sequencing, selecting, summarizing, synthesizing) can also be considered learner-control strategies.

Prescriptions for Learner Control

There are several different method components, each of which is prescribed based on different condition variables, so that users can *mix* and *match* according to their particular needs. Below is a list of learner control prescriptions that, based on the appropriate conditions, will optimize desired instructional outcomes.

A. Content Control.

Offer content control WHEN:

1. Students have significant previous knowledge in a content area, because presentation of known materials could be irrelevant and uninteresting to them (Gay, 1986). If one knows about content, one can use options effectively. Selection of topic is dependent on the learner's competencies in the topic (Judd, Bunderson, and Bessent, 1970; Sasscar and Moore, 1984).

2. Students are permitted to set their own learning goals.

3. Students are of higher ability, because such learners may be better able to make content choices based on their needs.

4. There is a high probability of success relatively independent of the chosen content, and students perceive through feedback that success is under their personal control and is in fact relatively controllable.

5. Different students may see the relevance of different content and are able to use this information effectively in novel ways during the learning of cognitive strategies and higher-order problem solving (Gagne, 1985).

6. Learner control is likely to work well compared to program control when higher-order skills rather than factual information are being taught, and when the content is familiar to learners (Hannafin and Peck, 1988). Provide learners with more opportunities to make content selection as learners grow older (Merrill, 1984).

DON'T use learner control of content WHEN all topics in instructional presentation are required for successful completion of the program, or WHEN there is a hierarchical order to the materials.

B. Sequence Control

Provide learner control of sequence WHEN:

1. Lengthy instructional programs are introduced with no specific presentation order, because sequence control can help maintain learner motivation and interest.

2. Students are familiar with a topic and are able to make appropriate sequence choices that are relevant to them (Gay, 1986).

3. There is a high probability of success relatively independent of the chosen content, and students perceive through feedback that success is under their personal control and is in fact relatively controllable.

4. Students have previous knowledge of content or are of higher ability, because they may be better able to construct or reconstruct schemes in ways that are meaningful to them.

5. The type of learning includes cognitive strategies or higher-order problem solving, because sequence control will allow students to make selections that may facilitate flexible and novel thinking (Gagne, 1985).

6. The opportunity arises for the student to sequence the objectives within a particular course of instruction in any order IF the student so desires.

7. *Self-paced individualized materials* (such as workbooks, textbooks, etc.) are used.

8. Learners are able to use prior knowledge to

determine their instructional sequence (Mager, 1961; Mager and Clark, 1963).

DON'T provide sequence control to students in situations where the materials have a specific prerequisite order, because learning could be inhibited if the sequence is improperly chosen. DON'T use sequence control WHEN the objectives or contents (segments, lessons, and units of instruction) are sequenced, as in *linear delivery systems* (lectures, videotapes, filmstrip presentations, or movies) which make the reordering of content components difficult.

C. Pace Control

Provide learner control of pace WHEN:

1. Control can give students greater relevance and satisfaction by allowing them to spend more time on those topics that relate to their personal needs and goals.

2. Students believe that expending more time will increase their success.

3. Learners are using individualized instruction or self-paced instruction (Merrill, 1984).

4. Attributional feedback may suggest spending more time on certain topics (for those students who do not achieve the required objectives).

5. Students would benefit from additional time to integrate new information with previously constructed schemes.

6. A moderate level of control over learning time would tend to improve the performance of the learner (Tennyson, Park, and Christensen, 1985).

7. Coached practice on self-directed study can increase performance and motivation, and can reduce instruction time (Campbell and Terry, 1963).

D. Display (or Strategy) Control

Provide learner control of display or strategy WHEN:

1. *A single subject-matter idea* (a generality or a specific example) is presented.

2. Students are provided a mechanism for selecting and sequencing those displays which they feel are required in order to understand a given objective; at least three types of display control are involved (Merrill, 1984):
   - selection of the *number of displays* required for perceived mastery;
   - control of *sequence of different types of displays*;
   - selection of *various displays.*

E. Internal Processing Control

Provide learner control of internal processing WHEN:

1. The learner interacts with the presentation of the instruction. Interaction of a variety of internal processes with the stimulus materials will help the learner perform effectively and efficiently.

2. In order to encode the information presented by a given display, the learner should use mental processes (conscious cognitive skills).

3. In order to compensate for inadequate display, learners appropriately select the *cognitive processing activities* such as *rehearsal, repetition, paraphrasing, imaging, encoding via mnemonic, exemplifying,* and *covert practice.*

4. In order to obtain a record of the processing attempted for each display, an *introspective interview with the learner* is used.

5. In order to guide interaction with an instructional system being used, the learner should use the "how to study or learn" model (not the cognitive skills).

6. Learners are taught to use more appropriate methods; thus, they acquire not only subject matter but also some internal theory about "how to learn."

7. The introspective interview technique is used in order to assess the meta-cognitive models being employed by a student (Merrill, 1984).

F. Advisor Strategies

Provide learner control of advisor strategies WHEN:

1. In order to determine whether a given learner needs a particular type of interaction ("transaction"), which was not originally included in

the transaction frame sets of the course (Merrill, Li, and Jones, 1990), an Intelligent Advisor System is used.

2. Advisement is based on Bayesian adaptive models in order to effectively adopt learner control strategies, such as amount of practice or review (Tennyson, 1980, 1981).

Learner Control and Hypermedia Learning Systems

In hypermedia learning systems, the following prescriptions for learner control are applicable:

1. Provide extra guidance or teaching objectives in hypermedia systems for low-ability learners to develop their metacognitive skills. Provide a *default path* or *guided tour* through the knowledge base if learners are new to the hypermedia system or lack confidence in their navigation skills (Jonassen, 1989).

2. Provide a *graphical browser*, the most common navigation aid, to help hypermedia users navigate through a sea of information—where they started, where they are, or how to return to familiar terrain (Wilson and Jonassen, 1989).

3. Provide *audit trails* (which are histories of the nodes and links that the user has accessed in a linear order) to help users make informed decisions, and to help them encode the structure of the knowledge base (Wilson and Jonassen, 1989).

4. Offer standards for screen layouts and link identification when helping learners to synthesize information in collaborative settings (Sadler, 1991).

5. To lesson user "disorientation" in hypermedia learning systems: Allow learners to make conceptual links in their own personal information management systems.

(In presentation settings)
- Develop systems in which the information is presented in breadth rather than depth, both in terms of content and system structure.
- Develop systems in which the user is able to determine his/her relative and logical location within the system.

(In collaborative settings)
- Develop or utilize a common metaphor.
- Utilize narrow paths and consistent link marking.

(In navigation settings)
Provide fast stem speed, user navigation strategies, and the placement of an "exit" button on each screen (Sadler, 1991).

6. To mitigate user "distraction" in hypermedia learning systems:

(In presentation settings)
Intuitively provide methods of navigation to the users.

(In collaborative settings)
Develop and provide standards for screen layout and links.

(In navigation settings)
- Develop a standard hierarchy for the presentation of information.
- Allow the user to determine the number of linked windows open at one time.
- Utilize the infinite "undo" within the system (Sadler, 1991).

7. Provide learners with continuously available "help" to ensure successful use of learner control and learner self-regulation, and to minimize frustration in hypermedia systems (Kinzie and Berdel, 1990):
   how to take notes or use the drawing tablet,
   how to get more information,
   how to look up a word,
   how to return to a previous point,
   how to move ahead to new information,
   how to exit the program.

8. Use expert systems technology to facilitate learner control decisions in hypermedia. The combination of expert sytems and hypermedia systems can generate new content, look for inconsistencies in the knowledge base, model the user's learning style and preferences, make decisions about teaching strategies and sequence, and provide explanations for system behavior (Wilson and Jonassen, 1989).

Conclusion and Implications

We have discussed learner control as one of the main issues in instructional management (Reigeluth, 1989) and noted the importance of effective and efficient instructional guidance to help learners control their decisions. There are different method components, each of which is prescribed based on different condition variables, such that the user of these prescriptions can mix and match according to his/her particular needs. Teachers and instructional designers may have the chance to consider the functional relationship among learner control strategies, learner characteristics, types of learning (or learning domains), and learner motivation. They can use this prescriptive knowledge base of learner control in order for their students to maximize the effectiveness and efficiency of a given learning situation.

All instruction involves some learner control. Our challenge is NOT whether or not learner control should be used, BUT rather *how* to maximize the learner's ability to use the learner control available and to decide what kinds of learner control to make available. Every student has some type of internal "how to learn" model that directs his/her control of the learning situation.

Therefore, the most promising area for future exploration is to help learners to develop internal adaptive models that direct their use of appropriate internal processing. We should seek to identify the nature of learner control in every instructional situation, and know more about the types of conscious cognitive control which may be appropriate for different outcomes and for different strategies. Outcomes considered within learner control research should include the development of effective learning strategies and the continuing motivation to learn. We should explore ways in which advisement can be offered to assist individuals in the use of learner-controlled features and regulation of their own learning. □

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