Designing Practice: A Review of Prescriptions and Recommendations from Instructional Design Theories

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Abstract. Most instructional theories offer some unique and valuable suggestions related to the design of practice activities. However, no single theory or model is available which provides instructional designers with answers to many basic questions related to designing practice activities. The purpose of this paper is to summarize the strategies and suggestions offered by various prominent instructional theories and thereby provide a useful guide for designing the practice component of instruction.

Various instructional theories include recommendations for designing practice activities for different types of learning tasks. Each theory offers some unique and valuable suggestions related to the design of practice activities. However, no single theory or model is available which provides the answers to many of the basic questions instructional designers frequently encounter in designing the practice component of instruction such as: "How much practice is required for skills which will later serve as subskills to more complex skills?" "Should separate skills be practiced separately or should they be practiced together?" "Where should help be used during practice?" "When should practice items be selected at random?" In order to aid instructional designers in answering these questions, a more useful and complete guide is needed. The purpose of this paper is to summarize the somewhat piecemeal strategies and recommendations included in various prominent instructional theories and thereby provide a useful guide for designing the practice component of instruction.

It might be appropriate to state why such a focus on the practice component of instruction is needed. One reason comes from research in modern cognitive learning theory which suggests that in order to perform complex intellectual tasks such as reading, computing, or computer programming, many of the subskills involved have to be *automatized* so that attention can be devoted to the more intricate and complicated aspects of the total task (Anderson, 1980). Certain critical subskills must not only be mastered but must, through practice, be brought to a state of automaticity. Research in areas such as reading and mathematical problem solving suggests that one reason students have difficulty performing higher order cognitive skills is due to a lack of automatic performance of the underlying subskills (Lesgold, 1983; Lesgold & Resnick, 1982; Resnick & Ford, 1981).

Another reason to concentrate on practice stems from the increased use of computer-based training. Microcomputers allow designers to incorporate into practice strategies psychological techniques and procedures beyond what might otherwise be possible. However, designers still need some guidance in selecting the appropriate instructional techniques for various types of computer-based practice activities.

A third reason is the current use of authoring systems or templates for the design of CAI. Generally, the various authoring systems that have been developed offer only one strategy for practice while most instructional design theories prescribe different practice activities for different types of learning tasks. For this reason, several authors have recommended the development of more specialized templates for authoring. To quote Merrill (1981): "The use of templates would be more acceptable if a variety of templates were provided for the different types of learning" (p. 10). An integration of the various strategies and prescriptions provided by instructional design theories is needed in order to design authoring templates for specialized types of practice activities.

Some theorists have made the observation that there is already a great deal of scientific knowledge about learning and cognition and what is needed now is a synthesis of those areas of knowledge which are most likely to increase the quality of instructional products (Reigeluth, 1983; Reigeluth, 1985; Gerlach, 1984). Conceivably, this synthesis would result in prescriptive models or generalizable rules which would guide the behavior of instructional designers. This paper attempts to provide such a synthesis in the area of designing practice. It is also hoped that this work will stimulate the formulation of other syntheses.

Rationale for Selection of Theories

Theories which provide the most pertinent information for the design of practice have been selected for review. There are many good instructional models which are not included because they concern themselves primarily with course development or large-scale curriculum or program development and do not provide recommendations for the design of the practice component of individual lessons.

The motivational design model of Keller (1983) was included because motivation is important in the design of practice and because it is relatively neglected in other instructional theories. While some of the theories regard motivation as an important element of instruction, none provide any concrete strategies for enhancing motivation.

Recommendations for the Design of Practice Activities Derived from Behaviorism

Behaviorism is concerned with those factors in learning that are external in nature. The behaviorist is interested in predicting and controlling behavior through reinforcement. In a behavioral approach, the learner is presented with a stimulus, and a response is made. The response is then reinforced. When a stimulus is presented repeatedly, and the appropriate response to it is made, the response is said to be under the control of that stimulus. Establishing stimulus control depends upon two conditions: active practice of the correct response; and, reinforcement of the response following its practice.

Stimulus control is established through four levels of skill acquisition. These are: *discrimination* level (learning to discriminate one stimulus from another), *generalization* level (learning to respond to any stimulus belonging to the same class of stimuli), *association* level (learning to associate an appropriate response with a stimulus or class of stimuli), and *chaining* level (learning to combine S-R associations into a complete chain). Learning to perform an activity involves learning to discriminate stimuli, generalize, associate, and chain. The object of practice is to help the learner master all the S-R associations in an activity and to integrate them into a complete chain. Techniques such as *incrementing*, *shaping*, and *fading* are used to accomplish this.

One might view the behaviorist theory as a collection of general principles and concepts which govern the acquisition of a skill. George Gropper has done a great deal of work in integrating the general principles of behaviorism into concrete prescriptions for designing instruction (Gropper, 1973, 1974, 1975, 1983). Gropper identifies six "tools" which instructional designers can apply directly to specific instructional tasks. In essence, these tools are components of the learning environment which can be varied to increase or decrease the demands put on students at any stage in a practice progression. *Early practice* sessions are designed to place less demand on students, *intermediate practice* sessions increase demands on students in one or more ways, and *final practice* sessions require students to perform the skill in criterion mode. The six tools are:

1. The amount of cueing that is provided for a practice task,
2. The size of the unit of behavior that is practiced in a practice task,
3. The mode of stimulus and response that is required in a practice task,
4. The variety that is built into a practice task,
5. The type of content involved, and
6. The frequency with which a task is practiced.

> What is needed are prescriptive models or generalizable rules which can guide the behavior of instructional designers.

The designer uses these tools to systematically vary the practice so that *early*, *intermediate*, and *final* practice differs in one or more of these six ways. For example, in early practice, cues are provided, in intermediate practice fewer cues are provided, and in final practice no cues are provided. Gropper's model shows how to vary practice sessions using the six tools in order to increase the demand placed upon students in the three stages of practice. Gropper provides prescriptions involving cue strength, behavior unit size, stimulus and response modes, practice example variety, content of practice, and frequency of practice.

Gropper also provides suggestions for organizing practice activities and matching practice activities to objectives. The following table summarizes his recommendations for five types of learning objectives.

Recommendations for the Design of Practice Derived From the Work of Gagne and Briggs

According to Gagne (1984, 1985), learning tasks can be classified into five categories: verbal information, intellectual skills, cognitive strategies, motor skills, and attitudes. The learning (and consequently the practice) within one category is different in important respects from the learning (and practice) in the other four categories.

Gagne and Briggs (1979) outline nine *events of instruction* which facilitate the five different types of learning. Because different conditions are required for different learning outcomes, the nature of the events of instruction also differs for each type of learning outcome. The Gagne and Briggs theory also includes some guidelines for selecting instructional media. The nine events prescribed by Gagne and Briggs are shown in Table 2.

According to this formulation, practice is defined as the portion of instruction which takes place after students have initially been presented the information needed to perform an objective (events 1-5) but before they have had an opportunity to master it. This definition of practice views practice as what student do after having been guided through the material and before being tested on it (event 8). If the students fail the test, they should then receive more practice (more of events 6 and 7). Enhancing retention and transfer is also accomplished in part through the practice component of instruction.

Some of the guidelines for selecting media coming from the theory are also applicable to the design of practice activities. Briggs defines instructional media as all methods used to present stimuli to students. In this sense, media include not only audiovisual materials, but also include the teacher and other activities. Briggs recommends that media be selected separately for each instructional event depending on what conditions are necessary to present that event. Based on this idea, media for the practice component of instruction would not necessarily be the same as the media

Table 1
Practice Treatments for Five Types of Learning

Type of Learning	Initial Practice	Intermediate Practice	Final Practice
Learning Facts	• Tell students the facts they are to learn. • Provide cues to highlight the facts when a number of facts are to be learned at one time (e.g., a table of basic multiplication facts highlighting pairs of numbers and their products). • Require practice of only a few facts at a time.	• Have students apply the facts as well as state them (e.g., using the basic multiplication facts). • Fade cues used in initial practice. • Increase number of facts practiced.	• Have students apply all facts when possible. No longer require students to state the facts. • Eliminate all cues. • Have students practice the total criterion behavior (e.g., all multiplication facts are practiced in a random order).
Defining Concepts	• Define concept and ask students to state it. • Use cues to differentiate between instances and non-instances. • Have students classify instances. • Use concrete objects in early practice when possible.	• Continue to give instances and non-instances but make them more difficult to differentiate. • Have students generate some instances. • Still ask students to state definition. • Gradually make instances more abstract.	• Require students to state definition, and classify or generate instances *without* cues. • Make practice abstract, verbal, or symbolic.
Giving Explanations	• Provide students with the explanation and require them to practice stating it. • Provide specialized cues (like flowcharts and demonstrations) to help students relate *multiple concepts*. • Give examples and non-examples of the explanation.	• Continue giving examples and non-examples but gradually make them more difficult. • Require students to produce their own explanations in their own words *in addition* to giving the model explanation. • Gradually fade cues.	• Have students state the explanation in their own terms without the use of cues. • Require students to *use* the concept being explained *instead of just* giving the explanation (e.g., using the principle of reinforcement, not just stating it).
Following Procedural Rules	• Provide students with the steps for following the procedure or give a demonstration of the procedure. • Require students to practice the steps in the procedure. • Break down long or difficult procedures into smaller units and practice the individual units (e.g., learning to drive may start with learning the rules of the road before getting behind the wheel.)	• Continue practice of the individual steps in the procedure. • Add additional steps to long or difficult procedural chains.	• Require students to practice the procedure in full with no breaks in the chain.
Solving Problems	• Give students the rules needed to solve the problem. • Require students to distinguish correct answers from incorrect ones. • Break up difficult or long problems into smaller units and practice the individual units (e.g., solving long division problems is practiced step by step.)	• Give students a problem with a wrong answer and ask them to correct it. (Practice moves from the recognition phase to the editing phase) • Require students to generate their own rules for solving a problem.	• Require students to solve the problem with no help. (Practice moves into the production phase). • Ask students to generate their own solutions when possible (e.g., answering long division has a fixed procedure, and unique solutions may not be found). Other problem solving can be unique.

Table 2
Instructional Events

1. Gaining attention
2. Informing the learner of the objective
3. Stimulating recall of prerequisite learning
4. Presenting the stimulus material
5. Providing learning guidance
6. Eliciting the performance
7. Providing feedback about performance correctness
9. Enhancing retention and transfer

Table 3
Practice Activities for Different Types of Learning

Learning Outcome/ SubCategory	Eliciting the Performance	Providing Feedback
Intellectual Skills		
Discriminations	Provide a variety of items which require students to show that they see two or more objects as different objects by responding to their names.	Indicate if response was correct or incorrect. For multiple discriminations also give correct response.
Concrete Concepts	Provide a variety of items which require students to point to two or more instances of the concept. The instances should differ as widely as possible in their non-elevant or- characteristics.	Refer to properties present or not present in instances.
Defined Concepts	Provide a variety of items which require students to identify the referents of the words which make up the definition and show their relationship to one another.	Refer to the parts of the demonstration which were incorrect and tell why they were incorrect.
Rule Using	Provide a variety of items which require application of the rule.	Refer back to rule and show how correctly or incorrectly applied.
Problem Solving	Provide a variety of problems for solutions.	Change stimulus situation in response to learner's action and/or state the rule being followed or violated at each response.
Verbal Information		
Facts	Ask student to state each fact verbally.	Identify what is wrong or omitted from the statement of the fact.
Names/Labels	Ask student to provide the name/label for each object.	Identify what is wrong or omitted in the name/label.
Connected Discourse	Ask student to state the material verbatim.	Identify errors and state correct version.
Organized Knowledge	Ask student to state proposition in own words.	Identify what is wrong or omitted from the statement of the proposition.

used to present the other events of instruction. Also, the selection of media for the practice of a skill will depend upon the type of learning outcome involved.

Table 3 outlines the recommendations for eliciting responses and providing feedback for two kinds of learning: intellectual skills and verbal information. Note that the stimuli and the feedback differ for each subcategory in the two learning categories.

Component Display Theory and the Design of Practice

According to the Component Display Theory (Merrill, Richards, Schmidt, & Wood, 1977; Merrill & Tennyson, 1977; Merrill, 1983), instruction to teach cognitive subject matter consists of a series of presentations that convey information or ask questions. These presentations, or instructional building blocks, can be described using five partially independent taxonomies. These taxonomies and their categories are as follows.

1. *Type of content*: Facts, concepts, procedures, and principles (rules).

2. *Level of Performance*: remember (recall, recognize), use (classify, demonstrates), and find (discover, deduce, derive).

3. *Abstractness of Subject Matter*: generalities (definitions, list of steps) and instances (examples, specific cases).

4. *Presentation Mode*: expository (tell, illustrate) and inquisitory (question).

5. *Presentation Form*: primary presentations (generalities, examples, and practice), secondary presentations (elaborations, helps, mnemonics, feedback), process displays (advice about how to learn), and procedural displays (instructions about how to use delivery media).

This theory specifies the types of presentation (the mix of the 5 taxonomies) to include for effective instruction. Practice consists of inquisitory (4) primary presentation forms (5) that require students to demonstrate knowledge of generalities or instances (3) at any level of performance (2) and for any type of content (1).

The relationships among the 5 taxonomies can best be seen using three 2-way matrices. The first matrix (Figure 1) combines performance level and type of content. All practice activities in a subject area can be classified into one of the 10 cells of the matrix. Sample practice questions from a variety of subject areas are included in each cell as an illustration.

According to the component display theory, learning is most likely to occur when instruction properly uses primary and secondary presentation forms. Primary presentation forms deal with the essence of the objective to be learned. Secondary forms add to that essence such things as cues, background information, advice about learning, and feedback. Primary and secondary forms can be presented together (as an integrated display) or separately.

There are four types of primary presentation forms that can be made by crossing abstractness of subject matter with presentation mode. Figure 2 contains this abstractness-mode matrix with a sample primary presentation in each cell. Practice is represented by the inquisitory column.

There are eight types of secondary presentations. Use of each type depends upon the context, performance level, abstractness, and mode of the primary form with which it is associated. For example, a secondary presentation for an expository generality about a complex concept could be brief definitions of subconcepts. The most important secondary presentations for practice are feedback and alternate representation of questions. Component display theory prescribes the minimum set of primary and secondary presentations for each performance level and for each presentation mode. Figure 3 presents a brief summary of these prescriptions. Practice again is represented in the inquisitory column.

Component display theory provides numerous guidelines regarding the quality and quantity of practice. Seven guidelines are summarized below.

1. Make practice activities (inquisitory presentations) *consistent* with the type of content and performance level specified in the objective.

2. Require a *use* or *find* level of performance as much as possible.

	FACTS	CONCEPTS	PROCEDURES	PRINCIPLES
FIND		Sort these rocks into piles. Tell how somebody would sort them into the same piles later.	Write a computer program that will index and retrieve recipes.	Set up a demonstration that will help show how water gets into a well.
USE		Is this mountain a folded mountain?	Demonstrate how to clean a clarinet.	Explain why one of the two boats is much lower in the water than the other.
REMEMBER	What is the value of pi?	Define positive reinforcement.	What are the steps in balancing a checkbook?	Explain the three techniques used to make projection maps of earth's surface.

Figure 1. Performance-Type of Content Matrix.

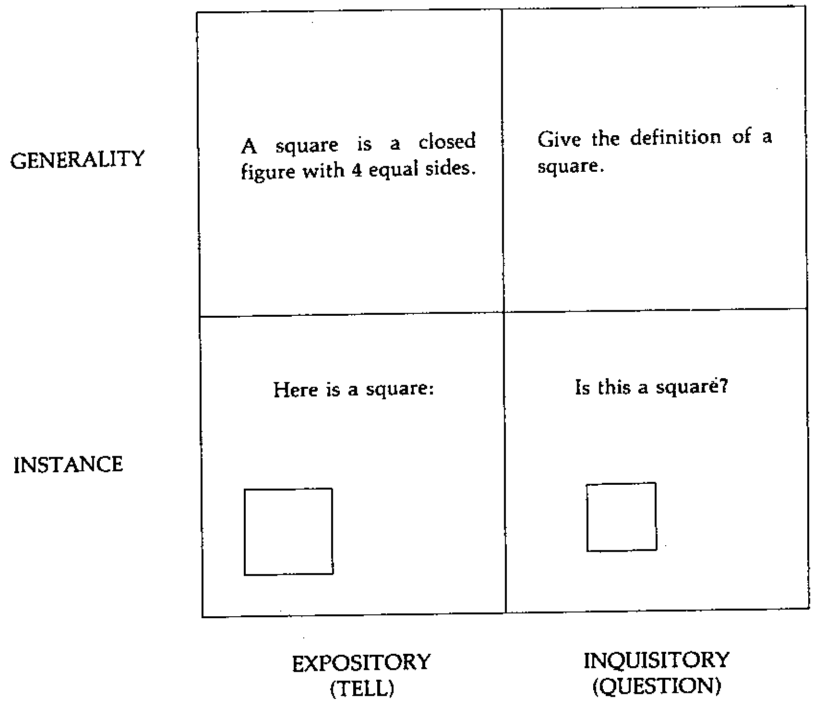

Figure 2. Abstraction-mode matrix.

		EXPOSITORY MODE	INQUISITORY MODE
FIND			PPF*: 1) Give *several* problems that require finding solutions. SPF+: 1) Give *new* problems leading to *new* solutions. 2) For feedback, have students test each other's solutions.
USE		PPF: 1) State definition, list of steps or principle. 2) Illustrate generality with *several* examples. SPF: Give background info, review prerequisites and include attention focusing cues as necessary.	PPF: Give *several* problems. SPF: 1) *Vary* representation of problem and do not repeat them. 2) Provide feedback that includes why an answer is right or wrong.
REMEMBER	VERBATIM	PPF: Give facts, concept, procedure or principle *or* example of them depending upon which is to be memorized.	PPF: 1) Ask for exact recital. 2) Require recognition of an exact duplicate. SPF: Indicate with feedback if recall or recognition was correct.
REMEMBER	PARAPHRASE	PPF: Give fact, concept, procedure of principle and *one* example.	PPF: 1) Ask for a paraphrased recital. 2) Require recognition of different representation of the same thing. SPF: Indicate with feedback if recall or recognition was correct.

*primary presentation form
+*secondary presentation form*

Figure 3: Minimum prescriptions for primary and secondary presentation forms.

3. Embellish primary practice forms with secondary presentations, especially feedback. Match the feedback to the level of performances and type of content.

4. Systematically vary non-relevant attributes of instances; make the set of instances as diverse as possible.

5. Gradually increase the difficulty of the practice.

6. Clearly separate and identify practice presentations from other primary and secondary presentations.

7. In many circumstances, give students freedom to choose the number of practice presentation forms in the overall instructional sequence.

Recommendations for the Design of Practice Derived from Cognitive Research

There are several issues arising from recent research in cognitive learning theory which are not incorporated *per se* in any instructional theory. This section summarizes these issues and their implications for designing practice.

Automaticity

One important issue relevant to the design of practice activities which is not discussed in any of the instructional theories reviewed is the issue of automaticity. Automaticity refers to the state at which a skill ceases to consume much of the attentional capacity of the brain. This means that an automatized skill can be performed simultaneously with other tasks without interfering with the performance of those tasks. People commonly automatize skills such as typing, discriminating numbers from letters, or decoding common words.

Current research suggests that the performance of complex skills such as reading, computer programming, or mathematical problem solving requires that many of the subprocesses become automaticized (Anderson, 1980). It is not sufficient that these subprocesses be performed correctly—they must be brought to a state of automaticity or the performance of higher-level tasks is impaired (Lesgold, 1983; Lesgold & Resnick, 1982; Resnick & Ford, 1981).

Practice drills intended to promote automaticity include three stages. The first stage helps the student learn to perform the skill *accurately*. The second stage introduces speeded practice and continues until performance is both *fast* and *accurate*. The third stage requires students to attend to a competing task while continuing to perform the original task until performance becomes *fast, accurate*, and *automatic*.

Interference

Most instructional theories emphasize how to teach a single fact, concept, rule, or procedure. They do not give specific recommendations on how to design practice for many facts, concepts, rules, or procedures. Consequently, these theories do not thoroughly consider the issue of interference.

In order to perform complex intellectual skills such as reading, computing, or computer programming, many of the subskills involved have to be automatized.

Interference occurs in practice activities involving many similar items. Interference occurs when students confuse one stimulus-response association with other stimulus-response associations. One type of interference, where new associations interfere with old ones, is referred to as *retroactive* interference. Another type of interference, where old associations interfere with the formation of new ones, is referred to as *proactive* interference. Both kinds of interference increase with the number of items to be practiced. Consequently, special considerations must be made for designing practice involving voluminous subject matter.

Designers can reduce the amount of interference present in a practice exercise by following a few simple guidelines:

1. Rather than having students work on all of the content at once, have them practice a small subset of the content. By practicing on a small subset of the content, the amount of interference is reduced. Group the content to be practiced into subgroups to be practiced separately, or introduce new material progressively as old material is mastered.

2. Since the strength of an association is weakened by the learning of new associations, review old items or material as new material is introduced.

3. Compare and contrast similar practice items with special cues so that the student can observe and note the differences. This is particularly useful when items are initially presented in a drill. As the drill progresses, eliminate the cues completely.

Spacing of Practice Sessions

There is much evidence in the literature to suggest that short, spaced periods of practice give better results than long concentrated practice periods (Anderson, 1980). Studies on the effects of spacing have shown that the probability of recall of items increases proportionally with the spacing between practice periods (Gay, 1973; Madigan, 1969). This spacing effect appears to be very robust and occurs with many different types of material. Bray (1948), for example, reported an experiment which showed that students could learn the Morse code with four hours a day of practice as rapidly as students who practiced seven hours a day. Students who practiced seven hours a day were apparently wasting the additional 3 hours of practice they were receiving per day. The reason spaced practice is considered to be more effective than massed practice is that the learning context on each occasion is somewhat different thus causing the information to be encoded somewhat differently each time. Also, by breaking up practice sessions into several spaced sessions, students experience less fatigue and boredom.

This evidence suggests that practice activities should be designed so that students can stop in the middle of a practice session or drill and then resume at a later time picking up the same items or material that they were working on during the previous session. In some cases, this can be done by dividing the content into difficulty levels and allowing the students to specify the appropriate difficulty level at the beginning of each new session. In other cases this requires that a record be kept of student performance from session to session. This record would contain the data necessary to allow students to restart the practice or drill using the items or material that they were working on during the previous session.

Spacing of Review Sessions

Spaced review has been shown to be a significant means of enhancing retention of learned material. For example, Tiedeman (1948) found that after two spaced reviews students retained for 63 days the same amount of information they would have retained for only one day without the reviews. Gay (1973) demonstrated the superiority of an early and late review over two early or two late reviews. Other studies have shown these same superior effects for spaced review over massed review (Ausubel & Youssef, 1965; Hannum, 1973; Peterson, Ellis, Toohill, & Kloss, 1935; Saxon, 1981).

The research on spaced review suggests that designers should provide for several reviews of mastered material and that each successive review be spaced farther apart than the previous review. This can be done by setting up a series of review stages allowing mastered material to be reviewed at different stages, say after a day, then after two days, then after a week, then after ten days, etc. Practice drills should provide increasing-ratio review where the ratio of new items to review items changes as students progress through the drill. When students first begin the drill all items will be new items. As students master items, these become review items and are re-introduced systematically. Toward the end of the drill most of the items presented to the students will be review items. Drills structured in this way can be very effective for the purpose of skill maintenance in addition to initial learning.

Making Meaningless Material More Meaningful

There is much evidence to indicate that people remember meaning and relationships rather than exact details. For example, Wanner (1968) had students listen to tape-recorded instructions and then, in a test, compare several alternative sets of instructions with the one they heard. Results showed that students could identify word changes which resulted in changes of meaning, but could not identify word changes which resulted only in changes of style. The same point has been demonstrated in experiments which have contrasted memory for meaningful sentences with that of memory for random word strings revealing that people remember the meaning rather than the exact wording of a verbal communication (e.g. Pompi & Lachman, 1967).

The superiority of memory for meaning over memory for details is accounted for by the idea of *propositional representation* which is currently one of the most popular concepts of how material is represented in memory. According to this conception, material is stored in memory in the form of propositions which include only the meaningful parts of an event or learning task and do not include details considered to be unimportant (Anderson, 1976). Students tend to exclude from their propositional representations material

Table 4
Recommendations for the Design of Practice Derived from Cognitive Research

Issues	Recommendations
Automaticity of subskills	In addition to accuracy, speed and the ability to perform the skill without interfering with a secondary task should be used as criteria for mastery.
Interference	Have students drill on only a small subset of items at a time. Provide review of old items as new ones are introduced. Initially use cues to emphasize differences among competing stimuli and then fade the cues gradually.
Spaced Practice	Allow students to specify the difficulty level at the beginning of each session or provide a mechanism to keep track of the items that a particular learner was working on during the last session.
Spaced Review	Gradually increase spacing between practice of mastered items. Utilize increasing ratio-review.
Making Meaningless Information Meaningful	Help students add meaning to the material by utilizing mnemonic devices, mediators, or other memory or organizational strategies, or emphasize networks inherent in the content.

deemed unrelated or to which they cannot give meaning.

Because students can remember meaningful information better than meaningless information, instruction should seek to make material as meaningful as possible. Therefore, the objective of a good practice drill should not be just to "burn it into memory" but to convert a learning task which may not have much inherent meaning into something more meaningful. Several strategies students can use to give meaning to material have been researched by Dansereau (1978), Weinstein (1978, 1982), and Vaughn (1981). Some of these strategies are: (a) *paraphrase-imagery* (intermittently rephrasing material in own words and forming mental pictures of the concept); (b) *networking* (forming networks or mode-link maps, hierarchies, or chains which help students see relationships among concepts); (c) *analysis of key ideas* (identifying key ideas in the material); (d) use of *analogies* for recalling connected discourse; and (e) use of *grouping, segmenting, sequencing,* or *acronyms*. These strategies can either be taught to students or can be provided as part of the practice activity. Whichever is done, efficient practice activities should make use of these strategies where applicable. Other memory devices such as mediators, mnemonics, keywords, and loci (associating material to be learned with spatially organized objects and places) have been shown to help impose some artibrary meaning on otherwise meaningless material. The power of these techniques in improving memory of meaningless material has been consistently demonstrated (Atkinson & Raugh, 1975; Gilbert, 1978; Higbee, 1977; Bower, 1970a, 1970b, 1970c). Table 4 summarizes the issues discussed in this section and provides relevant recommendations for the design of practice activities.

Keller's Motivational-Design and Practice

It is widely accepted that motivation plays a role in how much a student learns. Even though this notion is believed to be true, some of our current instructional theories fail to address motivation as a part of the design process. Where does one look to find an instructional design theory which includes recommendations and precriptions for making instruction more motivating?

John Keller's motivational design model (Keller, 1979; 1983; in press) specifically focuses on this aspect of instruction—how to make instruction more motivating and engaging for students. Keller's model draws together knowledge from various theoretical perspectives into a set of prescriptions for making instruction more motivating and engaging. As defined by Keller (in press), "motivational design is an aspect of instructional design which refers specifically to strategies, principles, and processes for making instruction appealing." Motivational design adds another dimension to the traditional idea of instructional design. Instructional design shows us what instruction should be like in order to be effective and efficient. Motivational design shows us what instruction should be in order to be interesting and appealing.

Four basic categories of conditions which designers should consider in order to produce motivating instruction are presented in Keller's model. These four categories are: *attention, relevance, confidence,* and *satisfaction*. Within each category, Keller offers strategies for making instruction more motivating. What follows is a brief description of these four categories along with some sample strategies that can be incorporated into practice activities to make them more motivating.

Attention

A first step in motivation is to gain and maintain the learners attention. As a motivational variable, attention involves several theories of curiosity and arousal. According to Keller (1983), attention is a state which exists when something unexpected occurs in a person's perceptual environment, or when there is a gap between a given and desired state of knowledge. Several motivational strategies to enhance attention can be applied to the design of practice activities. These include:

- Varying the amount of participation, so students can actively practice in challenging, yet safe situations (games, simulations, role-playing)
- Presenting a paradoxical example of a concept or problem in a practice situation
- Varying the overall style of the presentation so that the style changes from fast to slow, active to passive, or humorous to serious,
- Having students engage in practice that allows them to act on their curiosity by exploring and manipulating their environment

> **The objective of a good practice drill should be to convert a learning task which does not have much inherent meaning into something more meaningful.**

Relevance

In order to have sustained motivation, the learner must perceive that important personal needs are being met by the learning situation (Keller 1983). After having his attention aroused, a person will question the relevancy of a situation before becoming highly motivated. Motivational strategies to increase the relevancy of a practice situation include:

- Relating the content of practice items to the student's interests and past experiences
- Stating explicitly how the practice relates to future activities of the student
- Providing an opportunity for students to practice under conditions of moderate risk so they can achieve standards of excellence
- Providing meaningful alternative methods of practice for students to accomplish a goal

Confidence

The idea of confidence relates to the belief that an individual's attitudes toward success or failure have a causal influence on his actual performance of an activity. A positive expectancy for success is the third requirement for motivational learning. Practice activities, as well as other instruction, should include strategies to enhance the learner's confidence. This can be done by:

- Clearly stating the expected performance and evaluation standards of a practice activity
- Structuring practice material so it is presented in identifiable units
- Beginning a practice session with the more easily obtainable skills
- Providing feedback that supports student ability and effort as the determinants of success in a practice setting
- Redesigning practice items and activities which frequently cause failure

Satisfaction

The concept of satisfaction refers to the idea that learners must feel satisfied that the rewards gained from an activity are consistent with their expectations. Furthermore, an individual must believe that the outcomes of success are directly related to performance on a particular activity. Some strategies to enhance learner satisfaction are:

- Providing an opportunity to practice using a newly acquired skills in a realistic setting as soon as possible
- Allowing those who have mastered a skill to help others practice that skill
- Rewarding intrinsically interesting practice task performance with unexpected non-contingent rewards, and boring practice tasks with extrinsic, anticipated rewards.

Summary and Conclusions

Several prominent instructional design theories are reviewed in this paper and recommendations and prescriptions for designing the practice component of instruction are derived from them. The following general findings and conclusions can be stated based upon this review.

First, the instructional design theories reviewed are generally complementary in nature rather than contradictory. Many of the guidelines derived from one theory are supported by several of the other theories. Different terms are often used to refer to the same phenomenon in different theories which tends to make the knowledge base for designing practice to appear more complex than it really is. However, it is also evident that each theory provides some unique contributions which have important implications for the design of practice. Therefore, in order to design optimally effective practice, the instructional designer will need to be familiar with all of the instructional design theories reviewed, not just one of them.

Second, classifying tasks into *types* or *categories* of learning does reveal important differences in the application of the recommendations and prescriptions. In some cases, the differences among categories of learning for a particular recommendation are minor but in other cases the differences are critical to effective learning.

Third, there are several areas of research in cognitive learning theory which are not formally treated in any of the instructional design theories reviewed. These areas of research have important implications for the design of practice. These areas include automaticity, interference, spacing of practice and review, and the use of memory devices and learning strategies. Further development of instructional design theories should more formally incorporate findings from these areas of research.

Different instructional theories often use different terms to refer to the same phenomenon which tends to make the knowledge base appear more complex than it really is.

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