# Chapter 3

# First Principles of Instruction

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## Editors' Foreword

Vision
- To distill a set of interrelated prescriptive instructional design principles

Demonstration Principle
- Instruction should provide a demonstration of the skill **consistent** with the type of component skill: kinds-of, how-to, and what-happens.
- Instruction should provide **guidance** that relates the demonstration to generalities.
- Instruction should engage learners in **peer-discussion** and **peer-demonstration**.
- Instruction should allow learners to observe the demonstration through **media** that are appropriate to the content.

Application Principle
- Instruction should have the learner apply learning **consistent** with the type of component skill: kinds-of, how-to, and what-happens.
- Instruction should provide intrinsic or corrective **feedback**.
- Instruction should provide **coaching**, which should be gradually withdrawn to enhance application.
- Instruction should engage learners in **peer-collaboration**.

Task-Centered Principle
- Instruction should use a **task-centered** instructional strategy.
- Instruction should use a **progression** of increasingly complex whole tasks.

Activation Principle
- Instruction should activate relevant cognitive structures in learners by having them recall, describe, or demonstrate relevant **prior knowledge** or experience.
- Instruction should have learners **share** previous experience with each other.
- Instruction should have learners recall or acquire a **structure** for organizing new knowledge.

Integration Principle
- Instruction should integrate new knowledge into learners' cognitive structures by having them **reflect** on, discuss, or defend new knowledge or skills.
- Instruction should engage learners in **peer-critique**.
- Instruction should have learners create, invent, or explore **personal ways to use** their new knowledge or skill.
- Instruction should have learners **publicly demonstrate** their new knowledge or skill.

Four-Phase Cycle of Instruction
- The four principles of activation, demonstration, application, and integration form a four-phase cycle of instruction.
- At a deeper level there is within this cycle a more subtle cycle consisting of *structure–guidance–coaching–reflection.*

A Scale for Rating Instructional Strategies

- The quality of the instruction will improve with each principle that is added: demonstration, application, task-centered, activation, and integration.

— CMR & ACC

## First Principles of Instruction

I systematically reviewed instructional design theories, models, and research. From these sources I abstracted a set of interrelated prescriptive instructional design principles (Merrill 2002). A subsequent paper (Merrill 2007) quoted similar principles that have been identified by other authors and supported by research.

For purposes of this work a principle is defined as a relationship that is always true under appropriate conditions regardless of the methods or models which implement this principle. Principles are not in and of themselves a model or method of instruction, but rather relationships that may underlie any model or method. These principles can be implemented in a variety of ways by different models and methods of instruction. However, the effectiveness, efficiency, and engagement of a particular model or method of instruction is a function of the degree to which these principles are implemented.

To be included in this list, the principle had to be included in most of the instructional design theories that the author reviewed. The principle had to promote more effective, efficient, or engaging learning. The principle had to be supported by research. The principle had to be general so that it applies to any delivery system or any instructional architecture (Clark 2003). Instructional architecture refers to the instructional approach, including direct methods, tutorial methods, experiential methods, and exploratory methods. The principles had to be design-oriented, that is they are principles about instruction that have direct relevance for how the instruction is designed to promote learning activities, rather than activities that learners may use on their own while learning.

From this effort five principles were identified. Following is an abbreviated statement of these principles:

- The **demonstration** principle: Learning is promoted when learners observe a demonstration.
- The **application** principle: Learning is promoted when learners apply the new knowledge.
- The **task-centered** principle: Learning is promoted when learners engage in a task-centered instructional strategy.
- The **activation** principle: Learning is promoted when learners activate relevant prior knowledge or experience.
- The **integration** principle: Learning is promoted when learners integrate their new knowledge into their everyday world.

In this chapter I elaborate these five principles and their interrelationships. Please refer to previous papers for a brief identification of some of the theories and research that support these principles (Merrill 2002; Merrill 2007).

## Demonstration Principle

- Learning is promoted when learners observe a demonstration of the skills to be learned that is **consistent** with the type of content being taught.

- Learning from demonstrations is enhanced when learners are **guided** to relate general information or an organizing structure to specific instances.
- Learning from demonstrations is enhanced by **peer-discussion** and **peer-demonstratio**n.
- Learning from demonstrations is enhanced when learners observe **media** that is relevant to the content.

### Demonstration Consistency

First principles are most appropriate for generalizable skills. A generalizable skill is one that can be applied to two or more different specific situations. Remembering the name of a specific object or naming the parts of a specific device is not a generalizable skill. The demonstration principle is most appropriate for three types of generalizable skill: concept classification (or *kinds-of*); carrying out a procedure (or *how-to*); and predicting consequences or finding faulted conditions in the execution of a process (or *what-happens*). A generalizable skill is represented by both information and portrayal. *Information* is general, inclusive, and applicable to many specific situations. *Portrayal* is specific, limited, and applicable to one case or a single situation.[*] Information can be presented (tell) and recalled (ask). A portrayal can be demonstrated (show) and submitted to application (do). The demonstration principle emphasizes the use of specific cases (portrayal). Failure to provide sufficient demonstration is a common problem in much instruction. While the demonstration principle emphasizes portrayal, effective and efficient instruction involves

[*] Editors' note: Information and portrayal correspond to Merrill's earlier distinction between generality and instance.

both presentation of information* and demonstration with portrayal.† Table 1 indicates information and portrayal that are consistent for each category of generalizable skill. A presentation and demonstration must be consistent if they are to promote effective, efficient, and engaging learning.

**[Insert Table 1 about here]**

**Table 1. Consistent Information and Portrayal for Categories of Component Skill‡**

| | INFORMATION | | PORTRAYAL | |
|---|---|---|---|---|
| | **PRESENT (TELL)** | **RECALL (ASK)** | **DEMONSTRATE (SHOW)** | **APPLY (DO)** |
| **Kinds-of** | **Tell the definition.** | **Recall the definition.** | **Show several specific examples.** | **Classify new examples.** |
| **How-to** | **Tell the steps and their sequence.** | **Recall the steps and their sequence.** | **Show the procedure in several different situations.** | **Carry out the procedure in new situations.** |
| **What-happens** | **Tell the conditions and consequence involved in the process.** | **Recall the conditions and consequence involved in the process.** | **Show the process in several different situations.** | **Predict a consequence or find faulted conditions in new situations.** |

## Learner Guidance

Learner guidance helps focus the learner's attention on critical elements of the information and relate these critical elements to the portrayal. The following paragraphs list

* Editors' note: Presentation of information is universal, for it is useful for fostering other kinds of learning, such as remembering, naming, and understanding, as well as for generalizable skills.
† In contrast, demonstration with portrayal is not universal, for it applies primarily to generalizable skills.
‡ Editors' note: This table and the related discussion identify situationalities (the three different kinds of generalizable skills) that call for variation in the methods. Hence, while present, recall, demonstrate, and apply are – at a very imprecise level of description – universal methods for generalizable skills, if you want to provide more precise (detailed) guidance about how to use each of those methods, you must offer variations in the description of the method based on a situational variable, in this case, the kind of generalizable skill. For more about this, see Chapter 1.

steps for presenting and demonstrating each kind of generalizable skill (Merrill 1997). The learner guidance that enhances the demonstration is indicated by hollow bullets.

**Kinds-of**

Kinds-of or concept classification occurs when learners must discriminate among members of two or more related categories of objects or events. An effective presentation/demonstration for concept classification (kinds-of) requires the following instructional activities.

- Tell learners the name of each category or alternative procedure.
- Show learners an example of each category.
- Provide learners a definition for each category. (A definition is a list of discriminating properties that determine class membership).
- o Emphasize the discriminating properties for each category.
- Show learners additional examples of each category. (Portrayals for examples must illustrate the discriminating properties).
- o Call attention to the portrayal of each discriminating property for each example.
- o Show matched examples among categories – examples which have similar non-discriminating properties.
- o Show divergent examples within a category for which non discriminating properties are different.
- o Show increasingly difficult-to-discriminate examples among categories.

**How-to**

How-to or procedure learning occurs when learners must carry out a series of steps. A presentation/demonstration for a procedure (how-to) involves the following instructional activities.

- Show learners a specific instance of the whole task.
- Demonstrate each of the steps required to complete the whole task.
  - Clearly identify and label each step as it is executed.
  - Show the consequence of each step.
  - Focus the learner’s attention on the portrayal of the consequence, especially if the consequence is hidden from view or not obvious.
- Summarize the steps in the procedure and their sequence.

**What-happens**

What-happens or process learning occurs when learners understand how some device works or the process underlying some phenomenon.  A presentation/demonstration for a process (what-happens) involves the following instructional activities.

- Demonstrate the process in a specific, real or simulated situation.
- During the demonstration tell the name and show the portrayal for each necessary condition for each event in the process.
  - Focus the learner’s attention on the consequence of each event and the consequence of the process as a whole.
- Repeat the demonstration for several increasingly complex scenarios.

## Relevant Media

Mayer (2001; Clark and Mayer 2003) identifies a number of principles for the effective use of media. Demonstrations are enhanced as these media-use principles are implemented. These principles are summarized without elaboration as follows:

- Include both words and graphics as long as the graphics convey information that is being taught and are not merely decorative.
- Place corresponding words and graphics near each other.
- Present words as audio narration rather than onscreen text.
- Presenting words as both text and simultaneous audio narration can interfere with learning.
- Adding interesting, but unnecessary, material can interfere with learning.

## Peer-demonstration and Peer-discussion

Learning from demonstrations is enhanced when learners actively engage in interaction with one another rather than merely passively observing the demonstration. When learners are required to find a new portrayal of the information that has been presented, they are required to process the information at a deeper level in order to identify and demonstrate this new portrayal. Requiring them to demonstrate their new portrayals to one another provides additional portrayals of the information being taught, thus increasing the richness of the instruction.

Peer discussion promotes opportunities for learners to discuss a given portrayal with one another to determine whether or not it is a good representation of the information, i.e., Is this example really an example of a kind of x? Does this specific execution of a procedure really involve each of the steps in the statement of the procedure? Does this consequence really follow from the conditions that have been identified for a specific process?

## Application Principle

- Learning is promoted when learners engage in application of their newly acquired knowledge or skill that is **consistent** with the type of content being taught.
- Learning from an application is effective only when learners receive intrinsic or corrective **feedback**.
- Learning from an application is enhanced when learners are **coached** and when this coaching is gradually withdrawn for each subsequent task.
- Learning from an application is enhanced by **peer-collaboration**.

This paper uses the word *practice* to refer to those instructional interactions for which learners are required to recall information. This means to recall a definition of a concept, recall and order the steps in a procedure, or recall the conditions and consequences for a process. The word *application* refers to those instructional interactions in which learners are required to use the knowledge and skill they are in the process of acquiring. Using the knowledge or skill means to classify a new example, carry out a new procedure, predict a consequence, or find faulted conditions in a new specific situation. As indicated earlier in this paper, first principles are most appropriate for generalizable knowledge and skills. Generalizable knowledge and skills are applied when learners use them to solve a new problem or complete a different task from the one that was used for demonstration.

## Application Consistency

Table 1 indicates consistent practice and application for each of the three types of generalizable skill:  kinds-of, how-to, and what-happens.  Application for kinds-of occurs when learners are required to classify new examples of each category by labeling, sorting, or ranking the examples.  Application for how-to occurs when learners are required to carry out each step in the task in a new real or simulated situation.  Application for what-happens occurs when learners are required to predict the outcome from a given set of conditions in a new specific situation or when learners are required to find faulted conditions when an unexpected consequence occurs as a result of a process.

## Feedback

Intrinsic feedback for application of **kinds-of** allows learners to see the consequence of their classification decision.  Corrective feedback focuses learners' attention on the discriminating properties that determine class membership.[*]

Intrinsic feedback for application of **how-to** enables learners to see the consequences of their actions.  Corrective feedback informs learners of the quality of their performance and shows them how they did or should have performed the step.

Intrinsic feedback for **what-happens** executes the process to enable learners to see if the consequence is consistent with their prediction.  Intrinsic feedback also occurs when, after correcting faulted conditions, learners can see if the expected consequence occurs.

[*] Editors' note:  Here is another example of universal methods (within the domain of generalizable skills) becoming variable methods when we seek to provide more detailed guidance.  Here, the same situationality (kind of generalizable skill) is used to indicate when to use each variation of the method.  Try to identify other cases of variations with situationalities as you read on.

Corrective feedback focuses learners' attention on the consequence and helps them see that the expected consequence is consistent with their prediction.

### Enhancing Application Performance

Application for **kinds-of** is enhanced when learners are asked to explain their classification by pointing out the presence or absence of discriminating properties. Application of **how-to** is enhanced when learners are required to carry out a progression of increasingly complex tasks. **What-happens** application is enhanced when learners are required to make predictions or correct faulted conditions for an increasingly complex progression of specific situations.

### Coaching

Application is also enhanced when learners are given considerable help or coaching with their performance on early component skills and this help is gradually withdrawn with each succeeding application of this component skill.[*]

### Peer-Collaboration

Learning from an application is enhanced when learners collaborate with each other on the application. Collaboration requires more active learning. The most effective use of peer collaboration is when learners must first come to some solution on their own and then interact with fellow learners to describe, discuss, and defend their solution in an attempt to come to some agreed solution.

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[*] Editors' note: This may not be a universal method within the domain of generalizable skills. If the task is relatively easy to learn, the coaching may not be necessary or beneficial.

## Task-Centered Principle

- Learning is promoted when learners engage in a **task-centered** instructional strategy.
- Learning from a task-centered instructional strategy is enhanced when learners undertake a simple-to-complex **progression of whole tasks**.

### Task-Centered versus Problem-Based Instructional Strategies

While there are many different variations of problem-based instructional strategies, a typical problem-based instructional strategy gives a small group of learners a complex problem to solve, identifies resources that can be used to solve this problem, and expects learners to acquire the necessary skills by searching the resources and struggling with the problem solution.[*] Learners are expected to learn from each other and to seek other sources when the identified resources are insufficient to solve the problem. A large body of research during the past several decades has demonstrated that this type of open problem solving is frequently not only inefficient but often ineffective in teaching the desired skills (Kirschner, Sweller et al. 2006) A task-centered instructional strategy is not the same as problem-based learning. A task-centered instructional strategy is a form of direct instruction but in the context of authentic, real-world problems or tasks. Van Merriënboer (1997) has described such a task-centered instructional strategy in some detail.

Topic-centered instructional strategies typically teach the component skills for the task in a hierarchical fashion by teaching all the related skills of one type and then the related skills of another type, chapter by chapter, until all of the component skills have been taught.

[*] Editors' note: For more details, see Chapter 8.

Learners are then given a task to which they can apply their skills as a final project in a course. A topic-centered approach is often characterized as the "you won't understand this now, but later it will be very important to you" approach to skill development.

Figure 1 illustrates an example of a task-centered instructional strategy. The *Ts* in the diagram indicate a progression of whole complex tasks from the same class of tasks. The increase in size of the *Ts* indicates an increase in task complexity with each subsequent task in the progression. (1) Rather than teaching topics out of context, a simple whole task of the type they are learning to do is demonstrated right up front. (2) Learners are then given instruction – presentation, demonstration, application – of the skills required to do this task. This instruction does not teach all there is to know about a given topic or component skill, but only what learners need to know to complete the task. (3) The whole task is revisited at this point, and learners are shown how these component skills were applied to complete the task or solve the problem. This constitutes one cycle of instruction. (4) A new, slightly more complex task is then given to the learners.[*] Learners are asked to apply their newly acquired skills to this task. (5) In addition they are taught additional skills or more detail for the initial skills that are required for this new task. (6) Again learners are shown or asked to recognize how the previous and new skills are used to complete the task. This constitutes a second cycle of instruction.

**[Insert Figure 1 about here]**

[*] Editors' note: For more information about how to identify and sequence tasks in order of increasing complexity, see Reigeluth's Elaboration Theory chapter in Volume II.

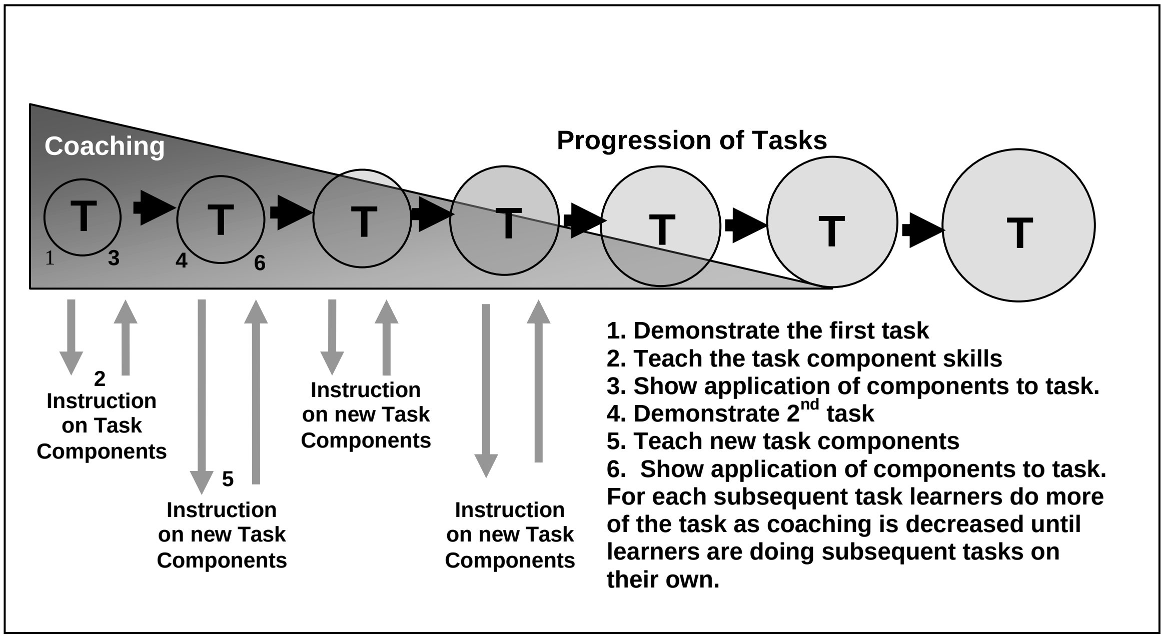


**Figure 1. An Example of a Task-centered Instructional Strategy**

This cyclical procedure is repeated for each new task in the progression, with the learners required to do more and more of the task as they acquire skill, while the instructional system demonstrates less and less. Eventually learners are expected to complete the next task in the progression on their own. If the progression of tasks is carefully chosen and sequenced, then when learners have demonstrated their ability to satisfactorily complete one or more whole tasks without coaching or additional demonstration, they have acquired the skill intended by the goals of the instruction.

A minimal task-centered instructional strategy is a single worked task. However, a truly effective task-centered strategy involves a progression of increasingly complex tasks and a corresponding decreasing amount of learner guidance and coaching.

## Activation Principle

- Learning is promoted when learners activate relevant cognitive structures by being directed to recall, describe or demonstrate relevant **prior knowledge or experience**.
- Learning from activation is enhanced when learners **share** previous experience with one another.
- Learning from activation is enhanced when learners recall or acquire a **structure for organizing** the new knowledge, when the structure is the basis for guidance during demonstration, is the basis for coaching during application, and is the basis for reflection during integration.

### Prior Knowledge or Experience

Associative memory is insufficient for performing complex tasks. Complex tasks require learners to use some form of mental model that organizes the diverse skills required into some interrelated whole. When left on their own, learners often activate an inappropriate mental model, thus increasing the mental effort required to acquire the integrated set of skills necessary for doing the task. Building on an inappropriate mental model often results in misconceptions that show up as errors when learners attempt to complete the new task. Directing learners to recall past relevant experience and checking this recollection for relevance to the task under consideration are more likely to activate an appropriate mental model that facilitates the acquisition of the new set of interrelated skills (Mayer 1992).

## Sharing Previous Experience

Peer sharing of previous experience is a way not only to have the learner who is sharing activate their related mental model for the experience, but also to provide vicarious experience to their fellow students and to stimulate similar recollection on the part of those hearing the shared experience.

## Supporting Structure and Structure-Guidance-Coaching-Reflection Cycle

Learners are often not efficient in constructing frameworks that they can use to organize their newly acquired skills. Left on their own, they often use inefficient or even inappropriate organizational schemes. Providing learners with a structure that helps them interrelate the required skills often makes their acquisition of the new set of skills more efficient and facilitates their forming an appropriate mental model.

The four principles of activation, demonstration, application, and integration form a four-phase cycle of instruction (see Figure 2). Effective instruction involves all four of these activities repeated as required for teaching component skills or whole tasks.

**[Insert Figure 2 about here]**

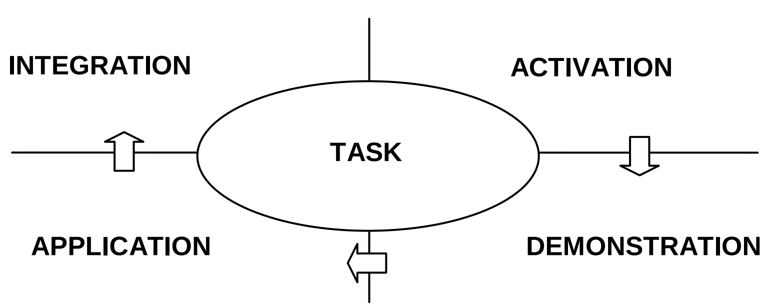


Figure 2 The Four Phase Cycle of Instruction

The cycle of instruction identified for first principles suggests two layers of relationship. On the surface first principles identify learning activities that should be included in effective instruction as described in this paper. At a deeper level there is within this cycle a more subtle cycle consisting of *structure–guidance–coaching–reflection.*

> In general, research has demonstrated that making students aware of specific structure in information helps them summarize that information [and subsequently be able to remember and use this information more effectively] (p. 32) (Marzano, Pickering et al. 2001).

Rosenshine (1997) describes the importance of well-connected knowledge structures. He says that asking students to organize information, summarize information, and compare new material with prior material are all activities that require processing and should help students develop and strengthen their cognitive structures.

During the activation phase first principles prescribe that the instruction should provide an organizing **structure** based on what students already know. This structure should then be used to facilitate the acquisition of the new knowledge during the remaining phases of the instructional cycle. During the demonstration phase not only should **guidance** help learners relate general information to specific portrayals, but guidance should also help learners relate new material to the structure provided during the activation phase. During the application phase **coaching** should help students use this structure to facilitate their use of the newly acquired skill to complete new tasks. During the integration phase **reflection** should encourage learners to summarize what they have learned and again examine how the new knowledge is related to what they previously knew via the structure that was recalled or provided.

It is interesting to note that many of the courses we have critiqued on the basis of first principles fail to include activation or integration in any form, so the use of guidance or coaching to relate new material to previously learned material via some structure is therefore not included. This deeper cycle, *structure–guidance–coaching–reflection*, deserves more study and research.

## Integration Principle

- Learning is promoted when learners integrate their new knowledge into their everyday life by being directed to **reflect**-on, discuss, or defend their new knowledge or skill.
- Learning from integration is enhanced by **peer-critique**.
- Learning from integration is enhanced when learners create, invent, or explore **personal ways to use** their new knowledge or skill.
- Learning from integration is enhanced when learners **publicly demonstrate** their new knowledge or skill.

### Reflection

"Think about it" is an admonition often given by effective teachers. But merely admonishing learners to think is usually not sufficient. It is often said that the teacher learns more than the student. When instruction provides an opportunity for learners to discuss what they have learned with other students or to defend what they have learned when challenged, then they are put in the role of teacher. Meaningful discussion and the need to defend one's skills requires the kind of deep reflection that enables learners to refine their mental models, to eliminate misconceptions, and to increase the flexibility with which they use their new skill. An opportunity for meaningful reflection increases the probability that the skill will be retained and used in the everyday lives of the learners.

**Peer-Critique**

Evaluating the work of other learners requires learners to once again reflect on what they have done and how it compares to what others have done. They must revisit the information involved to see if the portrayal they are critiquing does indeed implement this information. When done by a group of 2 or more students, peer-critique can also involve peer-discussion where learners must defend their own interpretation and application of the material in their attempt to critique another application.

**Personal Use**

When instruction is remember-information-only, it is stored in associative memory. Except for traumatic events or significant amounts of rehearsal, associative memory has a steep forgetting curve, and large amounts of the information are difficult or impossible to recall after only a short time. On the other hand, integrated skills that can be used to complete real-world tasks are stored in schematic memory as mental models. If a mental model is used over a progression of whole tasks, then, except for the information-only components of the task, forgetting is much less pronounced, and learners retain their ability to perform complex tasks over much longer periods of time. Even when learners do not use their skill for a period of time, their relearning time is much less.

When learners can immediately use their newly acquired skills to do necessary or desired tasks in their everyday lives, then the learning is even more stable and likely to survive for much longer periods of time. Effective integration finds ways to extend the instruction beyond the classroom or on-line course into the everyday life of the student.

### Public Demonstration

Graphics, animation, and other presentation enhancements are often used with the intent of increasing learner motivation. While these devices can attract a learner's attention, they are usually insufficient for sustaining attention over an extended period of time. Too often such devices become tiring and actually interfere with effective learning. Perhaps the greatest motivator of all is learning itself. Human beings are wired to learn. When learners perceive that they have acquired real skill – that is the ability to solve real-world problems or complete real-world tasks – they are usually anxious to demonstrate this skill to significant others in their lives. When learners know that they will have an opportunity to demonstrate their newly acquired skill to significant others in their world, then their motivation to perform in an effective way is significantly increased.

## Instructional Strategy Scaling

Even though these first principles of instruction are well known, it is obvious even to the casual observer of current instructional products that much instruction fails to adequately implement these principles. It is hypothesized that there is a scale of instructional strategy that will correlate with levels of performance on complex tasks. The reader is familiar with the prevalence of information-only instruction with "remember-what-I-told-you" questions tacked onto the end, which might be identified as a level-0 instructional strategy.

The author hypothesizes that performance on complex, real-world tasks will be incremented (successively improved) when an instructional strategy implements each of the first principles in turn (Merrill 2006; Merrill 2006b). Adding consistent demonstration to information promotes the first increment (level 1) in learning effectiveness, efficiency and engagement. Adding consistent application with corrective feedback to information with demonstration adds a second increment (level 2). Using a task-centered instructional strategy adds the third increment (level 3). Activation will add an additional learning increment, especially if the structure-guidance-coaching-reflection cycle is also implemented. Personal-use and going-public integration will also add an additional learning increment. Much research remains to be done to support this hypothesized scale of instructional strategy efficacy.

## Conclusion

The quest for first principles of instruction was launched with the publication of the second "green book" (Reigeluth 1999). The author argued that in spite of the diversity represented by the various instructional theories and models represented in that volume that, in fact, the underlying principles for all of those theories are fundamentally the same. Reigeluth questioned this hypothesis and challenged the author to identify these underlying principles, if, in fact, they do exist. This paper and those cited are a result of that challenge.

The above litany of principles may not be complete. Many of the theories and models reviewed do not include all of these principles. However, to date the author has not identified any theory or model that includes contrary principles. Anecdotal evidence from a number of development projects has demonstrated that, when instructional design incorporates these principles, the resulting instruction is more effective. A major study by a large corporation found that, when their flagship instructional product was compared to a new product that incorporated these first principles, the new product was significantly more effective and efficient than their existing product (Thompson_Inc. 2002).

Being involved in application of their new skills early in the instruction provides significant motivation to students. Learning is the greatest motivator when learners can see that they have acquired a new skill. Merely remembering concepts, terminology, principles, and facts for recall on a multiple choice test in a testing center is not motivating. However, being able to do something that they could not do before is very motivating. Students who have engaged in problem-centered courses that implement first principles of instruction express greater satisfaction and interest in the course and actually perform better than students in more traditional courses (Frick et al., 2007; in press; 2008a; 2008b).

As all dissertations end with “more research is needed,” so, true to his academic roots, the author also acknowledges that much remains to be done to verify these principles in a wide variety of settings, for a wide variety of different audiences, in other cultures, and across subject-matter domains. It is the author’s hope that perhaps these principles might form a starting point for developing a common knowledge base about instructional models, methods, and theory, and for encouraging future research on instructional design.

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