Instructional Skills For Healthcare Professionals

A Textbook On Basic Teaching Skills for Healthcare Practitioners and Students

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INSTRUCTIONAL SKILLS FOR HEALTHCARE PROFESSIONALS

FOREWORD

Instructional skills are essential to practice in all healthcare professions. Accordingly, the author believes that all practitioners should have some assistance in developing those skills. This is a manual that is intended to support learning about instruction. It is not intended as a scholarly work; it is written in plain language, so non-educators can understand the facts, concepts and principles herein. The content is practical in nature. Although much of the content is based on information learned in graduate level education courses, much of the basis also derives from over twenty years of teaching allied health students in various clinical and non-clinical settings. Mostly, good teaching comes from common sense and creativity, but there are many important and useful instructional skills that can be taught and learned.

This manual would useful as a text for a course in instruction in any educational program for healthcare professionals. Personnel in health care organizations, like hospitals, who have primary instructional responsibilities, also would find this manual useful. A syllabus for a course in instructional skills is included in the appendix of the book.

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INSTRUCTIONAL SKILLS FOR HEALTHCARE PROFESSIONALS

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CHAPTER ONE
INTRODUCTION TO EDUCATION

Goals:

- Describe situations in allied health practice that require instructional skills.
- Describe some consequences of inadequate instruction on the part of a practitioner.
- Identify the attributes of an effective teacher.
- Contrast instructional goal with objective
- Contrast curriculum with instruction.
- Describe two major paradigms of instruction.
- Describe competency-based education.

The following terms are introduced in this chapter:

- Instruction
- Goal
- Task analysis
- Enabling objective
- Terminal objective
- Instructional objective
- Instructional effectiveness (efficacy)
- Instructional efficiency
- Paradigm
- Competency
- Behaviorism
- Information processing
- Competency
- Curriculum

This chapter, as well as those to follow, intend to develop the instructional skills of allied health educators and practitioners. The reader may be inclined to question the value of instructional skills in their practice and question the relevance of this course. He or she may think, "I don't want to become a teacher. All I want to do is take care of patients." For one thing, the reader may decide one day to become a teacher. More importantly, a practitioner cannot practice effectively without instructional skills. For examples of clinical circumstances that require instructional skills, see Table 1.1.

Instruction in Clinical Practice
Who and What We Teach

- Patients- disease management, incentive spirometry, medical devices, etc.
- Families- disease management, metered-dose inhalers, medical devices, etc.
- New employees- policies and procedures, medical devices, institutional geography.
- Colleagues; e.g., nurses, physicians- medical devices, patient assessment, etc.
- Students- procedures, professional behavior, information

Table 1.1

Instruction is the transfer of a skill from one person to another. As described in a subsequent chapter, there are several types of skills, each with incremental levels of complexity. We assume that the learner does not have the skill, and that the instructor does. Instruction succeeds when the learner acquires the skill; it fails when the learner does not acquire the skill. In other words, if the learner hasn't learned, the instructor hasn't instructed. This failure can result from inadequate communication from the teacher to the learner. However, the failure often results from the instructor's failure to verify whether learning has occurred.

In clinical practice, allied health practitioners spend a lot of time teaching. They teach patients how to take various treatments, as well as why they need to cooperate with procedures that may be painful. Often, practitioners teach families how to participate in patient care. The practitioner may perceive this clinical teaching as informal; therefore, not subject to sound teaching methods. Nothing could be farther from the truth, because in this context, ineffective teaching means ineffective care. A practitioner may actually harm a patient through ineffective teaching methods. For example, a patient who gets improper instruction on the use of an inhaler could die of an asthmatic attack. A family care giver who gets improper instruction on recognition of life-threatening signs could fail to seek emergency assistance.

Besides patient care, there are other aspects of a practitioner's job that require instructional skills. When a colleague from another discipline, like nursing, asks about a device or procedure, the practitioner's response involves instruction. When a physician asks about the meaning of certain laboratory values, the response involves instruction, as well. When practitioners orients a new employee to their job, they are instructing. Finally, when practitioners are responsible for students, they assume a primary instructional responsibility. All of these are extremely important clinical roles for practitioners, and they require instructional skills.

What makes instruction effective? What are the attributes of an effective instructor? What other attributes will likely increase an instructor's efficacy; that is, what are desired attributes? For starts, **instruction is effective when learners attain the goals of the instruction.** Therefore, instruction is ineffective when learners do not attain those goals. Table 1.2 lists the essential attributes of an effective instructor.

Essential Attributes of an Effective Instructor

- Subject matter expertise
- Motivation to teach
- Competence in goal identification
- Competence in determining goal attainment

Table 1.2

Subject matter expertise is a prerequisite for instructional effectiveness. Because instruction as the transfer of skills from one person to another, the instructor must have the to-be-learned skill in the form of subject matter expertise. In other words, one cannot teach what one does not know.

There are several factors that motivate instruction. It would be wonderful if all professionals engaged in teaching for the sake of the students, their patients, their professions, and for the general good of society. This is often the case with professional educators; but, not always. For example, some university professors prefer to conduct research, and devote the least time permissible to teaching.

Clinical practitioners sometimes have no desire to teach, and may dislike having students or orientees under their charge. Under these circumstances, the practitioner may teach only because they are required to do so. This kind of motivation often results in submaximal instruction, as well as discomfort for all concerned. However, the instruction still may be effective if the objectives are reached. Ideally, a person teaches because it is satisfying and enjoyable to assist

another person develop their professional skills. Teaching is a way to magnify one's own capabilities by enabling others to emulate them.

Goal Orientation Questions

- Where are we now?
- Where are we going?
- How do we know when we're
- there?

Table 1.3

Table 1.3 lists three questions that relate to goal orientation. Goal identification, is the definition of desired end-points of instruction, or what the learner should be able to do as a result of the instruction. For example, an experienced practitioner wants to instruct a student on tracheal suctioning. The practitioner knows that the desired outcome of the instruction is for the student to suction the patient's airway, safely, and with minimal discomfort to the patient. Furthermore, the practitioner realizes that the student must be able to do other things before attempting suctioning. For example, pre- and post-oxygenation are important to suctioning a patient's artificial airway. This scenario describes the concepts, 'enabling,' and 'terminal' objectives.

Instructional Goal, Versus Objective

Instructional goal- a desired outcome of instruction, which may be expressed in broad terms, and without specification of criteria or conditions for measurement of attainment.

Instructional objective- a desired outcome of instruction, expressed in precise terms, usually specifying criteria and conditions for measurement of attainment.

Table 1.4

A terminal objective is the end-point performance objective of a unit of instruction. Enabling objectives are those that must be attained to make it possible to attain the terminal objective. The student's safe suctioning of the airway is a terminal objective. Prerequisite skills, like pre-oxygenation, are enabling objectives. An effective instructor must have instructional objectives and know their learners' starting points, just as a cab drivers must have pickup and destination points for their riders. The terms, 'goals,' and 'objectives,' often are used interchangeably. See Table 1.4 for an explanation of how these terms relate.

In addition to having a clear definition of the objectives of instruction, it is important that instructors know how to determine when an objective has been attained. This determination requires some kind of evidence, based on performance by the learner. One form of evidence is the observation that a student suctions a patient's trachea without making a mistake. In the classroom, the evidence usually takes the form of a paper-and-pencil test.

Transfer of skills from instructor to learner is accomplished by communication of some kind, be it vocal instructions or physical demonstration. For example, a clinical practitioner may teach a procedure by demonstrating and explaining. A classroom instructor may use lecture-discussion to convey information. A computer program may teach by providing drill-and-practice on drug dosages. Regardless of the medium, it is abundantly clear that skills must be clearly communicated to be acquired by learners. Therefore, communication to the learner is absolutely

necessary; but, it is not enough. It is critical for instructors to receive communications from learners, as well.

Instructors should observe and listen **actively**. Instructors determine whether learners have prerequisite skills by watching and listening. They know when goals are reached by watching, listening and testing. Importantly, instructors can monitor the progress of their own efficacy as instructors. People experience frustration with computer programs because of their cryptic messages and their failure to respond to our individual input. An instructor who acts like a computer, giving nothing but error messages, evokes the same emotions from learners in addition to compromising instructional efficacy.

The attributes an instructor **must** have to be effective include: (1) subject matter expertise, (2) motivation, (3) goal orientation, (4) multi-directional communication competence. There are other attributes that upgrade an instructor from "effective," to "good," or even "superior." Some of these are listed in Table 1.5. First, an instructor who enjoys teaching is a dead giveaway to students. This enjoyment translates into enthusiasm, which can be contagious, and therefore, motivating to students. Probably, there is nothing less conducive to learning than an instructor who makes it clear, through words or actions, that she/he would rather not teach.

Elements of Instructional Excellence

- Enjoyment of teaching
- Competence with instructional media
- Professional behavior
- Friendliness
- Humor
- Empathy
- Impartiality

Table 1.5

Instructional medium refers to the primary transport vehicle for the instructional subject matter, or message. Instructional media take many forms, such as: textbooks, videotapes, audiotapes, computer software, notes, etc. Expertise in media gives the instructor a decided advantage. Media that are appropriate for the message and goals can enhance instructional efficacy and efficiency. **Instructional efficiency is the time required to attain instructional objectives.**

The learner will hear and read the word, ‘competence,’ many times during this course of study. Probably, the learner even has an intuitive feel for what it means. But, when we discuss competency and competency-based education, the word takes on special meaning. **A competency is a set of skills that make a person capable of filling a role or performing a job. A competency-based educational program is one that requires learners to demonstrate competencies to graduate**. Professional competency involves three general categories of skills:

- skills related to a person's command of a body of information,
- skills related to physical task performance and
- skills related to personal and interpersonal skills.

Although the relative amounts of the aforementioned types of skills vary among health care professions, all professions require considerable competencies in all three categories. All professions require a command of information by their practitioners. All professions require some physical performance. Finally all of them require interpersonal skills, as well.

Personal and interpersonal skills, are especially important to health care practitioners. These skills are difficult to teach, but we generally believe that role-modeling by instructors is an important instructional medium. Therefore, professional behavior is important for an instructor of prospective professionals.

Friendliness and humor are the final items on the list of desirable attributes. Although it can be a mistake for instructors to form close friendships with current students, it is desirable to foster relationships with students that enable them to relate in a friendly manner. Classroom discussion is a valuable medium. It will not take place in an atmosphere characterized by coldness. Furthermore, a hostile atmosphere often permeates to the subject matter. An instructor who is unpleasant can cause student's to dislike the subject matter, as well.

Humor plays an important role in the classroom. It can relieve tedium, provoke memorable examples and bring some fun into the classroom. This is not to suggest that every class session ought to be a party; but, neither should they have the look and feel of a funeral. Student practitioners are headed into a world that is often stressful, sad and otherwise emotionally draining. Humor helps people cope with stress and provide some emotional rejuvenation.

Curriculum, Versus Instruction

This book intends to teach about both curriculum and instruction. As defined earlier, instruction is transfer of skills from one to another. **Elements of instruction include objectives, media, strategies, testing, evaluation, etc. On the other hand, curriculum is the overall plan for carrying out instruction. Elements of curriculum include curricular goals, the sequencing and scheduling of courses, coordinating clinical and laboratory facilities.**

Examples of a curricular goals: addition of a career-ladder track for non-degreed practitioners, converting to open admissions and deletion of a course. Instructional elements are nested within the curriculum. Generally, individual faculty assume responsibility for instruction within their own courses. However, the role of faculty in developing curriculum varies widely among institutions and educational programs. Chapter 10 in this manual describes the fundamentals of curriculum development and evaluation.

Instructional Paradigms

A paradigm is a point-of-view regarding an area of knowledge, a way of looking at things, a model. Instructional paradigms represent distinct points-of-view on instructional theory and methods, including how instruction is evaluated. The bases for these paradigms are different philosophies and psychologies. Although there are several paradigms that relate to learning, this chapter focuses on two of them, which are: **(1) behaviorism and (2) information processing.**

Behaviorism

Behaviorist Model
S ==> R ==> Sr

Table 1.6

The reader is likely to be somewhat familiar with behaviorism. Its basis is the stimulus-response mechanism. Applied to human learning, a stimulus representing the to-be-learned (TBL) information is presented to the learner, who responds to the stimulus. When the correct response is elicited from learners, they have learned the information. **Any response by the learner elicits another message from the instructor, intended to encourage repetition of the correct response. This message is called reinforcement.** Table 1.6 shows the basic model. Instructional message presented to learner (S), a response by the learner (R), another stimulus presented to learner, to reinforce the behavior (Sr)

Behaviorist Contributions to Instruction

Behaviorist psychology dominated instructional theory and practice for many years, culminating with B.F. Skinner's teaching machines of the 1970s. Adherents to behaviorism made important contributions to instructional theory and practice. Table 1.7 lists a few of those contributions. Behaviorism, along with its instructional methods have been soundly criticized by educational psychologists. Still, there is little doubt that certain elements of behaviorism will remain in use. This is because these elements are practically indispensable to instructional development.

Behaviorist Contributions to Instruction
▪ Instructional objectives, ▪ Competency-based education, ▪ Task analysis, ▪ Instructional systems design

Table 1.7

The terms in Table 1.7 have been defined previously, except for two of them. **Task analysis is a process to identify all behavioral components of a task.** The primary purpose of a task analysis is to identify all skills that are prerequisite to the task. This relates back to "crawling before walking." The next term, **instructional systems design (ISD), describes a systematic method for developing instruction.**

Information Processing

The information-processing paradigm for instruction gained prominence along with cognitive psychology and computer models for memory. **Adherents to information-processing attempt to explain learning phenomena in terms of what goes on is the human brain**. There is no representation of the brain in the behaviorist model. The brain is a 'black box' to behaviorists, who generally believe that we don't really know much about what goes on in the brain, and it is not important to instruction. **This has been the primary criticism; that behaviorism is de-humanizing, because it considers the brain a non-entity.** So, Chapter Two of this manual addresses issues; like attention, long-term and short term memory, etc. Importantly, information-processing theory provides clues as to why some instructional strategies do or do not succeed.

Competency-Based Education

CBE is very important to the learners. For one thing, they currently are students in a CBE program. Furthermore, any instruction they deliver in the future to health care practitioners probably will be competency based. As pointed out earlier, a competency is a set of skills. Any profession or occupation demands a set of competencies for practice. Therefore, a CBE program assures that its graduates demonstrate those competencies before they graduate.

What are the differences between CBE programs and other types? The primary difference is that students in CBE programs are not permitted to advance through the program until the prescribed competencies are attained. That is, there is no such thing as a "C" level competence; either you are or you are not competent. Another difference is that a student in a CBE program is given a number of opportunities to demonstrate competence. Theoretically, the time to attain competence is variable for each student. Some students would complete the program faster than others. It should be obvious to the learner than, that CBE, in its pure form, does not exist in colleges, mainly because of administrative and logistic difficulties.

CHAPTER ONE STUDY QUESTIONS

1. List eight examples of instruction delivered by practitioners as part of their normal duties.
2. List five ways you could harm a patient by inadequate instruction.
3. List five attributes of an effective instructor, in addition to those listed in this section.
4. Classify the following as goals or objectives:
    a. Perform arterial puncture on the stick arm with no critical errors.
    b. On a written examination, list six hazards of aerosol therapy
    c. Describe competency-based instruction
    d. Develop a positive attitude toward elderly patients.
5. Classify the following as to whether they are curricular or instructional issues.
    a. Student attrition
    b. Writing laboratory check-off forms
    c. Writing a lecture.
    d. Selecting library materials.
6. Describe the major difference between the behaviorist and information-processing instructional paradigms.
7. List five competencies in your own program.
8. Contrast competency-based education with a conventional liberal arts degree program, such as English or biology.

CHAPTER TWO

INFORMATION PROCESSING

Learning objectives:

X Describe the primary structures involved with memory.
X Describe the processes of encoding and retrieval
X Discuss the importance of inter-connectivity between information units and relatedness of information.
X Describe teaching and learning strategies to support information-processing
X Describe how instruction can improve problem-solving skills
X Describe learning transfer and its explain its significance

The following terms are introduced in this chapter:

attention	levels of processing	problem-solving
encoding	metacognition	rehearsal
encoding specificity	semantic memory	retrieval
elaboration	long-term store	transfer (of learning)
episodic memory	short-term store	spreading activation
organization	advanced organizer	levels of processing
sensory register		

This chapter describes and explains many of the concepts of the information-processing instructional paradigm. We are particularly interested in the importance of information-processing concepts to instruction. The learner is cautioned that there are many variations and explanations within cognitive psychology. This author has selected among those variations. Mechanisms for information-processing and the structure of memory are central to the discussion. Importantly the learner should note that the intention of this chapter is to lay a foundation of theory for chapters to come. That is, rather than attempt to memorize the facts contained herein, use the concepts to understand why certain instructional strategies are likely to encourage learning.

Memory Structures

Early models of memory compartmentalized the brain into separate physical structures for storage and processing. These models imply a physical transfer of information between a short-term store (STS), where information is processed, and a long term store (LTS), where information is stored. In other words, bits of information would shuttled between the LTS and STS. Current theory favors one memory store, mainly because

Memory Structures

- Sensory register
- Short term store (STS)
- Long term store (LTS)
- Episodic memory
- Semantic memory
- Schemata

Table 2.1

cognitive scientists found it unlikely that information was transferred around the brain, like through phone lines.

Current theory models LTS and STS as one single structure. **This single memory store serves both purposes, long-term and short-term storage. Within this dual-purpose store, nodes of information alternate between being active or dormant. When a node is active, it is STS, also known as 'working memory.'** Information from the environment is received by a sensory register, then converted into memory, or mnemonic code (encoded) in the STS (see Figure 2.1).

Again, when information is active, it is short-term, or working memory; while inactive, it is long-term memory. Information is available, but dormant in LTS until accessed and activated by control processes, which are not well understood. Activation of information in the LTS is called 'retrieval.' During retrieval dormant, long-term memory, becomes working memory. When activated, the information stored in therein is remembered. The storage and reactivation processes are governed by yet another brain function called the 'executive controller.' This is the controller over all memory processes, and little is known about its origins and functions.

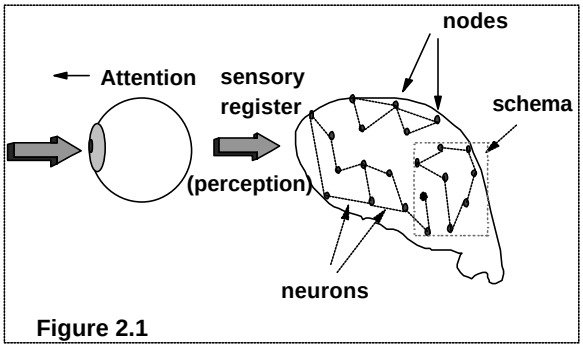

Figure 2.1

Nodes, which are the containers for information, are interconnected by a network of neurons. The term 'schema' is sometimes applied to this network. Theoretically, schemata (plural for schema) provide formats for information, like scaffolds. Formatted information provides both related information and structure for additional information in the form of prior knowledge.

Neisser (1976) wrote that **schemata provide information frameworks to help humans make sense of the world and enabling them to make predictions about what is coming, based on what is already known.** For example, prior knowledge about the heart includes certain facts, concepts, and principles about the heart, and the organization of this information about the heart would be the 'heart schema.' This schema provides a scaffold with uncommitted slots for additional information about the heart, so new information is stored and formatted with related information.

Rumelhart & Norman (1981) explained how learning proceeds under the schema-based representational system, and they identify three qualitative learning categories:

- Accretion- the encoding of new information in terms of existing schema. This is the most common type of learning.
- Tuning, or schema evolution- modification and refinement of schema, as a function of the application of the schema. This mechanism is essential in the development of expertise.
- Schema creation- the creation of new schemata

Encoding, or accretion, is the process by which information from the outside world is converted into memory. Although the code is unknown at the present time, it is likely that the encoding entails a restructuring of neurons by a neurochemical process, making the information recognizable for access and activation by the control processes. When new information is incorporated into a schema, the encoding of the information has been achieved, and learning by accretion has occurred. It is worth noting that the encoding of new information is not the sole mechanism for learning.

The refinement of a schema is another mechanism for learning. By refinement, the information within a schema is restructured, changing its organization, rather than the information. The information remains intact, however the rules by which the information is used changes. For example, a person who has developed a schema for the heart and its function is thinking about the heart and generates a concept about the operation of the mitral valve through the application of logic. The information about the heart has not been amended by information from the outside, but has been structurally changed through the refinement process. The relationships between information have been changed by the learners own thought processes.

New schemata are created when a novel experience arises and existing schemata are applied without success. In the novel experience, whatever parts of a best-match schema that can be applied to the novel situation are used to generate the new schema. This would be like taking a word-processing document on a computer diskette, copying it, and making alterations to create a new document. If one were to suddenly find himself/herself on Mars, with no schema to apply, he/she could activate the 'weird schema', with certain facts, principles, and relationships and attempt to work from there, until such time that a Mars schema can be generated.
The question regarding the source of the initial schemata for an individual is unanswered and may remain that way. The process of knowledge acquisition must begin somewhere, and if schemata are necessary for the generation of memory one could only speculate a congenital supply of schemata. These may provide only structure for information, without related information.

Episodic, Vs. Semantic Memory

Theoretically, the LTS is further compartmentalized into episodic and semantic memory. **Episodic memory is autobiographical data about events, linked to space and time**. Examples of episodic memory would be another person's face, or an event, like a birthday. The vividness and detail of episodic memory seem to be at least partly linked to emotional impact, as well as outstanding or unusual features. It is usually episodic memories that are challenged by lawyers. Episodic memory is vulnerable to the passage of time and to interference from other information. Finally, episodic memory is not the memory of reasoning. The memory of reasoning is the semantic memory. Table 2.2 lists some of the distinctions between episodic and semantic memory.

Semantic memory consists of facts, concepts, interrelationships, and meanings. The key words here, are 'interrelationships and meanings.' While episodic information originates as sensation, with events as the unit of information, semantic information arises from comprehension. The unit of information in semantic memory is 'ideas.' To present a contrast, a new word starts as episodic memory as an image of the word, linked to an event with which it occurred. But, as the word gains meaning, and is related to concepts in LTS, it becomes semantic information. As semantic memory, the word is less connected to the space and time relations of events, and more connected to concepts related to its definition.

DISTINCTIONS BETWEEN EPISODIC & SEMANTIC MEMORY

	Episodic	Semantic
Information source	Sensation	Comprehension
Information unit	Event	Idea, concept
Organization	Temporal	Conceptual
Contextuality	More	Less
Subordination to:		
Interference	More	Less
Amnesia	More	Less
Intelligence	Less	More
Hypnosis	More	Less

Table 2.2

For example, you hear the word, 'sesquepedalianism,' for the first time. You can practice memorizing this word until you turn blue, but it remains episodic memory, because it is only a word, composed of certain letters, which has no meaning. I will now inform you that sesquepedalianism means the practice of using long words. Therefore, it is a candidate for inclusion in your semantic memory. Both forms of memories are important to learning, since memories usually start as episodic. Probably, semantic and episodic memories interact to support both encoding and retrieval. It's helpful for instructors to understand the differences, and how they relate to instruction. Namely, that we must introduce new topics in a manner that initially supports episodic encoding, then conversion of the meaningless information into something that makes sense.

Memory Processes

There are four primary information processes: perception attention, encoding and retrieval. This chapter will discuss all of these except perception.

Attention

At any moment, more information than can be simultaneously processed in consciousness is available, both from the environment and from within memory. **The process responsible for selecting information for processing in memory is called attention.** It is important to note that attention is an active, rather than passive process.

Information Processes

- Attention- active selection of information from the environment.
- Encoding- conversion of information to mnemonic code
- Retrieval- activation of information in LTS

Table 2.3

People attend to information actively and select which bits will be further processed. Generally, the information is selected with some motive, or purpose. For instructional purposes, there are three components to attention: First, the learners' attention is gained; then, it is directed; finally, it should be maintained. When there is interference with any of these components, attention to the presented information is lost, and the information is not subjected to the next process, which is encoding.

Encoding

Encoding is the process that converts incoming information into mnemonic code, or incorporates it into the LTS. Information is detected by senses, selected by attention, then converted into mnemonic code. Although there is evidence of physically separate stores for episodic and semantic memory, the existence of different kinds of memory probably results from different kinds of encoding operations, instead of separate stores. Furthermore, it is likely that episodic and semantic memories support one another in retrieval operations. For example, a classroom event or an image on a notebook page, may represent a cue leading to solution of a problem on an examination. Conversely, a semantic operation may test the plausibility of an episode to aid accurate recollection of the episode.

Another important concept from information-processing theory is **encoding specificity, which refers to the linkage of information to events, or context.** The context in which incoming information is encoded decide the cues that trigger retrieval of the information. For example, a learner may be able to recall certain memories if put in the same circumstances in which they were first encoded. This explains why witnesses return crime scenes, in hopes of fostering recall of events. It explains why cues, such as odors, trigger memories. Loss of contextual cues for information can lead to retrieval failure. That is, information available in LTS can become inaccessible to consciousness because the cues to find the information are lost. Encoding specificity explains the context sensitivity of learned material.

The nature of the encoding operation influences the recollection of information. While encoding specificity determines the conditions under which information is accessible, Craik and Lockhart's 'levels of processing' theory attempts to account for whether information is encoded as episodic or semantic. Working memory processes incoming information in different ways. Information may be superficially processed, resulting in a less durable, less meaningful memory trace, or deeply processed, resulting in a more meaningful and durable trace.

Encoding operations involve rehearsal, which can be passive or active. Passive rehearsal maintains information in working memory's rehearsal buffer by mental repetition. Active rehearsal uses pre-existing information to elaborate on incoming information. Hypothetically, active rehearsal leads to longer retention of information, and increases its meaningfulness by creating connections between information in memory and new information. This propagation of connections between nodes may encourage retrieval by providing more access routes.

Retrieval

A process analogous to elaboration occurs during retrieval. **The term, 'spreading activation,' describes retrieval of information from semantic memory.** The location of a node relates to its message; the distance between nodes is inversely proportional to the relatedness of their messages. This is called 'semantic distance.' For instance, on a semantic scale, dog' and 'cat' are closer than 'dog' and 'anvil.' If new bit information that has no relation to any information in memory, it has infinitive semantic distance. Therefore, this unrelated bit is episodic, rather than semantic memory. One cannot reason the way to that information; it must be accessed by locating encoding cues.

Retrieval, as described by the Loftus model, involves a search through nodal links for comparisons to be made, but the search is in a single stage, and involves a unique process called 'spread of activation.' Lachman (1979) likened this process to a group of tuning forks, where a tone from a similar fork will spread its vibration to others of similar tune. In the brain, this is analogous to a chord being struck in a given node, and others that are associated being activated. The stronger the association with the primary activated node, the more likely it is that an associated node will be activated. This spreading activation is the route for the search through semantic memory for verification of the concept in question.

The activation signal 'tags' each node as it spreads, until a node is reached upon which a decision can be based. If the stronger associations (closer in semantic distance) can indicate truth or falsity of the proposition regarding the concept, a decision can be reached more quickly. If the closely associated nodes do not contain the necessary data, then the search is prolonged. This is why decisions in the negative direction require more time to make.

Spreading activation starts with activation of a primary node by control processes that activate conduction of a nerve impulse. The nerve impulse travels away from the primary node in a search for target information. Stronger, or shorter connections between the accessed node and the target increases the probability for activation of the target.

While elaborative encoding increases the probability for retrieval by increasing accessibility of information, retrieval is also helped by encoding to-be-learned (TBL) information with related information. This results in shorter semantic distances between accessed nodes and target information. Retrieval of TBL information can be aided by retrieval structures, which are specialized schemata. Presumably, retrieval structures locate cues at readily accessible memory addresses, reducing the search for TBL information.

Implications of Information-Processing for Teaching and Learning

Cognitive science is relatively new and there is much to be discovered about information processing. However, the information-processing paradigm provides a useful framework for

developing and testing instructional strategies. The following sections describe the relationship between instructional strategies and information processes.

Strategies to Support Attention

To learn information from an instructional message, students must first select it, then encode it. As evidence that this learning has taken place, the learner takes a test that requires retrieval of the encoded information. Although the cycle just described appears simplistic, complex cognitive processes occur at each stage of the loop. **When a learner fails an exam, it is unknowable whether the failure involved encoding or retrieval processes.** In other words, was the information never learned? Was it learned in a manner that made it hard to remember in the examination environment? Since failure at any stage in the cycle decreases achievement, learning strategies should support selection, encoding, and retrieval of TBL information. The learning process begins with attention, because attention causes information to be processed by working memory.

Strategies to Support Attention

- Inform learners of learning objectives
- Embed content-relevant questions in presentation
- Pause to permit time for elaborative processing, especially for images
- Provide notes, including key points of instruction
- Encourage only elaborative notetaking.
- Embed headings in visual aids
- Vary tone, pace of speech
- Maintain personal contact with learners
- Interject novelty, humor
- Avoid lengthy presentations

Table 2.4

Recall that the initial encounter with information involves attention. **Learners' attention must first be gained, then directed and maintained.** Gaining attention simply means getting the learners to look at, and listen to, the instructional message. Once attention has been gained, it must be directed for the learners to select information from the message, then maintained for the duration of the lesson.

With adult learners, gaining attention should pose no challenge. Gaining the attention of children may require loud noises or bright colors. But, with adults, instructors depend on courtesy to serve as the attention gaining device. For example, an instructor standing at readiness at the front of the classroom at the appointed time should gain the attention of a class.

After **gaining** the learners' attention additional strategies can **direct** their attention to select information from the instructional presentation. First, establishing the relevance of the instruction can prepare the learner to select information with a specific intention. For instance, an instructor may point out how a learner will eventually use the information in practice, as well as how incompetency in the lesson content could injure a patient. This will establish both importance and relevance for the information. Attention can be directed by informing the learners of the instructional objectives. These describe what information the learner should select, as well as how the learner will be required to use it.

Instructional materials that are presented at the beginning of a lesson, and that serve to guide learning during the lesson, are called advanced organizers. Instructional objectives can serve in this capacity. Another type of advanced organizer is study questions, which may provoke selecting and thinking about lesson information. Advanced organizers can support additional information processes, thereby increasing learning.

Various strategies are used to direct attention to audiovisual media. For example, an instructor may point to key elements in a display. Colors can be used to differentiate between elements, thereby directing attention, as well. A common error among instructors is to present visual displays that are so overcrowded, that learners don't know where to start their selection. More often than not, this type of display actually inhibits learning by misdirecting attention.

Maintaining attention can be a forbidding task for instructors. However, those who ignore the need for this may as well be teaching to an empty classroom after ten minutes into their presentation. First and foremost, instructors must maintain personal, eye contact with students, because their affect yields cues as to their attentiveness, as well as their interest and understanding of the material. Monotonous presentations lose students very quickly, so instructors should vary the pace and tone of their voices, ask questions related to the content and try to inject humor and novelty, where appropriate. Finally, there is an old instructional axiom, 'the mind will absorb only what the seat can take.' Therefore, presentations should be limited to fifty minutes, maximum.

Strategies to Support Encoding

Once the TBL information has been selected for processing, it needs to be encoded. It's important to remember some of the earlier discussion relating to semantic and episodic memory, schema, levels of processing and retrieval. The first thing to think about is that there's no point in encoding the information if it can't be retrieved. As a corollary of this, good instruction aims to support encoding of TBL information in a manner that facilitates its retrieval.

Brand new information, which has no precedent information is difficult to encode as semantic memory. Therefore, it is necessary to encourage episodic encoding until schemata develop to support semantic encoding. We can encourage episodic encoding by connecting the TBL information to events, such as clinical ‘war stories.’ For instance, an instructor who is trying to make some initial instructional point with new

Strategies to Support Encoding

- Stimulating recall of prior knowledge
- Strong sensory or emotional stimulus- encourage episodic encoding
- Contextual cues- encourage episodic encoding, retrieval.
- Citing examples, non-examples
- Mnemonics
- Simple rehearsal- repetition, drill & practice
- Elaboration- thinking about things; making connections with other information in memory.
- Organization- establishing connections with similar information.
- Metacognition

Table 2.5

students may describe how a clinical error killed a patient. This can induce fear in the students, which may cause some kind of mnemonic bell to ring when the situation is again encountered. Humorous stories may serve the same purpose.
Other strategies to support episodic encoding are generally called ‘mnemonics.’ For example, students may learn a mnemonic for the names of the cranial nerves, "on old Olympus, towering tops, a Finn and German viewed some hops." This rhyme helps to remember those nerves; that is, if one can remember what the letters stand for. Other mnemonic devices include mental images, which can be used in a number of ways to encode and assist retrieval.

One learning method that applied imagery is called the "Method of Loci," which was used by the ancient Greeks as a mnemonic device. To apply this method, a person takes a walk along a path or corridor and associates specific images along the way with units of information intended for memorization. During the walk, the learner creates connections between the images and the information. To recall the information, the learner then imagines himself/herself along the same path and each imagery cue along the path stimulates recall of associated information. Table 2.6 exemplifies this process.

Images & Remembering

Did you ever hide something away, in hopes that no one but you would find it; then, forget where you put it? After you've looked for awhile, you may be unsure if you hid it, or lost it. How do you go about finding the hidden object? First, you may find comfort that if you can't find it, it will never be stolen. Then, you remember that it won't do you a lot of good, either.

So, You walk around your place, looking at things that might serve as cues to the hiding place. Other memories can act in the same way. In fact, people who excel at remembering things use cues, such as rhymes or mental pictures to help them retrieve the information. We use those same strategies to facilitate retrieval of learned information.

Table 2.6

Simple rehearsal is a strategy to support episodic encoding. This involves repetition, or drill and practice on the facts. For instance when a learner initially memorizes medical terms, they make no sense, but they are learned. After frequent use of the terms, they enter into reasoning, or semantic memory. Most people consider memorization of fact to be tedious. Although this may be true, memorization is necessary for certain types of material, at certain stages of education. Instructors may shy away from simple rehearsal because it is boring. However, making a game of it can make simple rehearsal fun and interesting.

Elaborative processing prepares learners for more complex cognitive tasks, such as application of information. **Elaboration is addition of information by the learner to incoming information;** it builds more connections between to-be-learned information and that which is in memory. Recall that units of information are nodes, which are interconnected within schemata by a neural network. The proliferation of neural connections between nodes enhances activation of information because more pathways between nodes are available. For example, if a greater number of concepts are connected to the concept ‘valve,’ then there are more pathways in memory by which ‘valve’ can be reached. Elaboration
strategies can involve either verbal or visual forms of information. The application of visual elaboration requires imagery.

Another strategy to support semantic encoding is presenting examples and non-examples. **A non-example is a case where the definition of a concept does not hold true.** Consider the concept, 'sphere.' Examples of spheres are 'baseball' and 'orange.' On the other hand, non-examples of sphere include everything that is not a sphere, like 'shovel' and 'pencil.' Citing non-examples is an effective instructional strategy, especially when the instruction targets discriminations between concepts that appear similar. An objective for this type of instruction frequently uses the verbs, 'contrast,' or 'compare.'

Visual aids are used extensively in education, mostly under the assumption that a picture is worth a thousand words. While there may be some truth to this adage, the pictures would probably be more effective if elaboration strategies such as instructions to form and manipulate mental images of TBL subject matter were employed in support of the intended learning. A visual elaboration strategy may be something as simple as instructing students to think about a visual aid and try to imagine how changes in specific areas would impact others.

Verbal elaboration can take a number of forms. Among these are summarizing, paraphrasing, creating analogies, question answering, and note taking. Participative classroom discussion is a verbal elaborative strategy, since it requires learners to add some of their own information to the lesson material during the course of a discussion. Notetaking may serve as either basic or elaborative rehearsal. Copying notes verbatim, prepares for basic cognitive operations, at best, and at worst distracts attention from the message of the lesson. On the other hand, elaborative notetaking prepares for more complex cognition.

Organization helps the encoding-retrieval interaction by selectively locating information in schemata. Theoretically, organization improves connections between units of information, resulting in reduced demands on the STS. Organization is the process by which persons selectively locate information within schemata facilitating its retrieval. Gagne suggested that the effect of organization on recall may involve improved connections between bits of information in memory, resulting in reduced capacity demands on the STS. That is, if information is more tightly arranged, the search for the information is shortened. Outlining is one example of an organizational strategy for learning.

Comprehension monitoring strategies require metacognition. Metacognition is one's knowledge about their own cognitive processes. Metacognition is a process that students can use to monitor their own progress in learning. For instance, a person who is learning about the heart may intentionally search through memory to activate information about the heart, generate questions about what is in memory, and perform self-testing. For instance, "Do I know about...?"

Knowing about what is known can be achieved by various types of self-testing, and is a strategy that can be supported by providing learners with instructions perform self-testing. Having a learner reproduce what is in memory about the subject matter in one form or another can produce metacognition; that is, if the learner knows he/she can or cannot reproduce it, he/she will become more aware of his/her state of knowing the subject matter. Awareness of what one knows and does not know about a subject promotes the learner's access to the knowledge. Furthermore, awareness of knowing is increased by having learners verbalize or write about the subject.

Strategies to Support Retrieval

Several strategies can be used to support retrieval of information. For example, there are the aforementioned imagery devices and verbal devices The same strategies used to encode information also are strategies to activate it. Encoding specificity has important implications for retrieval. The significance of encoding specificity is that the instructional conditions should prepare the learners for the retrieval of the TBL information. If there is a mismatch of the conditions when the information is to be applied, the re-activation may not occur because the activation conditions are inappropriate.

Strategies for Retrieval

- Images, mental models
- Mnemonics
- Review notes
- Match encoding context
- Metacognition

Table 2.7

Review notes may serve as retrieval aids, and therefore should be constructed to support retrieval in a manner that reflects the expected performances by learners. For some kinds of knowledge a format, like a matrix, may be better than an outline (refer to Chapter Five). While an outline shows hierarchical relationships, a matrix encourages visualization of interrelationships between ideas. A matrix presents information concisely, and the organization eases visualization of relationships between concepts. Matrix notes may be particularly compatible with subject matter, like physiology, that involves dynamic interrelations between concepts. They also may be compatible with complex multimedia because of the variety of pathways to follow through the instruction.

Metacognition probably has a role in retrieval by facilitating the search for information. That is, it probably represents a control process. Metacognition may lead to a more skilled search through memory because it may include expertise about how to find and activate desired information. Reviewing for tests relates to retrieval, as classroom rehearsal and elaboration relate to encoding.

Special Issues in Cognition

Expertise & Problem Solving

Allied health educators are expected take novices and help them become experts. As expert allied health practitioners, the student's eventual professional functions involve problem-solving. Although it is possible for practitioners in many situations to go about their business in a prescriptive fashion; that is, just reading and following orders, this is not an apt conception of a professional practitioner. One probably could train almost anyone to perform some psychomotor skills in allied health practices. However, a professional practices under the assumption that patients ought to get the care they need, with all due consideration to cost, safety and other

factors. Each patient is an entirely different person with a special set of signs, symptoms and needs. Therefore, each patient also is a problem, or set of problems, to be solved by experts in their respective areas of practice.

Some time in the past, the author heard a story that always comes to mind when the subject of expertise arises. There was a fellow who worked at an electric plant for years as the person who operated the control panel for the entire plant. After he retired, there arose a problem at the plant that no one seemed to be able to solve. So, the company officials called the man at his home and asked him to come back and fix the problem. He agreed, providing they would pay him $5000. He went to the plant, looked around, then whacked the control panel with a hammer. As a result, all operations returned to normal. When he was asked why he deserved $5000. Just for whacking the panel, he replied, 'You didn't pay me the money for whacking the panel, you paid me to know that it needed whacked and where to whack it.'

Similarly, practitioners need to be capable of more than treating patients; they need to find out whether and with what to treat them. Rather than 'dropping meds,' we are in the business of finding whether patients need respiratory therapy, which therapeutics are appropriate, and determining whether our therapy is having its desired effects.

Problem-Solving Defined

A problem is a situation in which there is a goal, and the problem solver must find a way to reach the goal. A person has solved a problem when they have been confronted with a novel situation, and have achieved a desired goal. A key word here is novel situation, because a problem that has been encountered and solved in the past can be solved by memory without invoking problem-solving skill. In essence, a problem solver uses strategies to create a solution from information that is presented with the problem, as well as information that resides in the solver's memory.

Examples of problem solving include activities like writing this article, solving a mathematical word problem and correctly responding to a clinical situation which has previously been unencountered. Non-examples of problem-solving include things like responding to a clinical situation from rote memory, answering a trouble-shooting question to which the solution has previously been taught, and doing mathematic calculations when given the equations.

The disparity between math word problems and simple calculations lies in the fact that a new word problem causes the solver to find the equation to solve the problem; whereas, just working the equation is only application of rules. To clarify, a student who can find the factor for an E cylinder of oxygen, when given the pressure and volume of a full cylinder, has solved a problem. Conversely, a student who has calculated the amount remaining in a cylinder, based on the cylinder factor, has not solved a problem. They have applied a rule, which is an altogether different cognitive process.

Categories of Problems

Cognitive psychologists have categorized problems as to the prerequisite knowledge needed to solve problems. Within this framework, problems are either **knowledge-rich or knowledge-lean**. Solving knowledge-lean problems does not require prior knowledge on the part of the solver, because the information needed to solve the problem is presented with the instructions. Common **knowledge-lean problems are puzzles; like, tic-tac-toe and Rubic's cube.**

On the other hand, **a knowledge-rich problem is one that does require a knowledge base to solve**. A popular viewpoint among cognitivists is called, 'schema-driven' problem-solving, which attempts to explain differences between novices and experts. It is this latter category of problem, knowledge-rich and schema-based, that is of primary relevance to this discussion.

Problems also have been categorized as to how well they are defined: **Well-defined or ill-defined**. The difference between the two lies in the clarity of the initial state, the permitted operative rules and the goal that represents solution of the problem. **A well-defined problem has a clear description of the initial state, statements of operation and proof, as well as a clear-cut goal. An ill-defined problem lacks clarity in one or more of these.** An example of a well-defined problem might be an encounter with an activated ventilator alarm. The goal is to find the cause of alarm activation and resolve it, the initial state is the alarm, and the rules for solution are set in an algorithm. A mathematic word problem is another example of a well-defined problem.

Ill-defined problems pose additional challenges to the solver. Because some aspects about the problem are not known, solving it also requires defining the initial state, the rules for solving it, and possibly, the final desired end-point. Patient care is a prime example of an ill-defined problem. The patient must be diagnosed to define the initial state. Then, the desired outcome must be determined. Although this may be clear-cut with some patients, this is not always the case. We may not know whether palliation, cure or support are the desired outcomes. Finally, after generating ideas about a patient's status and what we hope to achieve with our therapy, we need to generate a plan on how to get there.

Problem-Solving Processes

Problem-solving includes two major components, which are: (1) the problem space and (2) the search for the solution. The problem space is defined as the solver's representation or understanding of the problem. To develop a problem space, the solver must assimilate the stimuli that pose the problem, then generate a mental model or image that represents the problem.

The search is the process of finding the solution. Schema theory identifies **three components of the search process for knowledge-rich problems, which are: (1) selecting the appropriate schema, (2) adapting the schema to the problem and (3) using it to solve the problem.** Confrontation with a problem activates a problem schema in the memory of the solver, which includes structure and information about the problem, as well as information about problem-solving procedures. To cite an example, an RESPIRATORY THERAPIST who is confronted

with a patient with a patient who is cyanotic will have a schema activated that relates to cyanosis. This schema represents a problem space that includes the therapist's knowledge about hypoxia, as well as rules for relieving the condition.

After the appropriate schema has been selected, it is adapted to the problem-at-hand by filling in its empty slots with information on the specific problem. For our cyanotic patient, adaptation of this schema involves filling in information about the specific patient, as well as other sensory information about the situation, like the ECG monitor display. Finally, the solver invokes the problem-solving procedures that exist within the schema to solve the problem. The hypoxia problem schema includes procedures for relieving hypoxia.

Expert-Novice Differences

Expertise is not well-defined, although it has been suggested that it takes several thousand working hours for one to become an expert. The results of expertise are twofold: first, an expert is more accurate than a novice; second, an expert is more efficient. That is, the expert solves problems more rapidly. There are several explanations as to how these differences arise.

Experts have a richer knowledge base and experience in a particular area. That is, they have highly developed problem schemata and more of them than novices. The additional information in the expert's schemata encourages solution of problems with less information needed from the external situation. This may be most important when attempting to solve ill-defined problems, wherein the solver must supply much missing information.

As development progresses from the novice to expert level, skills in both feature discrimination and generalization of data improve. The child learns to identify a small, stitched, white ball as a baseball, differentiating it from other balls. During this development the child also learns about more kinds of balls to include in the category of balls, thus providing for more generalization capabilities. Expertise appears to involve development in both directions; the construction of ill-defined prototypes for economical storage, and the capabilities for discrimination among specific instances. It would then appear that as maturation proceeds, the construction of schemata for formatting information proceeds, and as new information is encountered it is stored according to the schematic format.

The effect of more schemata is to increase the likelihood that the solver will be able to select a problem schema with a better fit to the problem. Neisser suggests that the schemata, themselves, are subject to the maturation process in that they are modifiable by experience. As the novice becomes expert she/he not only acquires more stored information for tasks, but becomes more skilled at efficient storage and retrieval as well.

Perceived probabilities for a given solution also seem to favor experts in problem-solving situations. Where the experiences of an expert suggests the plausibility of a solution, the novice perceives all possible solutions as having an equal chance. Therefore, the expert has a more

efficient search for a solution. Also, where there is information missing from the problem space, the expert will more successfully fill in the missing information with that most-probable.

Research in the area also has found that experts tend to 'chunk' more information related to a problem space than do novices. That is, the expert has more information about the problem space available in working memory, which enables them to address more components of a problem space than novices at any given time. Experts also seem to have better self-monitoring skills than novices. As a result, experts are better at monitoring the progress of problem-solving as well as estimating the difficulty of a problem.

Instructional Implications

Given the nature of problem-solving skills, it should first be clear to instructors that presenting students with the solutions to problems is ineffective in teaching the skill. On the contrary, they simply memorize the solution, which represents a low order of cognition. Instead, we must foster the conditions that promote the acquisition and implementation of problem schemata. The general steps in problem-solving are listed in Table 2.8. These steps can be taught to improve students' problem-solving skills.

Problem-solving steps

- Define the problem
- Identify relevant information
- Formulate alternate solutions
- Test alternate solutions

Healthcare practitioners encounter problems that are inherently knowledge-rich. Therefore, a prerequisite for solving problems in this domain is an ample supply of schemata. There must be an adequate knowledge base of the concepts and principles governing the practice, as well as the interrelationships between them. One implication here is that one cannot expect novices, without the necessary information to demonstrate expert behavior**.**

Another implication is that we should emphasize the learning of how the general constructs of our domain relate to one another. We can foster the development of mental models and cognitive maps to serve as problem schemata, as well. Given these tools, students are more capable of selecting, adapting and using their problem schemata in a variety of situations.

Development of strategies in problem-solving can be encouraged through several means. We can foster metacognition in students by encouraging them to think about their awareness of their own state of knowledge. To acquire and refine cognitive skills, students also must be required to practice problem-solving in all instructional settings. Once they have the prerequisite information, they can be confronted with problems that force them to generate solutions. Therefore, they learn not only the solutions, but also the strategy for solving the problem.

Finally, we can foster problem-solving skills by example. That is students can learn to develop

strategies by observing, interacting and practicing with experts in the field. Although we can encourage and exercise problem-solving in the classroom and laboratory, the clinical setting is where they can be guided to develop the most important problem-solving skills. Therefore, the role of clinical preceptorship gains prominence here.

Learning Transfer

To briefly describe learning transfer, it involves the capability of using information beyond the context in which it is learned. There is a cognitive distance component to this transfer. For example, a principle that is learned in a classroom often must be transferred to the clinical area for application. Some learners who are adept at classroom learning have great difficulty transferring the information beyond the classroom. Strategies that support transfer involve de-contextualizing the information; that is, varying the context in which the information is applied by the learner. Instructors can do this by providing various types of simulations, problems, examples and mental models.

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CHAPTER TWO STUDY QUESTIONS

1. Explain the relationship between long-term and short-term memory stores.
2. Describe the differences between episodic and semantic memory. Give examples of each.
3. Explain the functions of schemata in general memory processes and in problem-solving.
4. Describe the implications of encoding specificity for instruction and evaluation of learning.
5. List two specific strategies for directing attention.
6. Describe two specific instructional activities to support encoding of facts.
7. Describe two specific activities to support encoding of concepts.
8. Describe two specific activities to support retrieval.
9. Given a learner fails an examination, identify two information processes that could be the source of failure. Explain why this confusion exists.
10. Define metacognition and describe its importance to learning.
11. Considering encoding specificity and elaboration as information processes, what kinds of instructional strategies will support transfer of learning from one area to another?
12. Contrast simple rehearsal, versus elaboration with respect to kinds of supported learning.
13. Cite three examples of problem solving.
14. List the steps in problem-solving
15. Describe the implications of failure to transfer learning among students of health professions.
16. Describe how instructors can encourage learning transfer.

CHAPTER THREE

DEVELOPING LEARNING OBJECTIVES

Learning Objectives:

- Describe the identification of instructional needs.
- Describe the purposes of learning objectives.
- Describe how learning objectives are determined.
- Identify the domains of skills.
- Describe the taxonomies of skills for cognitive, psychomotor and affective domains.
- Write learning objectives for each skill domain, at all levels for the cognitive domain.

The following terms are introduced in this chapter:

- Instructional need
- Taxonomy (of skill)
- Domain (of skill)
- Psychomotor
- Levels (of skill)
- Cognitive
- Affective
- Professional behaviors

?

Authorship of the poem at right belongs to Dr. Robert Mager, one of the pioneers and proponents of learning objectives. The poem summarizes the importance of learning objectives; but, one important issue is missing. That is, the idea of entry-level skills. Most certainly, an instructor needs to know where to take the learner, how to get there, and how to know when they have arrived. However, we need to know the starting point, as well. The goal for instruction is that it meets the needs of the learners. **Instructional need is identified as the competencies that have not been attained by learners; the difference between entry-level skills and the desired outcome skills.**

There once was a teacher
Whose principal feature
Was hidden in quite an odd way.
Students by millions,
And possibly zillions,
Surrounded him all of the day.
When finally seen
By his scholarly dean,
And asked how he managed the deed,
He lifted three fingers
And said 'All you swingers
Need only to follow my lead.
To rise from a zero
To big campus hero,
To answer these questions you'll strive:
Where am I going,
How will I get there,
And how will I know I've arrived?

Robert F. Mager, 1984

One important issue in developing instruction is identification of its starting point. A safe bet for an instructor is to assume that the learners have none of the skills. Then the instructor must teach everything. Although this may ensure comprehensive instruction, it also can be detrimental. For one thing, it can waste time and energy in developing and presenting instruction unnecessarily; for another, it can be tedious to the learners.

Ideally, entry level skills are measured with a pretest, and in many situations, this is the recommended method. On the other hand, much instruction takes place in situations where a paper-and-pencil pretest might be absurd, like during clinical training. Other formal sources are

educational records of the learner and descriptions of courses which the learner has passed. Less formal methods include learners' self-reports of what they know and can do. Finally, well-formulated and executed oral questions on prerequisite information and procedures can be very effective in identifying entry level skills.

Instructors ought to verify learners' entry-level skills, regardless of what the records indicate, for two reasons: First, the questioning will determine whether the learner has forgotten what the records indicate; second, the questioning reminds learners of what they need to know. Once the instructor knows the starting point, he/she can identify instructional needs and develop instruction the is both effective and efficient in leading learners to the learning objectives. These objectives serve several purposes, as listed in Table 3.1.

Functions of Learning Objectives

As one can see from the list of purposes for objectives, they serve the learner as well as the instructor. Because objectives are so important, formulating and articulating them deserves special attention. At the very least, objectives must be formulated to describe the specific skill, which includes its domain and level. The concepts, domains and levels of skills are critical to developing objectives. These concepts are explained in proceeding sections.

Functions of Learning Objectives

- Determine instructional subject matter
- Guide selection of instructional media and strategies
- Guide construction of evaluation instruments
- Inform the learner of the purpose of the instruction
- Alert the learner to the relevance of the instruction
- Direct learners' attention to select key information
- Inform learners as to how they will use information
- Inform learners as to how they will demonstrate skill attainment.

Table 3.1

Skill Domains

Domains of skills refers to one of three general areas of skills. As shown in Table 3.2, the domains are cognitive, which requires learners to demonstrate a command of information; psychomotor, which requires learners to demonstrate physical skills; and affective, which requires learners to demonstrate attitudes and values.

Skill Domains

- Cognitive- information
- Psychomotor- physical skill
- Affective- attitudes and values

Table 3.2

One way of recognizing that these are different domains is to consider the kinds of tests needed to measure learning from each. Cognition can be demonstrated by paper-and-pencil tests, as well as oral questioning. But to show acquisition of psychomotor skills , the learner must perform some kind of physical task; such as drawing blood, exercising a limb, et cetera. Finally, a learner demonstrates acquisition of attitudes an values in various ways; such as interactions with other people. Of all the domains, the affective skills are the most difficult to teach and to evaluate in a consistent and objective fashion.

In reality, there is not a single skill that involves only one domain, because instruction and evaluation of any skill, especially a clinical skills, involves more than one domain. For example, it is very difficult to teach a learner a skill that they do not value. Therefore, acquisition of cognitive skills involves affect. Also, a learner cannot acquire or demonstrate a psychomotor skill without firsthand knowledge of the skill, as well as the inclination (affect) to do it.

To present a more complex example, learners who must demonstrate venipuncture, must know the equipment, the anatomy, and the procedure; they must have kinesthetic skills to locate and puncture the target; finally, to perform the procedure properly, they must have the skill to empathize with the patient, obtain their cooperation and the fortitude to puncture another person's skin with a needle. Because of the combination of domains involved in clinical practice this book calls this type of skill 'procedural,' rather than 'psychomotor.'

Finally, affect has a very important cognitive component. Attitudes and values are largely based on information. Therefore, they also can be changed by acquisition of additional information. To cite a simple example, a practitioner encounters a patient on several occasions, which have been unpleasant. In the practitioner’s mind, the patient ignores everything he says, and tends to be grouchy. So, the practitioner develops a negative attitude toward the patient, as demonstrated by avoidance on the part of the practitioner.

Later, the practitioner learns that the patient is hard of hearing, and is awaiting a hearing aid battery. This information causes the practitioner to change his mode of interaction with the patient and develop empathy, as well as accurate communications. Through these communications, the practitioner learns that the patient is actually worse than he first thought. Unfortunate; but, at least, the practitioner can now practice with valid information.

Attitudes and values can be very difficult to measure in the setting of professional education. Mainly, these attributes influence a person's tendencies to behave in certain ways. Because we cannot observe or measure tendencies, we use overt behavior as our measured variables. In other words, educators concern themselves with the behaviors that reflect relevant attitudes and values. For practical purposes, these are called, '**professional behaviors**.' These cover just about every behavior expected of a professional that cannot be labeled as cognitive or procedural.

Categories of behaviors included in the professional behaviors category are interpersonal skills, as demonstrated by communications and cooperativeness; work behaviors, like organization of assigned duties and attention to detail; professional demeanor, like appearance and hygiene. These collective behaviors represent competencies which are at least as essential as cognitive and procedural competencies. Taking into consideration these adopted labels, we label our **domains for clinical practice: Cognitive, procedural and professional behaviors.**

Skill Levels

Blooms's Taxonomy for Cognitive Skills

Bloom's Taxonomy

- Knowledge- knowing that
- Comprehension- knowing why
- Application- knowing how
- Analysis- interpreting components
- Synthesis- construction of information
- Evaluation- judging

Table 3.3

Now that I have explained domains of skills, we will proceed to discussion of skill levels. When we talk about levels, we are concerned with levels of complexity. For example there are various levels of skills in the cognitive domain. At the simplest level, one demonstrates command of the skill by recognizing or recalling facts or procedures. At more complex levels, one must work his/her way up the ladder of cognition through comprehension, application, and on. Why is this important? Because a learner must master skills at lower levels of complexity before tackling the more complex. For example, a physical practitioners generally know the name of a muscle before they evaluate its function in the clinical setting.

When we organize skills by order of complexity, we arrive at a structure called a 'taxonomy.' In biology, one learns about the kingdoms, genus, phyla, etc. That organization of organisms is a taxonomy. Similar organization of skills exist for each skill domain. Probably, the best-known and most widely used taxonomy is Bloom's Taxonomy (Table 3.3)[1], which addresses the cognitive domain.

Although it is located at the top of the taxonomy, Bloom classified simple **knowledge of information as the least complex cognitive skill**. Generally, this class consists of skills like recognizing and recalling information- simple memory tasks. Examples of behaviors reflecting this skill level include: List the bones in the hand; identify the steps in a procedure; state the hazards of venipuncture.

The second lowest in complexity is comprehension, which entails more than recall and recognition. Factual knowledge is prerequisite to this level, but comprehension is more complex. Generally, **comprehension is 'knowing why.'** It involves understanding concepts, which are beyond facts. Examples of behaviors reflecting this skill level include: explain the operation of a sphygmomanometer; describe the normal ECG pattern; explain why an artery needs compressed after puncture.

Next in line is the application level, which goes beyond knowing and understanding to skills that require use of information, or 'knowing how.' **When applying information, we must have the information, understand it, and now use it for something**. Application answers the question 'so what?' about much of the information we learn. For example, you will apply the information

[1] Used with permission from: Chang DW, Elstun LJ, Jones AP. The Multiskilled Respiratory Therapist: A Competency-Based Approach 2000; FA Davis: Phila.

presented here when you learning objectives, given the necessary information. When a practitioner does a clinical calculation, a drug calculation she/he is applying information. One step higher than applications on the taxonomy is analysis, which **involves disassembling a body of information, examining component parts, and gaining meaning from those parts.** Much of analysis in clinical practice involves interpreting clinical data. For example, interpreting blood gas results or complete blood count requires analysis.

Synthesis is the next step-up from analysis. **Synthesis involves creating new information.** One example of synthesis is integrating relevant clinical information about a patient with knowledge about therapeutics to develop a patient care plan, or treatment protocol. Note that following a protocol is not synthesis- it is analysis of information and application of the protocol. Another example of synthesis is development of a lesson plan. Finally, problem-solving is a special case of synthesis that we will address in a later section. **Problem-solving involves discovery of the solution, rather than remembering someone else's solution.**

Evaluation is the most complex cognitive skill, because the other skill levels must be mastered before evaluation can proceed. **Evaluation involves formulating judgements.** Therefore, one must analyze information about something, synthesize the information into a 'Gestalt,' or total picture, then weigh comparisons to assign some kind of value. Examples of evaluation in allied health practice include judging the quality of a radiograph, selecting a ventilator weaning technique and deciding on purchase of a medical device. **A key word to identify evaluation is the word, 'decide,' because evaluations lead to decisions.**

Taxonomies for Affective and Psychomotor Skills

To accompany Bloom's Taxonomy for cognitive skills, Kratwohl et al (1964) developed a corresponding taxonomy for the affective domain. This taxonomy is shown in Table 3.4. There are taxonomies for the third domain, psychomotor. One of these, Simpson's (1972), is shown in Table 3.5. As with Kratwohl's, this is included for the interest of the reader.

Kratwohl's Taxonomy of Affective Skills

- Receiving- awareness of existence of stimulus; willingness to receive.
- Responding- interest or involvement with stimulus.
- Valuing- preference for a value, commitment.
- Organization- restructuring values into a system.
- Characterization- acting consistently within a value or attitude framework. An individual is 'characterized' as ..(value)

Table 3.4

Simpson's Taxonomy for Psychomotor Skills

- Perception- awareness of physical objects, sensations.
- Set- adjustment to physical action or experience.
- Guided response- overt action, guided by another person.
- Mechanism- independent, habitual action, under appropriate circumstance
- Complex overt response- performance of complex motor act with optimal efficiency, aesthetic appeal, effectiveness.

Table 3.5

Writing Learning Objectives

Now that the foundation is laid, we proceed to writing objectives. **A learning objective is a concise statement of the end-point behavior that is desired as a result of the instruction. That is, what one expects the learner to be able to do after the instruction is delivered.**

One must begin by analyzing the end-point behavior or behaviors that reflect attainment of the objective. For example, you, the learner, **will be able to write learning objectives**. This is a statement of the **terminal objective** for this section. Before you can write objectives, you must have comprehension of the concepts related to domains and levels of skills. Because command of this information enables for the terminal objective, it was presented it in preceding sections. Furthermore, one must write objectives to plan a lesson; therefore, the skill of writing objectives enables for lesson-planning.

Measure a Pulse

- Define pulse
- Identify methods for measuring the pulse
- Identify locations for measuring the pulse
- Locate the sites for measuring the pulse
- Describe the steps in the procedure for measuring the pulse
- Measure a person's pulse

Interpret a CBC

- Identify the components of a CBC
- Recall normal values for the components
- Compare the measured values with normals
- Explain how disease affects CBC values
- Interpret the comparisons with normal values

Table 3.6

As stated in the preceding paragraph, one must analyze the end-point behaviors to write objectives. If the end-point is a cognitive skill, one must determine what a learner must do to demonstrate that skill. What is the task? What skills enable for the task? If the skill is a procedure, the learner must begin with information about the procedure. Next the learner needs to know the steps in the procedure, and finally perform the procedure. Example, given the skill, 'measure a person's pulse,' one must determine what skills enable for it. See Table 3.6 for an example of this concept.

If the objective is cognitive, an identical approach is required. We need to determine what cognitive skills enable to the final cognitive task. For example, we can identify numerous enablers for the terminal objective, 'interpret a complete blood count.' It is vital to remember that simpler skills must precede complex ones.

Once we have a general description of the desired skill, the key word in an objective is the verb. To cite examples, **measure** a pulse, **recall** normal values, **interpret** lab values. The verb should reflect the domain and level of the skill. The necessary components for learning objectives are listed in Table 3.7. In addition to a general description of what the learner must do, it is sometimes necessary to

Objective Components

- skill- action verb
  - appropriate level
  - observable
  - measurable
- performance conditions
  - written exam
  - oral exam
  - laboratory simulation
  - clinical practice
- criteria for success
  - at % accuracy
  - within 60 seconds
  - without critical error

Table 3.7

stipulate the conditions under which the learner must demonstrate the skill. The condition for demonstrating cognitive skills usually is a written examination. Conditions for demonstrating procedures can be laboratory simulations or clinical settings. To cite an example: ‘during clinical practice, the learner will measure a patient's pulse.’

Another component of learning objectives is the criterion for performance. That is, the specific behaviors that constitute success. The criteria for performance often are implied. They may be a blanket statement in a course syllabus, like 'a passing score on examinations is 75%.' For procedures, we usually identify the critical steps and stipulate something like, 'the learner will take the patient's pulse with perfect accuracy and no critical errors.

For professional behaviors, we identify behaviors that are important and state something like, 'the learner will demonstrate the following behaviors during clinical training.’ Obviously, there are certain behaviors essential for healthcare practice. Examples of these are **honesty, empathy, respectfulness, goal-oriented communications,** et cetera.

Examples of Objectives

- Learner will be able to:
  identify the muscles of the foot
  on a diagram
  at 95% accuracy
- Learner will be able to:
  locate the muscles of the foot
  on a live person
  at 95% accuracy
- Learner will be able to:
  demonstrate efficiency
  in clinical training
  by completing all clinical assignments

Table 3.8

A key to writing objectives is selection of the appropriate verb to describe the behavior that will demonstrate whether learning has occurred. Novices instructors tend to write objectives with words like 'know,' or 'understand.' While these may be the actual desired outcomes of instruction, there must be an overt act on the part of the learner that demonstrates the desired outcome. For example, a learner can demonstrate that they know certain facts by listing or stating them. Furthermore, they can show that they learned a procedure by doing it. Therefore, we must write our objectives using action verbs consistent with the desired behavior, its domain and taxonomic level. A list of verbs, covering most kinds of skills, domains and levels, can be found in the appendix to this chapter.

This chapter has described the fundamentals of writing objectives, which is an important skill for those who teach. Other than stipulating the skill levels, the task is not too difficult. However, it is a skill that takes practice to develop. The readers are encouraged to attend carefully to their objectives as they teach. They will find that clarification of the objectives will provide a strong organizing force within their teaching. Furthermore, writing the objectives helps to identify enablers for the terminal objectives. preventing one from putting the cart before the horse.

CHAPTER THREE
STUDY QUESTIONS AND EXERCISES

1. State four purposes for learning objectives.
2. Explain the importance of task analysis to writing objectives and planning lessons
3. Explain the importance of skill taxonomies.
4. Write one instructional objective for each level of cognitive skill.
5. Write three instructional objectives for procedures.
6. Write two instructional objectives reflecting professional behaviors.
7. Practice- for each of the following learning objectives, state the domain, level, criterion, condition, where the components are present.
    a. On oral examination, name 15 of the lung segments.
    b. In preclinical laboratory, perform tracheal suctioning on a manikin without critical error.
    c. Given a written clinical scenario, select an appropriate mechanical ventilator for a patient.
    d. Maintain a minimum of 95% punctuality for all clinical courses.
    e. Perform correctly as team leader during an actual ACLS (code Blue) situation.
    f. Given an actual patient, develop a therapeutic regimen.
    g. Demonstrate empathy toward patients and their families while attending clinical practice.

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CHAPTER THREE APPENDIX

VERB LIST FOR LEARNING OBJECTIVES†				
Cognitive Skills- Knowledge				
Cite Choose Copy Count Define	Diagram Draw Indicate Label List	Locate Match Name Pick	Quote Recall Recite Recognize	Repeat Reproduce Select State
Cognitive Skills- Comprehension				
Aggregate Associate Classify	Compare Contrast Describe	Diagram Discriminate Discuss	Distinguish Explain Illustrate	Itemize Sort
Cognitive Skills- Application				
Apply Calculate Compute	Demonstrate Diagram Employ	Illustrate Itemize Locate	Outline Practice Solve	Sort Write
Cognitive Skills- Analysis				
Analyze Appraise Examine	Differentiate Discriminate Distinguish	Experiment Inquire Inspect	Interpret Inventory Paraphrase	Question Summarize Test
Cognitive Skills- Synthesis				
Assemble Compile Compose Construct Create	Design Develop Expand Find Formulate	Generate Integrate Manage Organize Outline	Plan Prepare Prescribe Produce Propose	Specify Solve Synthesize Write
Cognitive Skills- Evaluation				
Appraise Assess Choose Compare Criticize	Critique Determine Estimate Evaluate Grade	Judge Measure Order Rank Rate	Recommend Revise Score Select Standardize	Sort Validate
†Several verbs are applicable to describing behavioral objectives for multiple domains and levels				

VERB LIST FOR LEARNING OBJECTIVES				
Procedure Skills				
Adjust	Detect	Instruct	Pour	Stop
Administer	Develop	Intubate	Practice	Tilt
Arrange	Dilute	Isolate	Prepare	Touch
Assess	Direct	Join	Preserve	Transfer
Approach	Disassemble	Lead	Puncture	Transport
Auscultate	Disconnect	Load	Process	Twist
Calibrate	Disinfect	Locate	Produce	Use
Check	Dismantle	Maintain	Raise	Vibrate
Clean	Dispose	Manage	Record	Waste
Collect	Employ	Manipulate	Remove	Weigh
Conduct	Examine	Measure	Repair	Wipe
Connect	Fasten	Mobilize	Report	Work
Construct	Fit	Operate	Replenish	Wrap
Conserve	Gather	Organize	Reset	
Contaminate	Guide	Palpate	Sample	
Correct	Handle	Percuss	Shake	
Cut	Inflate	Perform	Smell	
Decontaminate	Initiate	Pipette	Start	
Demonstrate	Insert	Place	Stock	
Determine	Inspect	Position		
Professional Behavior				
Accept	Communicate	Dress	Intervene	Research
Accomplish	Comply	Ease	Intrude	Respect
Achieve	Concentrate	Economize	Invade	Respond
Acknowledge	Conduct	Empathize	Investigate	Schedule
Act	Confer	Emulate	Invite	Search
Address	Confront	Encourage	Join	Serve
Admit	Conserve	Encroach	Lead	Share
Advise	Consult	Equivocate	Listen	Show
Affect	Contemplate	Exemplify	Loaf	Squander
Agree	Convince	Express	Maintain	Summarize
Appear	Cooperate	Evade	Malinger	Solicit
Appreciate	Coordinate	Find	Note	Study
Approve	Cope	Follow	Notice	Support
Assert	Counsel	Foster	Nurture	Suggest
Assist	Cultivate	Greet	Offend	Sympathize
Argue	Deceive	Guide	Operate	Tolerate
Articulate	Deliberate	Heed	Pacify	Unite
Attempt	Demean	Help	Participate	Upset
Attend	Direct	Influence	Perform	Verbalize
Behave	Discuss	Inform	Persist	Volunteer
Calm	Dissemble	Initiate	Provide	Work
Carry	Dramatize	Impart	Reciprocate	
Collaborate	Disclose	Inquire	Recommend	
Comfort	Display	Interact	Relate	
Comment	Disrupt	Interrupt	Relax	

CHAPTER FOUR

INSTRUCTIONAL PLATFORMS

Learning Objectives:

- Describe the factors that generally influence selection among instructional methods.
- Describe the following instructional platforms:
  - Lecture
  - Learner presentation
  - Discussion
  - Simulations
  - Demonstration
  - Games ?
  - Drill and practice
  - Electronic media
  - Socratic- oral questioning
  - Printed material
  - Tutorial
- Describe the advantages and disadvantages of the listed instructional platforms
- Identify conditions that support selecting each of the instructional platforms
- For each platform, describe the special techniques and strategies for effective lessons

The following terms are introduced in this chapter:

- Platform (instructional)
- Stand-alone (instruction)
- Context (instructional)
- Tutorial
- Aid (instructional)
- Interactivity
- Medium (instructional)
- Socratic

In the previous chapter, the reader learned how to write instructional objectives and how to write a lesson plan. This chapter intends to build on material from previous chapters to enable the reader to select among the platforms, or primary media for instructional delivery. Table 4.1 lists the major instructional platforms. For the purpose of this book, 'platform,' refers to any instructional delivery mode, electronic or not, that is the primary medium for a given lesson. **The platform is the main vehicle, or medium, used to deliver the instruction.**

Instructional Platforms

- Lecture
- Discussion
- Tutorial
- Demonstration
- Drill and practice
- Oral questioning (Socratic)
- Learner presentation
- Simulations
- Games
- Audiovisual media
- Printed material

Table 4.1

We will identify a primary medium, like lecture, discussion, et cetera, as the 'platform' for a given lesson. **Media that are used in support of the**

primary platform are 'instructional aids.' So, a medium used in one lesson can be a platform or an aid, depending upon whether it is the predominant medium. For instance, an instructor who delivers a demonstration lesson on a procedure may use a videotape of the procedure as an aid. On the other hand, a videotape that is used as the primary or sole instructional vehicle is a platform. To add another variable to the mixture, instructional strategies are specific efforts, within platforms and aids, intended to support information processing.

Platform Selection

Several factors enter into a decision to select a primary instructional platform for a lesson. The major reason for selecting a platform should be that it is the most effective for the instructional content, context and objectives. When educators lose sight of this principle, serious and expensive mistakes are made.

The most common mistake in platform selection probably is to select a platform out of habit or convenience. This explains why there are so many lectures in colleges and universities. A second mistake, which has become more common in recent years, is for instructors to jump on bandwagons by adopting current trends, paradigms or technologies. This adoption is often done on the basis of a few favorable anecdotes or biased evaluations, rather than solid research. One example of this is the technology bandwagon, which causes some instructors to use electronic media without due consideration of appropriateness or cost-benefit.

Platform Selection Factors

- Instructional objectives
- Instructional strategies
- Instructional context
- Convenience
- Preparation time
- Instructional time
- Expense
- Expertise- development and technology
- Availability of technology delivery systems

Table 4.2

As previously mentioned, platforms commonly are selected on the basis of convenience or habit, which are not appropriate criteria for selection. How, should selection proceed? Table 4.2 lists important factors in selecting platforms. Note that the list includes convenience as a legitimate selection factor; but, it does not list habit. This is because selection out of habit is more of a non-choice than a choice.

Instructional Objectives

Instructional objectives should influence platform selection in several ways. First, the action verb of the objective describes what learners must do to complete the instruction. Therefore, they also describe the behaviors the platform must support. If an objective describes a psychomotor skill, then somewhere in the lesson, the psychomotor skill must be demonstrated, then practiced. This

eliminates some of the platforms by default. For instance, discussion would be a poor choice of platform to teach a procedure. On the other hand, it would be difficult to conduct a physical classroom demonstration of something like philosophy.

Instructional Strategies

Given the basics of information-processing theory, one understands that different instructional strategies support different levels of learning. This should influence the selection of instructional media, because some media are better adapted to specific strategies. To cite examples: Computer courseware is effective for drill-and-practice; lecture-discussion or tutorials are more conducive to elaborative and modeling techniques for complex subjects, like physiology, that generally require extensive explanation.

Instructional Context

Instructional context is a description of the general setting in which instruction occurs. Context is very important to platform selection and includes several variables. Some of these are listed in Table 4.3. All instructional design must consider learner entry-level skills relevant to the subject matter. With regard to selection of platforms, additional factors require consideration. For example, printed materials are not very useful to learners who are either illiterate or visually challenged. This is particularly important in patient and family education.

Instructional Context

- Learner characteristics
  - -Entry level skills
  - -Age
  - -Limitations
  - -Motivation
  - -Learning style
- Number of learners
- Physical setting
- Available time
- Instructor characteristics
- Institutional characteristics

Table 4.3

Motivation of the learners is another important issue. Generally, instructors expect learners who are highly motivated to expend the greatest amount of effort to learn. A learner with motivation, metacognition and intellect will learn from any platform. The one which is least-liked by many students is narrative printed matter; probably, because of the perceived effort needed to read it. However, motivated learners are undaunted by the printed page and will find definitions for unknown words they encounter, rather than miss the entire sense of every other sentence.

Conversely, those who are not motivated will expend less effort and would prefer a little entertainment with their learning. The kids who cut their intellectual teeth on 'Sesame Street,' now are college students, and have not outgrown their taste for video. One very important point to make here is that **there are no research data that demonstrate a relationship between learners' preference for a platform and its instructional effectiveness. In other words,**

learners may like a platform, but learn nothing from it. Whereas, learners can learn from a platform they dislike. The important distinction may lie in the fact that learners are less likely to attend to a platform they find distasteful.

On the other hand, there is evidence of differences in learning styles among learners, which tends to make them more likely to learn from one platform than another. This should not be confused with learners' preferences. Some of the elements of learning style include those which are social; such as, competition, need for interactivity with instructors and whether they learn better alone, or in company. **Interactivity involves reciprocal communication between the learner and the instructor or instructional medium, such as a computer. When a computer-based tutorial includes variation of presentation in response to learner input, it is interactive. When a lecturer asks and answers questions, the lecture is interactive**.

Another component of learning style involves the types of stimuli that support learning best. Some learners are visually oriented, others may be aurally. Some learners respond better to graphic presentations, while others may respond to numbers in tables. Generally, platforms that address multiple sensory channels represent the best approach to meeting this problem. This is analogous to 'shotgun' antibiotic therapy.

Finally, there are psychological differences among learners. Some learners tend to need time to think about subject matter, slowly absorbing it, while others may learn by insightful leaps. Similarly, the challenge of problem-solving may motivate some students, but not others. These psychological factors may be important in confounding the evaluation of learning, because they govern the learners' abilities to demonstrate what they have learned. That is, they may have acquired the skills, but can not show it because of an extreme mismatch between their personality and the evaluation circumstances.

Another factor involving learners is how many can be accommodated at any given time by the platform. A great strength of electronic media is the capability to transmit expertise far and wide via many circuits. If Albert Einstein were still alive, perhaps we could take a physics course from him via the Internet. Although that would be an outstanding opportunity, would Dr. Einstein be available for student questions?

Several kinds of media, like lectures and videotapes, can accommodate multitudes of learners. The effectiveness of instruction delivered by these media depends on other factors; such as, student characteristics, instructional design, availability of tutoring and instructional aids. The reader should recall that instructional effectiveness is defined by learning achievement, as measured by attainment of learning objectives.

Instructional context also includes the physical setting for instructional delivery. Obviously, the setting will determine the quantity of learners; but the setting has additional influence over platform selection. Ideally, we teach in a modern classroom with lots of space, equipment and

electrical outlets. However, a health care practitioner is likely to deliver instruction in many different settings; such as patient rooms, private homes, intensive care units, et cetera.

An instructor must consider the setting carefully when selecting media. An instructional setting that does not fit the selected platform can lead to both embarrassment and ineffective instruction. One cannot assume that an unfamiliar setting will provide the most common instructional needs, such as chalkboards or electrical outlets. When in doubt, it is prudent to select a self-contained platform that will work for all settings.

The final consideration for platform selection involves instructor characteristics. Generally, instructors select platforms in accordance with their own comfort. However, instructors sometimes have platforms dictated to them, and sometimes they mistakenly select a platform, only to discover that it does not suit either their personal characteristics or capabilities. For instance, some instructors excel at one-on-one instruction, but perform poorly when confronted with a group. The reverse situation also occurs.

Instructors sometimes avoid electronic media because they are technologically weak. Instructors who do not develop their own technical skills are committing an unfortunate error, because they accept limits to their instructional capabilities. Although learning about technology involves a considerable investment in time, the increases in instructional effectiveness and efficiency make it worthwhile.

Portability

Portability is yet another selection factor. Portability relates to the instructional context, specificity the physical setting. If instruction is set in the ideal classroom, portability may not be a problem. The problems arises when an instructor selects a platform such as a videotape or computer courseware. Whether the platform can be used at all, then depends on the setting of the instruction.

Instructors can take their voices, small charts and printed matter anywhere. Therefore, permutations of a lecture are quite portable. But, as electronic technology shrinks and adopts lithium batteries, computerized media become more and more portable, as well. Current technology enables practitioners to deliver computer-based instruction in patient rooms, as well as in their homes. Furthermore, communications technologies like the Internet and interactive television have greatly expanded the geographic reach of instructors.

Costs of Media

Convenience and preparation time are closely related. So, we will explore them together. I have already mentioned that convenience should not be the only factor in selecting a platform. But, it remains an important one. It is probably better to look at the problem in reverse. That is, to rule out a platform determined to be inconvenient, increasing preparation time.

Platforms vary significantly with regard to the time required to develop a lesson. While a lecture takes about two hours for every hour in class, the same lesson may take hundreds of hours to develop for an electronic platform. A simple computer-based drill on a topic like blood gas interpretation may take several hundred hours to develop. The same practice could be developed for instructor-mediated classroom drill in hours. A lecture-laboratory presentation on cardiac output may be developed in ten to twenty hours, while a multimedia program takes months for several people.

If one end of the convenience factor is preparation, the other end is instructional delivery. If the classroom has a chalkboard or dry-erase board, it would hard to beat a chalkboard lecture for convenience. Also, at the delivery end of convenience, we need to consider setup time for the classroom. **It is essential that all audiovisual aids are ready to go before instruction begins.** One of the worst instructional scenarios involves an instructor, with chalk in-hand, lecturing with his/her back to the class, while writing on the board. With hands-on laboratories, setup time may be considerable. Medical laboratory instructors, for instance, often need several hours to set up for a single laboratory.

If the time investment results in a high-quality, durable product the investment can be offset by the fact that it can be used in future sessions without further time investment. Furthermore, if the instruction is developed to stand-alone, an instructor need only show learners how to use the technology. **By definition, stand-alone instruction presents complete lessons, including all stages and steps.** So, this preparation makes the instructional delivery convenient, if the necessary accouterments are in place.

Media Cost Factors

- Development time
- Development equipment
- Development supplies
- Delivery equipment
- Delivery supplies
- Delivery time
- Durability

Table 4.4

Expense, or the cost incurred for instructional development and delivery is yet another important medium selection factor. There are several aspects of this cost, which are listed in the box at right. I've already touched on the issue of development time. Especially where electronic media are concerned, this can be quite costly, because medium development requires expertise.

The cost of development equipment and supplies can vary from a few dollars, into the thousands. An overhead transparency can be developed for less than a dollar, and re-used in some cases. On

the other hand, development of multimedia for computer presentations requires a state-of-the-art computer and software.

Delivery equipment and supplies can incur further expenses. Standard delivery devices include slide projectors, overhead projectors and television video systems. These are not cheap. Recently, many of us have switched to liquid crystal display (LCD) panels and digital projectors, which cost in the thousands of dollars.

Electronic media that are commercially available can be quite expensive. However, it is generally less expensive to buy media than to develop them. Before any major outlay for media, the prospective purchaser must consider whether the necessary delivery systems are available on-site. Media can affect instructional delivery time in several ways. First, media slow instruction down when the instructor is unfamiliar with the delivery system. For instance, it may take some time to locate controls on a new style of slide projector. Another way media can slow instruction is by equipment malfunction, such as a blown bulb in an overhead projector.

On the other hand, media can increase instructional rate. Presentations with LCD panels, for instance, proceed more rapidly and smoothly than those using transparency material. Also, I believe that the organizational effort an instructor expends on developing a presentation translates to more efficient classroom instruction. Because a picture is worth a thousand words, graphic representations are more efficient than lengthy explanations of things.

Durability and reusability are closely related. Obviously, a platform that is not durable is less likely to be reusable. There are two separate connotations of durability here: (1) physical endurance and (2) subject matter endurance. Physical endurance simply refers to the capability of a platform and its delivery system to withstand the abuses of time, teachers and students.

Subject matter endurance refers to how long the subject matter will remain valid. In health professions, where both the body of knowledge and technology change at rapid rates, much subject matter has low subject matter durability. For instance, a book or videotape on radiographic equipment could reach obsolescence in a couple of years because of technologic advances. For example, a book that concentrates on technology may become relatively obsolete before it is printed because of new technology and research findings.

The question of subject matter longevity has interesting implications. For one thing, as subject matter becomes obsolete, physical endurance becomes unimportant. If we expect the information in a book to become obsolete in a year, why concern ourselves over the quality of the binding? It is more important for media that cover rapidly changing subject matter to be ungradeable, like a loose-leaf binder that will accommodate changing information. Finally, it is important to note that electronic delivery systems and software also reach obsolescence. Computer software that works only on a certain computer becomes useless when the computer stops working and cannot be replaced.

Platform Attributes

Now that we've explored some of the factors that should influence selection of media, we will explore attributes of the platform, then compare and contrast them. Please note that all instruction, regardless of platform, should proceed from a lesson plan.

Lecture

Lecture is quite popular among educators as a primary platform. In pure lecture, there is zero interaction between instructor or student and there no instructional aids. But, with a little help from classroom interaction and instructional aids, lecture can be quite effective. For the rest of this discussion on lecture, we will refer to the hybrid form, which is assisted lecture-discussion.

Lectures can teach a wide variety of subject matter, but their usefulness is limited primarily to the cognitive domain. We can use it to introduce procedures, as well as to teach the steps; but lecture cannot replace live demonstration. Recall that a complete lesson includes application and verification. So, a procedure must be practiced by the learners. Lecture can address the professional behaviors, but cannot replace other media that provide interaction. Also, lecture on professional behavior is worthless unless it is backed by demonstration of those behaviors by the lecturer. So, the objectives supported by lecture technique primarily are cognitive.

The hybrid lecture accommodates many instructional strategies. We can use it to rehearse, elaborate and organize learners' thought processes. Specific strategies for lecture include visual aids and handouts to help organize the information. Use visual aids appropriately, or they can reduce instructional effectiveness. A verbal description of something is likely to fail, where a simple visual aid will succeed in instructing. Oral questioning during lectures helps maintain attention and encourage encoding among learners.

The effectiveness of lectures increases with speaking skills, which include maintaining contact with the learner, good voice and posture, and injection of humor, where appropriate. A lecturer should display and explain new terms and develop new concepts and principles with examples, non-examples, analogies and models. It is also helpful and appropriate to repeat new or complex concepts. A lecturer should strive to keep students actively engaged in the learning process. It is quite possible that note taking during presentations distracts the attention of students. Therefore, instructors should discourage routine note taking by students and provide them with handouts as study materials.

Lecture is versatile with regard to instructional context, as it can be quickly adjusted to meet demands from changing environments and learner attributes. Furthermore, it is portable and convenient. Preparation time for lecture can vary tremendously, largely dependent on the conscientiousness of the instructor. Where one type of instructor will his/her way through a

presentation, without benefit of aids, another will diligently research their topic, generate a lesson plan and develop instructional aids. Preparation time varies within instructors, as well. A conscientious instructor who teaches a course for the first time will take about three hours of preparation for every hour of class. This time is reduced with experience in teaching the course.

The major disadvantages of lecture result mainly from its misapplication. As mentioned earlier, lecture is appropriate for cognitive lessons, in particular. It should not be used out of habit, especially when other media are more effective, efficient or cost-conservative. Finally, the effectiveness of lecture largely depends on instructional aids and interactivity with students. Learning is more likely to occur when a learner is active in the process. Except in the case of a few very talented instructors, a pure lecture is little more than a soliloquy that does little to encourage active learning.

Tutorial

A tutor is one who instructs on an individual basis. As such, as tutor will guide a learner throughout the learning process, from introducing topics to verifying their retention by the learner. **A tutorial, then, is a system of instruction for a body of skills intended for delivery to individual learners.** At the root of the tutorial concept is the idea of 'personalized' instruction, which in fact, is very rare. The ideal tutorial involves instruction by a person, but there are also tutorials that exclusively use other media, like computer software. This chapter addresses the personal tutor, as a later one addresses tutorials using other media.

Tutoring can be applied to any domain and level of skill. It is otherwise known as coaching when sports are involved. Tutoring is instruction in its most intense form, therefore all strategies may be employed. The primary advantage to tutoring is its goal of individualized instruction. The ideal tutor will identify weaknesses in the learner and adjust instruction accordingly. In other words, tutoring probably is the most effective instructional platform.

The problem with tutoring is its relative inefficiency. Since tutoring can accommodate a limited number of students, it is nearly impossible for instructors to tutor all of their students. The preparation time for tutoring may not be prohibitive, but instructional time is likely to be prolonged. Because of the numbers of students and the instructional time component, tutoring is a costly platform. Furthermore, a personal tutor must have expertise in diagnosing learning problems and generating strategies to encourage learning. He or she must be patient with learners and excel in one-on-one interactions.

Discussion

Classroom discussion can be one of the more enjoyable platforms, but one of the more difficult to use effectively. Although discussion can be used for cognitive subject matter, it probably is

better used to address professional behaviors and the affective domain. By its nature, discussion encourages communication, which is a professional skill. It is useful to share diverse experiences, opinions and attitudes, as well as to provoke thought.

As with all other platforms, discussion requires lesson planning, which generally includes study assignments to be completed before class. Preparation time for discussion is comparable to that for lectures. The instructor's role in a discussion is to initiate, moderate and steer. This role can be assumed by students to develop their leadership and communication skill. A discussion dominated by the instructor is more of a lecture, which will not meet objectives of discussions. Therefore, instructors need expertise and personal qualities to conduct discussions. To encourage discussion, the students should sit around a table or in a circle, with everyone facing inward.

Discussion is not very efficient. Because students must be permitted leeway during the discussion, it is likely to get off track. This can expend considerable instructional time. Gross ineffectiveness and inefficiency of discussions may be due to lack of instructors' supervision or expertise. Furthermore, discussion is ineffective and inefficient when students fail to prepare in advance.

Other problems associated with discussion include the self-appointed '**class prophet**,' who dominates the discussion, while at the other end of the spectrum is the student who does not participate. Finally, where sensitive subjects are at issue, discussions can degrade to arguments, which lead to interpersonal conflicts.

Demonstration

We use demonstration to teach clinical procedures, including the operation of medical devices. Instructional objectives associated with demonstrations usually include psychomotor verbs, like 'operate, puncture, measure and insert.' The instructional setting is important, as it should resemble the context in which the learners will perform the procedure in their clinical training.

For a demonstration to be effective, it must be part of a standard lesson plan. The demonstration will be the presentation stage; whereas, the application and verification involve learners performing the procedure for practice, then for evaluation. Demonstration is limited by several factors. First, since guided practice and evaluation are involved, we need to consider that the availability of space, instructors, equipment and supplies limits the quantity of students.

Portability and convenience of a demonstration largely depend on the nature and size of equipment and environmental circumstances for the procedure. Obviously, we cannot carry a magnetic resonance imaging (MRI) device into a college lab. So we must either conduct the lab at the site, construct a mockup of the device or control panel or use electronic media to demonstrate. Computerized courseware has been used for years to simulate devices of all kinds.

Acquisition of demonstration equipment and supplies contributes to the overall expense of the demonstration, as these can be very expensive. Instructional time can be a disadvantage of demonstration, especially when the demonstration accommodates few learners. Preparation time may be lengthy for some demonstrations, but investment of this time is unavoidable.

The effectiveness of demonstration depends on several factors. First, demonstration by the instructors should be flawless. So, they must practice the procedure and be familiar with all equipment and supplies. The procedure should be initially done at normal speed without explanation, then at slow speed with explanation of each step and key point. A strategy that may increase the effectiveness of demonstration involves giving learners checklists to help them memorize the steps. A second strategy is for learners to mentally practice the procedure.

Drill or Practice

Whether the platform is called drill or practice depends on the domain of skills. We practice psychomotor skills and we drill on information. Both platforms consist of rehearsing the information or physical task. Although drill or practice are essential to lessons, they rarely constitute a primary platform, at least in college classes. Drill or practice are effective rehearsal techniques, but they address information that has been presented at an earlier time. They are useful study techniques, but they are not the most effective use of classroom time, especially if this time is at a premium. Computer courseware is especially useful for drill.

Printed Media

Printed media may be the most versatile of all. However, their effectiveness as a primary platform depends on the affective and cognitive entry level skills of the learner. This is particularly true when the subject matter is inherently difficult. This is because attention is often difficult to maintain, and it may take several readings for concepts and principles to encode. Therefore, it takes a highly motivated, reasonably intelligent person to acquire skills from print. In addition to these characteristics, metacognitive skill is crucial to learning from print.

Printed material may be used for primary instruction in the cognitive and affective domains, and as a secondary platform for psychomotor skills. For the psychomotor domain, print can provide background for procedures and describe its steps. Printed media are limited neither by the number of students nor the physical setting.

Printed Media Types

- Conventional textbooks
- Journal articles
- Programmed texts
- Instructor developed materials
- Combinations of materials

Table 4.5

Common types of printed media are listed in Table 4.5. Many textbooks include all of the elements necessary for instruction,

including objectives, study exercises and examination items. It can be very difficult to find a textbook that stands alone for instruction. Even the best texts somehow manage to exclude subject matter that instructors include in their courses. Instructors often compensate for this excluded subject matter with reprints of journal articles and other supplemental materials. However, it is important to observe copyright laws when doing this. Also, instructors should be aware that journal articles usually are dry and difficult to read. The advantage of journal articles is that the information is more current than that contained in books.

When selecting or developing printed media, instructors must consider the suitability of the content, including its level of difficulty. Also, they must consider readability, which includes factors such as grade level, support of text with examples, illustrations, algorithms and tables. Finally, if a text is written with the passivity and technical language of an equipment manual, learners will find it extremely boring and difficult to pick up.

Instructor characteristics relate to the effectiveness of printed media in several ways. First, the instructor must have the skills required to select or develop the media, and to deliver effective instruction with it. The five-stage lesson plan applies to printed media, too. Therefore, an instructor who intends to use a book as a platform also must be prepared to develop the materials to support the book. These materials include assignments that use instructional strategies appropriate for the domain and level of learning.

The print platform also must include materials for application of the subject matter and summative evaluation of learning. The media must address the learners' motivation through encouragement, humor, et cetera. Frequently, the course instructor must develop the materials to accompany primary instructional media. As a platform, printed material require little instructional time. Although printed materials have many advantages over other media, it takes a special learner and especially good materials to be effective as a platform. Printed media are most useful in supporting other media. For example, printed handouts are used to support lectures.

Oral Questioning (Socratic method)

When used as a primary instructional medium, oral questioning commonly is called the 'Socratic' method, after the Greek philosopher, Socrates. As an instructional method, it intends to stimulate thought and develop problem-solving skills among learners. Therefore, it is appropriate for high-level cognitive and affective skills. The Socratic method actually is a type of tutorial. Effectiveness of the Socratic method heavily relies on cognitive and interpersonal skills of the instructor and learners. Instructors must prepare appropriate assignments and the framework of inquiry to guide the questioning. Learners must read assignments, in advance, and be prepared for questioning. Learners should assess their own preparedness through metacognition. All learners ought to be prepared to answer any question posed by the instructor.

As with discussion, the primary limitation to oral questioning, as a platform is class-size. If all of the learners are expected to participate during a one or two-hour class, thirty or fewer students can be accommodated. Ideally, fewer than ten learners should be involved. The Socratic method is intense in both instructional and preparatory time. Also, it accommodates relatively few learners at a time. Therefore, it is a relatively expensive platform.

Oral Questioning- Purposes

- Verify prerequisite knowledge
- Activate prerequisite information-preparedness to learn
- Gain and direct attention
- Stimulate active learning-schemata building
- Stimulate rehearsal of procedures
- Stimulate and practice problem-solving
- Stimulate thought about affective material
- Support and rehearse information retrieval
- Support development of metacognition
- Verify attainment of objectives

Table 4.6

As the reader recognizes by now, there are many reasons to incorporate questions into lesson plans for all of the instructional platforms, including stand-alone video and computer courseware. Oral questioning is a strategy used in nearly every instructional setting. Therefore, the reader should gain some knowledge on oral questioning. First, we have seen that oral questions serve numerous purposes in support of instruction. Some of these are listed in Table 4.6.[1] Note that these purposes fit neatly into the information-processing paradigm. Oral questions can support all of the information processes: attention, encoding, and retrieval. There are a few important points to make on questioning technique. Table 4.7[1] lists some of these.

Although the listed oral questioning techniques seem like common sense, even very good instructors sometimes forget them. Generally, we should keep the phrasing of an oral question simple, but encourage an answer that demonstrates the appropriate level of cognition. Questions that can be answered either 'yes' or 'no' are pretty much a waste of time, because they encourage guessing. Questions like these are appropriate, if they are followed by 'why,' 'explain,' or something else leading to a more complex answer.

Oral Questioning Technique

Ask question at appropriate cognitive level
Ask one question at a time- avoid multiple parts
Avoid questions with 'yes, no' answers, except to prime learner for additional query.
Avoid ambiguity- requires narrow scope of question
Permit time to formulate answer
Probe learner to remember related information that might lead to correct answer
Give corrective feedback

Table 4.7

To allow for information processing, instructors should ask only one question at a time and allow time for learners to formulate answers. The customary five seconds is inadequate. If a learner does not know the answer off the top of their heads, they can be assisted

[1] Used with permission from: Chang DW, Elstun LJ, Jones AP. The Multiskilled Respiratory Therapist: A Competency-Based Approach 2000; FA Davis: Phila.

by probing questions that guide them to related information, or providing clues. Importantly, it is always best when learners answer questions, because they have developed confidence and discovered how to find that information again. That is, the questioning has encouraged retrieval of information. If the answer is wrong, one must tell the student so.

Learner Presentations

Learner presentations are appropriate for instruction; but, not for consistent use as a platform. Generally, these presentations should be reserved for the application and verification stages of a lesson. For example, a course that adopts this manual may require students to present lessons, which serve as practice and criteria to measure achievement.

The objectives for learner presentations should reflect presentation skills; that is, students' capabilities to research, organize and communicate. For example, an objective for this course may be for students to present two 5-10 minute lessons, including all stages of the prescribed lesson plan. One of these might be informational, the other one, demonstration. Therefore, the terminal objectives for the lesson include high level cognitive and affective skills, as well as variable levels of psychomotor skills. The level of psychomotor skill depends on the particular skill demonstrated by the student. In allied health education, learner presentations are most appropriate for educational courses and those involving case and journal presentations.

The instructional effectiveness of this platform depends on the skills of the instructor in preparing learners to demonstrate their skills, providing appropriate guideline and corrective feedback. Learners must be motivated and capable of synthesizing information that they intend to present. Instructors should anticipate 'jitters' on the part of students, and provide reassurance to support their confidence for their presentations.

Instructional time for learner presentations is significant. One must consider the length of the presentations as a cost of returns. Therefore, presentation times should be kept at a minimum. Preparation time is considerable, as well, since learners must be prepares with the presentation skills. In addition to basic presentation skills, learners must be prepared to develop and use instructional aids. This may require one-on-one consultation. Because of the time involved, learner presentations tend to be inefficient as a platform.

Simulations & Games

Simulations and games use representations of reality to teach cognitive, affective and psychomotor skills. The difference between simulations and games is the element of competition. That is, someone wins a game, but not a simulation. Because we are unsure of the instructional value of competition between students, the remainder of this section focuses on simulations, only.

Simulations take many forms. Instructors simulate physical contexts, like in clinical procedure laboratories that use real or simulated medical devices and patients, which are usually students or manikins. If the goal of the lesson is to prepare students for clinical practice, the laboratory should closely mirror reality. Ideally, we use real equipment in simulations, but when size or cost prohibit, mockups are a fair substitute.

Simulation Types

- Physical replication
- Representation by text
- Representation by oral description
- Representation by illustration
- Representation by film, videotape
- Representation by computer

Table 4.8

Another form of simulation uses printed matter that represents reality in text. Although these may seem ineffectual, most people who have read a good horror book, and then seen the movie will testify that they were more frightened by the book than the movie. Our imaginations can fill-in with a host of horrid detail. Oral descriptions work in much the same way as text. A good storyteller and active imaginations can effectively simulate many situations to instruct on cognitive and affective subject matter. Various forms of visual displays also simulate reality. Among these are simple illustrations, videotapes and computer software. The computer has particular advantages over other media. This advantage is its capability for interactivity; that is, variable responses to learner input.

Instructional Applications for Simulations

- Present, practice and evaluate cognitive skills
- Present, practice and evaluate clinical procedures
- Present, practice and evaluate clinical problem-solving
- Present, practice and evaluate equipment operation
- Present, practice and evaluate equipment trouble-shooting
- Present, practice and evaluate professional behaviors

Table 4.9

Table 4.9 lists some of the instructional applications for simulations. As mentioned earlier, simulations can instruct all domains and levels of skills. Simulations are particularly useful to teach and evaluate problem-solving skills. A particular strength of simulations is that they support active, rather than passive learning. That is, learners must supply a certain amount of imaginative mental effort to participate in the simulation.
It is vital that learners are able to 'buy into' the simulation to participate in the instruction. Unfortunately, participation in simulations cause extreme discomfort for some people. This discomfort may be a disadvantage of simulations. On the other hand, the objective of a simulation can be to develop or evaluate the learners' ability to overcome discomfort and perform as required. For simulations to work, they must be believable.

Preparation time and instructional time vary greatly with simulations. Laboratory simulations require considerable preparation and instructional time, whereas text-based ones may require only minimal instructional time. The expense of a simulation varies as much as does the instructional times. All of these variables depend on the nature of the specific simulation.

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CHAPTER FOUR
STUDY QUESTIONS & EXERCISES

1. From memory, reconstruct the practice Platform Comparison Table in the Appendix to this chapter.
2. Describe two important sources of error in platform selection.
3. Explain the term 'instructional context.'
4. Describe the relationship between student preference and instructional effectiveness of platforms,
5. Describe the two kinds of medium durability.
6. Explain what is meant by the term, 'tutorial'.
7. Describe an instructor's role in classroom discussion.
8. Describe the relationships between an instructor's expertise and computerized instructional media.
9. Define interactivity and explain its importance to instruction.
10. Identify the cost factors related to media development and instructional delivery.
11. Describe the steps in instructional demonstrations.
12. Describe three specific circumstances that warrant instruction by simulation.
13. State the instructional proposes of oral questioning.
14. Identify attributes of proper oral questioning technique.

CHAPTER FOUR APPENDIX
PLATFORM COMPARISON TABLE[2]

	Domain/Level	Advantages	Disadvantages	Comments
Lecture	Cognitive/all levels Affective	Context- versatile, large classes, portable, inexpensive	Passive learning Platform of habit	Needs support of visual aids, interactive strategies & printed media
Discussion	Cognitive/higher levels, Affective, professional behaviors, especially communication and interpersonal skills	Shared experiences- promote understanding and team- building. Active learning	Inefficient Gets off-track Learners often unprepared Arguments, class size	Instructor should moderate, not dominate. All students should prepare and participate.
Tutorial	All domains/levels	Instructional strategies adjusted to needs of learner. Computerization	Very small classes, Expensive, with live instructor	Instructor must have strong one-on-one interpersonal, instructional skills
Demonstration	Primarily psychomotor (procedures)	Students can observe, procedure under controlled conditions. Standardizes procedure	Small classes Equipment expense Time-consuming Requires location	Rehearse before class & perform procedure perfectly. Can simulate
Drill	Cognitive, mostly lower levels	Computerization. Helps mastery and retention of key points	Limited class-size for corrective feedback from live instructor	Ineffective without corrective feedback.
Practice	Psychomotor/all levels	Only way to apply and evaluate psychomotor skill	Limited class-size Requires close supervision	Ineffective without corrective feedback
Printed media	Cognitive/all levels Affective	Versatile, portable, inexpensive, permits self-pacing	Unsuitable as platform for most students. Adequate, readable printed materials may be hard to find.	Requires motivation, metacognitive skills. Used to support other media
Socratic	Cognitive/higher levels Affective	Demands active learning. Excellent to foster problem-solving.	Small classes Time consuming Depends on student motivation.	Instructor and students need orientation to method.
Learner presentation	All domains/levels	Develops skills in synthesis and communications	Time consuming Limited class size	Requires clear directions, and enforcement of rules
Simulations & games	All domains/levels	Opportunity to apply and verify skills, when 'real' thing unavailable. Problem-solving	Time consuming May be expensive	Duplicate reality as closely as possible.

[2]Used with permission from: Chang DW, Elstun LJ, Jones AP. The Multiskilled Respiratory Therapist: A Competency-Based Approach 2000; FA Davis: Phila.

CHAPTER FIVE

INSTRUCTIONAL AIDS

Learning Objectives:

- Explain general guidelines for selecting and developing instructional aids.
- Explain general guidelines for using instructional aids.
- Describe specific types of instructional aids.
- Describe guidelines for selecting and using specific instructional aids.
- Describe methods for obtaining image files for presentations.
- Describe important factors in textbook selection and use.

The following terms are introduced in this chapter:

- Fonts
- Cuing
- Laser videodisc
- Multimedia
- Digital projector
- Pegagogical (features)

Chapter Four defined an instructional platform as the primary vehicle to deliver instruction in a lesson. It also defined instructional aids as devices used in lesson presentation to support learning. This chapter is about instructional aids; how to select them, develop them and use them effectively and efficiently. The reader should recall that some instructional aids, like videotapes, can be platforms, as well. The distinction lies in whether the videotape is the primary instructional vehicle.

Considering that instructional aids intend to support learning, the rationale for them is to increase the effectiveness of instruction. Studies have shown that when instructional presentations stimulate multiple sensory channels, retention of the information is increased. Table 5. 1 describes the relationships between what learners do and how much they retain.[1] As you can see, as instruction stimulates additional channels, learning increases. Furthermore, learner activity increases retention even further.

People Generally Remember

- 10% of what they read
- 20% of what they hear
- 30% of what they see
- 50% of what they see and hear
- 70% of what they say as they talk
- 90% of what they say as they do a thing

Table 5.1

Research on instructional effectiveness has shown that lecture, alone, is not a very effective medium for conveying skills. In fact learner recall three hours after lecture is about 70% and three days later is about 10%. However, when lecture is combined with visual aids, recall increases to 85% after three hours and 65% after three days.

[1] Used with permission from: Dwyer FM. Strategies for improving visual learning. State College; Pennsylvania State University, 1978. p 11.

So, there is empirical evidence to support the addition of visual aids to oral instruction. However, improper development or application of these aids can actually interfere with learning. It is important that we develop and use instructional aids to the greatest advantage.

Creating Instructional Aids

Instructional aids can be just about any item an instructor selects to help convey skills to learners. Before we describe and explain the specific aids, we will identify and explain some general guidelines for developing and selecting instructional aids. Table 5. 2[2] lists some of these guidelines.

General Guidelines for Creating Instructional Aids

- Prepare, review aids before class time
- If an aid is likely to be used repeatedly, make it durable.
- Do not crowd visual aids
- Use color for a purpose- to highlight and differentiate
- Consider effects of visuals on eye comfort
- Include appropriate detail in visual aids
- Emphasize structure, where appropriate
- Emphasize function, where appropriate.

Table 5.2

The first two guidelines primarily refer to chalk/dry erase board displays, which will be addressed again in a later section. Class time should not be wasted by drawing or writing during class. Furthermore, it is more efficient to make a permanent display if it will be used repeatedly.

One way to render a visual display ineffective is to crowd it with all the text and graphics possible. Recall that attention is the process that selects information for further processing. A crowded display impairs attention by presenting excessive information simultaneously. This is particularly problematic because learners have not the expertise to decide what to select from the vast array. So, beyond a certain critical mass, information on a display only overloads attention and detracts from the value of a display. A text display should present only key ideas, using clear, concise language. We will revisit this idea when we explain techniques for using visual displays.

The next two guidelines relate to the readability of textual displays. First, words should not be presented in all capital letters. Although all caps might highlight words, they are harder to read than words spelled with mixed text, as they appear in correct sentences. Similarly, the computer age has endowed us with a wide choice of fonts, or typefaces for text. It is wise to reserve the fancy fonts for things like greeting cards and certificates, using plain fonts in visual aids. Examples of plain fonts include helvetica and arial. Italic and script fonts are difficult to read.

[2] Used with permission from: Chang DW, Elstun LJ, Jones AP. The Multiskilled Respiratory Therapist: A Competency-Based Approach 2000; FA Davis: Phila.

People read from left-to-right. Therefore, a text display should be justified left, only. Full justification with word-processors often causes spaces between letters and words, making them harder to read. Centrally justifying an entire display makes it very hard to read because the reader must search for the beginning of each line to read it. A final guideline on fonts concerns their size. One should be relatively generous when it comes to the size of type. The display should be readable from the rear of the classroom.

The Commandments of Text

Thou shalt NOT:

- use more than 7 words per line
- use more than 7 lines per screen
- use all capital letters
- center text, except as headings
- use fancy fonts
- use weird colors
- use color indiscriminately
- include misspelled words

Table 5.3

In addition to a variety of fonts, computers have given us a wide choice of colors for our displays. Educational research has found that color increases the instructional effectiveness of visual aids. As with fonts, one should use colors judiciously. Used correctly, color can gain and maintain attention. Also, it can assist learners in classifying and differentiating information. For example, it probably helps to make a heading one color and its subordinate ideas another uniform color. One also must consider that some colors can detract from a display by reducing readability.. It is best use basic colors, rather than waste time delving into shades of orange, magenta, purple, et cetera. The color of displays also affect eye comfort. A display that is uncomfortable to the eye will divert attention from itself.

People are more comfortable reading printed material that is dark on white. On the other hand, video displays with light text on a dark background are more comfortable to read. This is particularly important when using overhead projectors with high luminescence. If the background is too bight, the display will cause discomfort. When developing a presentation, instructors should take all of these details about text into consideration. Then, they should confirm readability and comfort when previewing the display, before presenting it.

Detail in a graphic display relates to the quantity of information. In an previous paragraph, I explained the idea of too much text overwhelming the attention capabilities of learners. This concept relates to graphic displays, as well. A graphic display that is overloaded with detail is ineffective as a teaching tool. Figure 5.1 shows an example of how screens of a presentation can add detail in steps to prevent the learner from being overwhelmed by excess visual information presented at once. Consecutive screens in the presentation add more detail. This can be accomplished with both computer presentations and overhead transparencies.

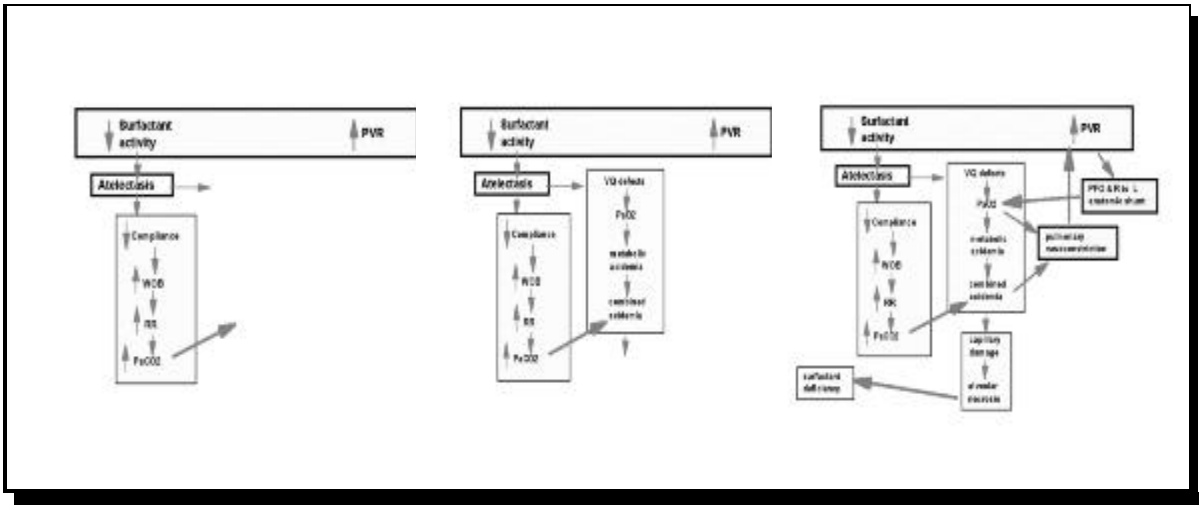

Figure 5.1 Addition of detail to displays in layers

When developing, selecting and using displays, the instructor must consider the objectives of the instruction. First, one might ask whether the intent of the display is to teach structure or function. When the instruction intends to teach structure, much detail may be necessary. However, it is usually possible to present detail in steps or layers, rather than all at once. This gives the learner the opportunity to attend to, and encode the information at a reasonable pace. When teaching structure, we sometimes need to use the 'real thing,' like a cadaver or medical device. **In situations like this, the instructor can help learners attend to specific details by pointing them out. This strategy is called 'cuing.'**

Numerous studies that tested cuing as an adjunct to various forms of visual aids have supported its effectiveness in increasing retention. Theoretically, a cue focuses attention and supports retrieval of information. The cue focuses attention by highlighting the information in one way or another.

Cuing Strategies

- Contrast
- Arrows
- Boldfacing
- Bullets
- Underline
- Size
- Color

Table 5.5

Displays intended to teach function should include only the level of detail necessary to demonstrate it. Structural details can interfere with learning about function by distracting from operational principles. This is because realistic structural detail often does not yield a clue as to function. For example, the appearance of a human brain yields not a clue as to its function. Also, the reader might want to think about whether an actual human heart, or a line drawing of the heart will better show its function.

Detail and realism do not necessarily increase learning about how things work. When we intend to teach about function, we use schematics that show functional components and how they work. Figure 5.2 illustrates using schematic to teach the physiology of circulation through the

transitional circulation of a newborn. Anatomic accuracy in this figure is non-existent, but the schematic aptly shows functional aspects.

Regarding function, we also need to consider the value of motion or animation in instructional presentations. Where is motion critical? One situation that warrants motion is demonstration of a procedure. A good video of a procedure done to perfection replaces lots of preparation involved with live demonstrations. Furthermore, the video be viewed repeatedly, when an instructor is unavailable. Video has an unquestionable value in instruction. However, we always must consider the cost, which is considerable. There are many videos on the market that are no more than canned lectures, which have been called 'talking heads.' These do not justify the production costs of video.

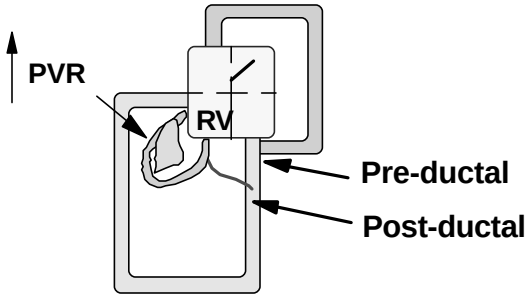

Figure 5.2 Schematic of transitional circulation in newborn.

Using Instructional Aids

Now that I have addressed general guidelines for selecting and developing instructional aids, we now turn to recommendations for using them. First, instructors should integrate all instructional aids into a lesson plan. Although we may use aids in any of the stages, they are most commonly used in the presentation and application stages. For example, an instructor may have a video that effectively presents certain skills. To integrate the video into the lesson, the instructor prepares the students, as described for lesson stage one, then identifies the key teaching points in the video. After the video, the instructor usually must complete the lesson with application exercises, then a lesson summary.

General Guidelines for Using Instructional Aids

- Integrate into a lesson plan
- Preview before using in class
- Check AV equipment before class
- Hide aids until needed
- Expose information as needed
- Cue displays that contain abundant detail or information
- Permit adequate time for students to encode information
- Encourage elaborative processing
- Encourage image processing-motion for dynamic processes

Table 5.6

Guideline #2 recommends that instructors preview aids before using them. This guideline applies to those aids developed in-house, as well as those acquired elsewhere. It is important to preview the in-house aids to refresh memories of their content and to determine whether they remain appropriate. Also, instructors need to check them for errors. Instructional aids with gross errors give an unprofessional appearance.

Ideally, instructors preview aids acquired through purchase before adopting them for a course. Failure to preview aids can lead to unpleasant surprises. For example, in 1996, some Texas elementary school teachers failed to preview a video before showing it to their students. The teachers turned the video on, left the room, and later discovered that their pupils were treated to an x-rated movie. The kids loved it; but, the school district and parents were rather displeased.

Another reason instructors need to preview AV aids is to ensure that the audiovisual equipment is operational. One can lose valuable class time troubleshooting equipment or obtaining replacements. It is wise to have an extra bulb on hand for all projectors. The next guideline pertains to instructional aids that are likely to attract attention. Although we can use aids to gain and sustain attention, they can have an undesired effect. That is, if an instructor displays an attention gaining aid throughout a presentation, students may attend to the aids throughout the presentation, rather than the presentation.

Consider an instructor who intends to teach a class on measuring blood pressure. He plans to teach about the theory and rationale for blood pressure measurement, followed by a demonstration. The demonstration will use several high-technology devices, which remain on display at the front of the room. These devices are such a curiosity that they attract the students' attention throughout the initial presentation. The net result is that the students learn little about the theory or rationale of blood pressure measurement. So, instructional aids that are likely to divert attention from the instructional message should be out of sight until needed.

A previous section described the effect of overcrowded displays on learning. Sometimes, instructors acquire visual aids with excellent potential for instruction, but display too much information at once; for example, a chart. An instructor can compensate for the overabundance of information with two different strategies: masking and cuing. Masking refers to covering parts of a display, exposing them only when the instructor is prepared to discuss them. This is often done with overhead transparencies, as well as charts and chalkboard displays. Cuing strategies can compensate for the overabundance of information by focusing the learner's attention on specific aspects of the display.

Among the many things that instructors sometimes forget is that people learn at highly variable rates. Despite this, they may proceed through presentations unaware that a considerable portion of the class was lost about ten minutes into the presentation. Instructors must give students time to perceive instructional aids, then think about them to encode the pertinent information.

Because many visual aids intend to convey complex concepts or principles, students must be assisted in encoding the information as intended. Encoding complex information requires elaborative processing. Therefore, instructors must support elaborative encoding. This can be accomplished by instructing learners to use their imaginations to think about the relationships between components of the display. Where dynamic processes are involved, instructors may ask

learners to imagine motion among the components. Although there are significant individual differences for image processing, this strategy can assist many learners.

Specific Instructional Aids

Table 5.7 lists the aids discussed in this chapter. Although there are others, this list covers the current popular aids. We will start with the most common and simplest instructional aid, the chalk or dry erase board. Oddly enough, many instructors commonly misuse this aid.

Chalkboards

Chalkboards have been used in classroom for many years, often as the only available instructional aid. More recently, dry erase markers have replaced chalk, bringing more vivid colors and eliminating chalk dust, which can pose significant discomfort to some individuals. Both of these boards are readily available and inexpensive. Their classroom applications are limited, mainly by the artistic talents of instructors and legibility of their handwriting.

Instructional Aids

- Chalk/dry erase boards
- Charts
- Overhead transparencies
- Computer presentations via:
  -Overhead liquid crystal display panel
  -VGA to television converter
  -Digital projectors
- Slides
- Videotapes
- Laser videodiscs
- Physical models
- Audiotapes
- Handouts

Table 5.7

Importantly, when instructors plan to use boards extensively, they should create their display before class time. The reader may have experienced an instructor who spent most of their classes with their backs to students while they scrawled on, and lectured to, the board. Even worse, they would repeat the identical presentations year after year. This exemplifies inefficient and ineffective teaching. If the same display is to be used repeatedly, it should be produced once in a durable form, like a chart or overhead transparency?. Finally, a board full of information is potentially distracting. So, such boards should be masked until they are needed.

Charts

Charts can take many forms and fulfill many instructional purposes. A familiar example is the pull-down map used by school teachers. Anatomic charts are pervasive among the health professions. These can be relatively expensive, but the durability of the content and the medium can offset the cost. Professionally made charts are loaded with visual detail and information, so cuing and masking are important to their effective use.

Another type of chart is the flip-chart, which is a large tablet, usually on an easel. This medium has been rejuvenated by consultants who use them in brainstorming sessions intended to build consensus. Although the flip-chart can be used in the classroom for similar purposes during conferences and discussions, a chalkboard serves the same purpose at lower cost. On the other hand, we can take chart pages away from conferences, while chalkboards are less transportable.

Overhead Transparencies

Next to the chalkboard, the overhead transparency probably is the most common instructional aid. A transparency is a piece of plastic, upon which one can write with markers, or transfer printed images and text. Although many instructors have come to rely on digitally projected images from computers, the transparency is a reliable backup medium, which is important to remember because the high-technology devices frequently fail. The overhead projector is a device found in most classrooms in the United States. Overhead transparencies share an instructional advantage with computer presentations; the capability for the instructor to face the class while referring to the presentation. Whereas instructors must turn from the class to refer to screens and chalkboards, the material on overhead projectors is in direct view.

All of the general rules apply to using transparencies. The most common errors in developing these involve either too much information or text that is too small to read. A common and effective strategy for using these includes masking information, then uncovering while progressing through the presentation. Another strategy is to make overlays, so information can be disclosed in layers, as illustrated in figure 5.1.

Transparencies are easy to create. One can obtain blank transparency film from any office supply store and place text and images on the material in several ways. First, there are water-based transparency pens that will write directly on the film. The film can be reused, since the ink from the water-based pens can be washed away. Like a chalkboard, however, the usefulness of this method of producing a visual aid depends on the legibility and artistry of the person making the transparency.

Another option for producing a transparency is to obtain film on which one can imprint images from copying machines. The original paper with the original image is placed on the bed of the copier, then the image is transferred to the film. Since there are color copiers available, attractive transparencies are easily made. Similarly, transparency film also exists that can accept images from laser printers. Then, any images from computer files can be printed on these.

Computer Presentations

Over the past few years, instructors have increasingly developed their own computer- based presentations for the classroom. This has been made possible by the decline in the cost of

computing, the availability of user-friendly presentation programs, and the availability of delivery hardware. Many of these presentations are identical to those that would be created for transparencies, but the computer presentation has several advantages.

Table 5.8 shows some of the advantages and disadvantages of computer-based presentations. Given the increased capabilities of computer hardware and software, instructors can add video clips, sounds, animation-- just about everything, except odors. **Media that are permutations of text, graphics, video and sound is called 'multimedia.'**

Computer-Based Presentations

Advantages	Disadvantages
More features	Requires expertise
Easily edited	Requires hardware
Easy to use	Requires software
No wasted materials	Requires delivery system
	Requires setup time
	System crashes
	Plagiarism

Table 5.8

Once a presentation is created, editing it usually is quite easy. Most presentation software make it easy for users to add, edit and remove pages at the press of a button. Computer presentations also are easy to use in the classroom. Once they are set up, one only needs to press a key to move from one page to the next. There are no plastic transparencies to get out of order or smear. Because there are no physical pages, computer presentations make it feasible to add one line at a time to text displays, which improves over masking. Similarly, graphics are easily layered, so that each press of a key adds graphic detail to displays (see Figure 5.1). Finally, computer presentations generate no plastic waste.

Besides the computer, some kind of device is needed to display the presentation for the audience. Most computer monitors are too small for classroom use. Therefore, we need devices like LCD projection panels, digital projectors and VGA-to-TV adapters. The LCD panel sits on top of an overhead projector, which should be of the high-luminescent type. Early models were monochrome-only, but color panels are now affordable. For larger audiences, a digital projector can be used. These will project computer images for audiences in large auditoriums. The most affordable option is the VGA-to-TV adapter, which allows the computer to interface with any television set. The audience size is limited by the size of the TV screen. A minor problem with these is that the signal clarity is not perfect, and some flicker occurs on the screen.

Disadvantages of computer-based presentations include expense. Most instructors have the hardware and software to create presentations, but may not have the delivery system. Another disadvantage of computer presentations include the time required to connect the hardware and boot up the computer. Lastly, technology seems to have a mind to fail at times that are most embarrassing and least convenient.

Computer graphics and sounds to use in presentations are easy to obtain from a number of sources. Any digital computer file can be imported for use with presentation packages, such as Lotus Freelance® for presentations is relatively easy. Table 5.9 lists some techniques for obtaining such files.

Digital Files for Computer Presentations

- Create images with paint programs
- Create images with digital camera
- Scan images from hard copy
- Import from programs, Internet

Table 5.9

The following paragraphs explain how to accomplish these, but one must be careful to stay within the boundaries of copyright law when using the work of others. Generally, as long as instructors give proper credit to the original author(s) of material, they can use materials in their classrooms once without obtaining permission. However, permission generally is required if the use will be repeated, if the material will be used commercially, or if it will go on the Internet. One could find oneself on the wrong end of a lawsuit, even become unemployed, because of an infraction of copyright law.

Given the precautionary notes about the law, instructors who can make their own digital images will be secure from copyright litigation. There are many paint programs commercially available. Among them, Microsoft Paint®, which comes with Windows®, is a common example. These programs have tools that enable, even the less artistic, to create simple drawings and diagrams. The resulting images can be saved in file formats, such as Tagged Image Format (TIF), Bitmaps (BMP), et cetera.

Similarly, instructors can create their own digital images by taking pictures with a digital camera. These can be purchased at electronic retail outlets, as well as over the Internet for a wide range of prices. Some of these also are capable of capturing motion digital video, as well as audio. Given these tools and a little time to learn their use, instructors can make digital images of anything they want to import into their presentation. However, one issue that comes into play with these, especially with vide, is the size of the files that are generated. The standard floppy diskette holds only 1.44 megabytes of data and one digital image can exceed this limit. Therefore, mass storage devices, such as compact disk writer are becoming the norm for storing these ‘multimedia’ presentations.

Digital scanners also are quite common these days. These can capture any image from hard copy and create digital files. So, instructors can copy images from sources, such as books, to put in presentations. However, one should recall the discussion on copyright law. Those instructors who have their own 35 millimeter cameras can take their own photographs and scan these to create legal digital files.

The Internet contains a wealth of sights and sounds that can be obtained and used for instruction. Much of the educational material is legal to download and use, but one should attend to the usage rules stated by the authors. Many sites on the World Wide Web have case studies, radiographs,

wave files and other useful media. Also, there is lots of clip art that is designated as 'freeware,' which means it is in the public domain for any use. Obtaining media from the Internet can be as easy as clicking on a download icon on a web page or using the 'file save' menu selection on the Web browser (see Table 5.10). One should be careful to note the file folder into which the file is downloaded.

Obtaining Media Using a Computer

- Download to a folder
- Save to a folder
- Browser cache files
- Screen dump

Table 5.10

There are two additional methods for obtaining media, however. The first of these is to locate the cache folder for one's browser. With a little sifting through the files in the cache folder, one can find the images and wave files that have been accessed. These can be renamed and saved to another folder for future use. This can be made easier by first emptying the cache folder beforehand. The second method is to use a 'screen dump.' Any image on a computer monitor is copied to the Windows® Clipboard when pressing the 'Alt' and 'Print Screen' keys simultaneously. Furthermore, there are programs specifically designed to capture and process computer screen contents. These can be found on the Internet at reasonable prices.

The screen dump results in a file that includes the whole window, including menus, et cetera. Therefore, it will require editing before it can be used. So, you need to open an application with image-processing capabilities, such as a paint or presentation program and paste the clipboard contents onto it. This is done by pressing the 'Control' and 'V' keys simultaneously. The screen can then be trimmed by cropping it, using the imaging tool. Then, it can be saved as a usable file format.

Slides

Slides rank very high among the tried-and-true instructional aids. They are durable and relatively inexpensive to create. The delivery hardware, slide projectors, are reliable and capable of projecting for audiences of all sizes. In fact, it is common for presenters to create their slide shows on computer software, then have it converted into a slide show, because of the availability and reliability of slide projectors. The primary disadvantage of slides is that commercially-available slide shows crowd information to save slides.

Videotapes

Videotapes are another tried-and-true aid. In many instances, videotapes intend to stand alone as a primary medium. But, there are relatively few that include all of the elements of a lesson plan. In fact, many of the commercially available videos are 'talking heads,' which are less effective

than live lecture, because there is zero interaction. However, there are some very good videos with content that would be very difficult to present in a classroom. As mentioned earlier, motion is important for teaching procedures. So, videotaped procedures generally are worthwhile.

Because camcorders are found in many homes, schools and hospitals the technology for creating videos is widely available. However, the expertise is not. Although we can make our own videos quite cheaply, there is a big difference in quality between a professionally done video and a home made one. The difference could be enough to impair the instructional effectiveness of the video.

Laser Videodisc and CD-ROM

Laser videodiscs were popular in the early 80s, when they were sold for home viewing of motion pictures. At that time, many major motion pictures were available on videodiscs, which look like compact disk, read-only memory media (CD-ROM), except they are about twelve inches in diameter. The advent of an affordable videocassette recorder caused the commercial failure of the videodisc, mainly because one can record onto videotapes and not videodiscs.

Otherwise, videodiscs are a superior medium. Compared to videotape, videodiscs permit nearly instantaneous access to frames. Furthermore, frames can display as stills indefinitely. Videodiscs are very sturdy, with a life span that is unaffected by number of playbacks. In the classroom, a videodisc connected to a monitor can be controlled by an instructor via a remote control or bar-code reader. Any of the stills or motion sequences on the disc are easily shown to the class.

There are many potential uses for videodiscs in allied health education. The videodisc is an excellent medium, and the players are reliable, though more expensive than VCRs. The major drawback has been that not enough videodiscs were ever produced and distributed to make the purchase of a player worth it. Also, a school doesn't easily create a videodisc. The hopes for the videodiscs probably will be fulfilled by CD-ROMs, as this technology advances rapidly. Currently, there are many instructional programs available on CD-ROM.

Physical Models

Allied health educators use many physical models for instruction. Every program has plastic replicas of various anatomic components, as well as manikins that simulate patients for various manipulations and procedures. We will revisit manikins and procedures in a later chapter. A good anatomic model will show the same detail as expected in the real thing. Therefore, the primary instructional guidelines involving detail. That is, instructors should use cues to assist learning of the structure. Also, this is one type of aid that can be very distracting. When possible, these should be kept out of sight and out of reach from students until needed for instruction. Of

note to those who are new to education, good anatomic models are usually quite expensive. So, their purchase should be warranted by instructional need.

Audiotapes

Some clinical skills depend on recognition of sounds. For example, assessment skills require recognition of heart and lung sounds, measuring blood pressures, and interviewing patients. Also, many of the alarm systems of medical devices are audible. Most commonly, instructors furnish classroom sounds with their mouths. However, it would be hard to emulate a heart sound with one's voice. So, audiotapes can fill an instructional need.

Presently, there are several instructional audiotapes available from commercial sources. There are several for heart and lung sounds, respectively. More recently, a CD-ROM of normal breath sounds has been marketed. Although these recorded sounds are useful in teaching recognition of basic sounds, I am not convinced that any skills acquired transfers to the clinical setting.

Printed Media- Review Notes

Printed materials used as instructional aids are otherwise called handouts or review notes. A previous chapter explained that note taking by students probably interferes with their learning by misdirecting their attention from instructional points to writing their notes. So, if they need something besides a textbook to study for tests, the instructor should provide it for them. Handouts serve two separate functions: Students use them to follow classroom presentations; then take them home to study for examinations.

Fortunately, current computer usage makes it possible to duplicate the presentation to give to students as handouts. Most presentation software has this capability. Therefore, the students may have all of the text, graphics and tables as presented by instructor. Handouts can display information in various forms, and it is important to recognize that some forms of information are better organized for student learning in one format than another.

When information is displayed as text, it may be suited for an outline, or hierarchical format. Other kinds of information fit better into formats like matrices. Still others fit better into graphs and flowcharts. The cognitive map is another interesting form of review note, wherein the spatial relationships among concepts reflect their semantic relationships. Figure 5.4 includes a cognitive map in the top panel and matrices on the bottom panel.

Instructors should be aware that there are individual differences among people with respect to visual learning styles. For example, some students learn more from data in tables, while others

learn more from graphs. Importantly, like all instructional aids, review notes are intended as adjuncts to the instruction.

Review notes are not intended to replace textbooks. As review materials, they intend to provide cues for retrieval of information. Therefore, students should not expect to find complete sentences, as found in textbooks. Unfortunately, many students have come to rely on review notes as the sole medium for study outside the classroom.

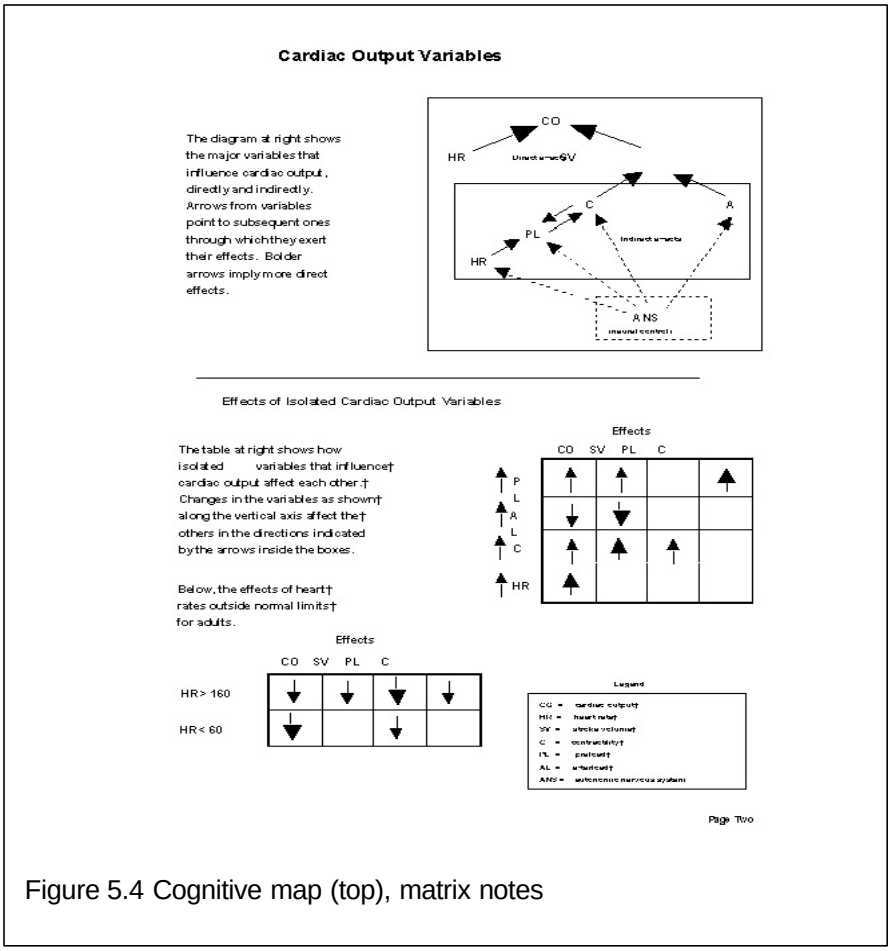

Figure 5.4 Cognitive map (top), matrix notes

Textbooks

Chapter Four discussed textbooks as platforms for instruction. However, it currently is rare for printed media to serve as a primary medium for instruction. Rather, textbooks, journal articles and the like are used as adjuncts for instruction; that is, instructional aids. Finding the best textbook for a course can be a difficult task, although sometimes there is little choice in the

matter. In some instances, there may be only one or two textbooks available on a particular subject. However, when there is a choice, the attributes of each possible textbook can be analyzed by instructors to determine a best fit. Table 5.11 lists some important textbook selection factors.

Textbook Selection Factors

- Comprehensiveness of contents
- Scientific accuracy
- Readability
- Organization
- Pedagogic features
- Cost
- Included instructional materials

Table 5.11

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The first issue instructors must face when selecting a textbook is whether the content is appropriate to assist the students in meeting the objectives of the instruction. Instructors must determine that the majority, if not all, of course topics are covered thoroughly and adequately. At the very least, students should be able to use a course textbook as a resource to review and elaborate on the information which has been presented within the instructional platform. For instance, if the platform is a lecture, a student should find supporting material in the textbook to review the lecture material. Also, they should be able to find answers to questions that they may have, away from the classroom. The content of the textbook should be consistent with the content of the platform, as well as scientifically accurate. Students who are confronted with frequent disagreement between what they read in the text and what they hear in class will perceive the text as valueless and will not read it.

Readability of a textbook is an important attribute, because the other qualities are of no consequence if students will not read the book. Therefore, books should be written at an appropriate reading level, vocabulary and style. If an instructor finds a book tedious to read, she or he can expect students to avoid reading it. This is especially problematic with texts devoted to medical devices and procedures, because technical information tends to be difficult to enliven with prose. Before adopting a new book, it is worthwhile to lend it to a couple of students to review and give their opinions about it. Their insights can prove valuable.

Besides vocabulary and style, the general appearance of the pages of a book affect students' inclination to read a book. Pages that are crammed with text in small print are uncomfortable to the eyes. This will limit reading time. Text should be interspersed with figures and text boxes, creating white space, which is appealing to the eye. Adding a touch of humor, color, content-relevant anecdotes and 'pearls' also reduces the tedium that many associate with reading.

Organization of a book is another important attribute to evaluate. Ideally, a book will parallel the organization of the material, as it is presented by instructors. However, this is not critical, as long as the chapter assignments are clarified for the students. Of greater importance is that the organization of topics within chapters is cohesive and logical.

Pedagogic features are those that contribute to the instructional capabilities of a book. That is, they are teaching aids. Table 5.12 lists some of these. Although some instructors tend not to use these aids, they at least should be familiar with the ones in each book used for their courses. It is also helpful for instructors to point these out to students and comment on their usefulness. One aid that is sometimes problematic is the chapter study questions. Some books have included very poorly constructed questions, sometimes with erroneous answers indicated as correct. Instructors should check these before letting them confuse the students.

Textbook Pedagogical Aids

- chapter learning objectives
- chapter outlines
- list of new terms, definitions
- embedded thought questions
- figures
- tables, text boxes
- chapter summary
- chapter study exercises
- glossary
- index

Table 5.12

Embedded thought questions are questions included within paragraphs of a book. These are built-in instructional strategies that intend to provoke elaborative processing and critical thinking about the chapter contents, which increases comprehension and retention of the subject matter. Also, these questions force students to practice metacognition and reread sections when needed. The other pedagogical aids exist in books in varying degrees. How important they are usually is dependent upon the preferences of the instructor.

There are two components that are extremely important to students, regardless of the instructors' preferences: the glossary and index. Textbook authors ought to be very careful to define and explain all new terms in text. Also, there should be a glossary in the back of the textbook so students can easily locate definitions for new terms. Finally, the comprehensiveness of the index is critical to the usefulness of the book. Anyone reading a textbook should be able to locate all key concepts in the book, easily and quickly, by looking in the index. Ideally, the index is cross-referenced, using alternative terms for key concepts.

Cost is another important factor to consider before adopting a textbook. Books are expensive, so students should not be expected to buy them unless they are of value to the instruction. Some books in the health professions, regardless of expense, are cost-beneficial, because they are cornerstone to the professional education. For example, anatomy and physiology books are vital to most health professions and are used in multiple courses, as reference sources. Also, books of this type prove valuable as reference sources for professionals after they graduate. On the other hand, an expensive book that is used for only part of a course and has little value for future reference should be considered very carefully.

Textbook publishers frequently provide instructional materials to accompany textbooks. Examples of these are student study guides, instructor's manuals, slides and test item banks. In some instances, these are provided free to instructors who adopt a textbook for their course.

Although these offerings should not induce an instructor to adopt a substandard text, all other things being equal, these instructional aids, free or not, are a factor worth considering.

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Chapter Five Study Questions

1. Explain the importance of instructional delivery that addresses multiple sensory channels.
2. List and elaborate on the general guidelines for selecting and developing instructional aids.
3. Define cuing, state its purpose and list several methods for curing visual displays.
4. List and elaborate on the guidelines for using instructional aids.
5. List specific instructional aids and describe how each is used correctly.
6. State the advantages and disadvantages of computer-based instructional aids.
7. Explain the difference between displays intended to teach structure, versus function.
8. Describe four methods for obtaining image files for presentations
9. Explain the importance of format selection for review notes.
10. List five pedagogical aids commonly included in textbooks and describe the importance of each.
11. Using the selection factors described in this manual, evaluate a textbook for adoption

CHAPTER SIX

DEVELOPING LESSONS AND COURSES

Learning Objectives:
- Describe the steps in writing a lesson plan.
- Describe each stage of plans, for both informational and procedural lessons.
- Explain the purpose for each lesson plan stage.
- Develop a lesson plan for an information lesson.
- Develop a lesson plan for a procedure lesson.
- Explain the purpose of a course syllabus.
- List the components commonly included in course syllabi.
- Describe the process for developing course syllabi.
- Write a course syllabus.

Lesson Development

So far, this manual has presented information about the theoretical underpinnings of instruction, writing learning objectives, instructional platforms and instructional aids. This chapter intends to teach the reader to use the information from previous chapters to develop lessons and courses. This section begins with lesson development. Table 6.1 shows the steps to take.

As with all tasks, we must first identify what we intend to accomplish. For a lesson, that means we must specify the objectives of the lesson, or, precisely what we want the learners to be able to do as a result of completing the lesson. In practice, the instructor conceptualizes the test that will measure achievement of the objectives before developing the lesson.

Developing a Lesson
- Specify learning objectives
- Sequence learning objectives
- Develop criterion test
- Analyze instructional context
- Specify instructional platform
- Specify strategies & aids
- Outline the lesson plan
- Rehearse the presentation

Table 6.1

After specifying individual criterion (main) objectives, the instructor must identify the skills that enable for each one. This is important, because an enabling objective that is not reached will prevent the learner from reaching the criterion objective. The instructor identifies the enabling objectives through task analysis. For a procedure, this involves the steps in the procedure; for a cognitive objective, it involves analyzing the enabling cognitive objectives.

Learning objectives usually demand a logical order for instruction. That is, the enablers must be reached first. So, the lesson presentation should address them in the appropriate order. For example, a learner must be able to identify the bones of a hand before they can be expected to explain the normal function of the hand. Similarly, a learner must be able to identify the correct hand position for chest compression before doing cardiopulmonary resuscitation. In many cases, there may not be a clear enabling order for objectives; it may seem like a case of which came first- chicken or egg. In this situation, one may select the order of instruction arbitrarily.

Once the objectives have been specified and sequenced, the instructor must analyze the instructional context, which is explained in more detail in Chapter Four. Table 6.2 shows the main elements of context. Instructional context informs one about the entry level skills of the learners, which helps identify where the instruction must begin. The numbers of learners, as well as the setting provide one with information about what platform and instructional aids would best suit the situation. Therefore, we can say that the context tells us how to present the material to the learners. Finally, the context includes the time available for the lesson. This will determine how much material can be presented within the lesson and will guide platform selection.

Instructional Context

- Learner characteristics
- Number of learners
- Physical setting
- Available time
- Institutional characteristics
- Instructor characteristics

Table 6.2

Next, one selects among the platforms for one most suitable to the situation. Instructors tend to choose lecture out of habit, as well as lack of expertise with other platforms. However, lecture often is inappropriate for specific content and context. An instructor should consider alternatives. Specification of the platform determines the primary method of instruction for a lesson.

Within the platform, however, one must decide which strategies and instructional aids to use. For example, the strategies might include employment of certain examples, non-examples and oral questions. The instructional aids are the sights and sounds an instructor uses to support the instruction. Decisions about instructional aids include such things as whether and which graphs, diagrams or pictures are needed. Another instructional aid decision involves the nature of any handouts to provide the learners for subsequent reference and study.

The instructor needs to outline the lesson, using a format like that shown in Table 6.3. This should not be a verbatim account of what the instructor will say, but a simple outline that shows each event that will be part of the instruction. This will show the key instructional points, in appropriate sequence and the specific strategies and instructional aids. Importantly, **one should view the lesson plan as a guide, which includes the critical elements of instruction; but, not as a constraint.** Good instructors frequently develop insights, inspirations and ideas during lesson presentation that enhance the instruction.

With experience, an instructor gains expertise in estimating how long it will take to make a lesson presentation. Also, one learns to increase or decrease the pace of instruction as time allows or demands. However, novice instructors are less likely to have these skills. So, novice instructors should rehearse lessons before they present to students. Besides verifying the time factor, rehearsal gives the instructor confidence and guides lesson revision, where needed.

Five Stage Lesson Plan

At one time or other, many students find themselves confronted with an instructor who teaches in a haphazard manner. In this situation, the student often asks questions like ,'Where is the instructor going with this?' What information is important here? What am I supposed to do with this information?' Haphazard instruction that raises questions like this among students has limited effectiveness and efficiency.

Like any other task, instruction should proceed from some kind of a plan, regardless of the setting or purpose of the instruction. In many instances, the plan may be a mental organization of the material within the instructor's mind. However, formal instruction should proceed from a written lesson plan. Herein, I advocate a five-stage lesson plan that provides a logical, common-sense sequence for teaching any kind of skill. Table 6.3[1] shows the stages and steps of this lesson plan. This outline presents the ideal plan, which includes steps that may not be feasible for all instructional situations. Proceeding sections describe the stages.

Five Stage Lesson Plan

Preparation (of learner) stage
- Gain attention
- State the objective(s)
- Establish relevance and importance
- Activate prior knowledge

Presentation stage

Information lesson
- Maintain learner's attention
- Present **distinct** stimuli for learner's selection
- Guide learning- encourage active learning

Procedure lesson
- Demonstrate, at real speed, no explanation
- Demonstrate at slow speed
- Learner follows with procedure checklist
- Explain each step, stressing key points

Application stage

Information lesson
- Oral questioning
- Student presentations
- Written tests, quizzes, exercises

Procedure lesson
- Learner describes procedure- oral or written
- Talk learner through procedure
- Guided practice- observe & correct

Verification or evaluation stage
- Information- criterion-referenced examination
- Procedure- criterion-referenced performance evaluation

Summary, review stage
- Summarize lesson content
- Review key points
- Recommend drill or practice exercises
- Recommend additional information sources

[1] Used with permission from: Chang DW, Elstun LJ, Jones AP. The Multiskilled Respiratory Therapist: A Competency-Based Approach 2000; FA Davis: Phila.

Preparation Stage

The first stage in the lesson plan is the preparation stage, **which intends to prepare the learner to receive the information from the lesson**. The reader will recall some of the teaching points from the chapter on information-processing relate to each step in this stage. Before we can expect learners to receive the instruction, we must first gain, then direct their attention. Instructors provide visual or audible messages to let learners know that instruction is forthcoming. We explain why the instruction is important to establish its relevance. We state the objectives to help learners select information from the instruction. Finally, we provide some kind of message to activate prior knowledge of the information.

Presentation-Information

After the learner is prepared, the instructor proceeds to presenting the information of the lesson and demonstrating the procedure, if applicable. These are addressed here, separately. To present a lesson, one must select a platform to deliver the instruction. The plan for each lesson also must consider the strategies included therein. The strategies intend to support information processing: attention, encoding and retrieval. Some of the major points include maintaining attention by avoiding boredom and providing information in a stimulating manner. Specific strategies for attention include speaking without droning, showing enthusiasm for the information and asking questions at appropriate intervals.

Besides supporting attention, oral questions also support encoding. By interacting with learners we encourage active learning, which has better success than passive learning. Remember the difference between passive rehearsal and elaborative rehearsal? Additional strategies to support encoding include contextual cues, examples, non-examples, analogies and models. These help the learner engage in building schemata with the new information. Simple rehearsal is an effective strategy to support recall and recognition.

Application Stage- Information

The application stage follows presentation of the lesson. An instructor should provide exercises to encourage learners to apply the information they have just received. The purpose of this step is to encourage further processing and to reinforce the material. Successful application of the material also encourages learners to develop confidence in what they know-- metacognition. The most common type of application exercise is oral questioning.

However, for many types of lesson content, other applications are more effective. For example, if the lesson included calculations, the application should be calculations, as well. If the lesson included complex information, applications should require learners to elaborate and explore the

complexities of the material. Examples of other types of applications include written quizzes, simulations, student recitation, games and discussion. Simulations, like role playing, are especially effective in teaching professional behaviors.

Verification Stage-Information

The verification stage of a lesson is some kind of a test. The purpose of this stage is to verify the extent of learning that has taken place. Most often, we reserve this stage of the lesson for a later time, when other lessons have been presented. Then, we administer a test to verify the extent of learning from the combined lessons. Therefore, we can use the application stage to serve as verification in units of instruction. Although this practice is not necessarily appropriate, it is done to save time.

Summary or Review- Information and Procedure

The final stage is a review of the material that has been presented. Usually, this is a thumbnail sketch of the material, emphasizing the key instructional points. Another component of this stage is to suggest further practice, drill or sources of additional information.

Presentation- Procedure

It should be apparent that if performing a procedure is an instructional objective, a lecture or audiovisual aid cannot serve as sole means for instruction. These methods are helpful in teaching the cognitive components; but, to learn a procedure, a learner must see it performed, then do it themselves. Ideally, the instructor performs the procedure at full-speed, without explanation, then demonstrates at slow-speed, explaining each step, emphasizing key points.

An essential instructional aid for procedures is a checklist that identifies the steps, in sequence. This can be used to help present the procedure, as a study guide for applications, and finally as the final examination for the procedure. The checklist must be created, based on analysis of the procedure, also known as a 'task analysis.' Task analyses also are used to identify terminal and enabling objectives for lessons, courses and curricula.

Application- Procedure

Before the learner attempts the procedure, they should be able to describe what they are about to do, either orally or in writing. Then, the instructor should talk the learner through the procedure. Finally, the learner practices the procedure while the instructor observes and provides feedback.

Verification- Procedure

To verify that a procedure has been mastered by learners, they must perform the procedure under specified conditions, like laboratory simulations or clinical practice, and in conformance with the pre-established criteria for satisfactory performance. The procedure checklist guides performance evaluation. Usually, instructors permit no critical errors and few minor errors to pass the procedure as the criterion for satisfactory performance.

Course Development

Course development is similar to lesson development, but on a different scale, and with some additional variables to consider. Course development also must correspond to curriculum development, which follows a similar development process, with additional variables to consider. Table 6.4 list the major steps in course development.

Course Development Steps

- Assess needs
- Develop criterion objectives
- Analyze context
- Define, sequence modules
- Define, sequence lessons
- Specify resources
- Develop syllabus
- Conduct course
- Evaluate course
- Revise, as needed

Table 6.4

Initially, one should consider the need for the course; that is, the motivation for its creation. If it is a new course within a curriculum, the course intends to address specific instructional goals that are not met by pre-existing courses. A course, such as a staff development program, should be motivated by need.

Indicators of instructional need appear in Table 6.5. Many health care professions experience expansion in their scope of practice over the years. This usually is reflected by the professional literature and eventually becomes integrated into credentialing examinations. Such evidence warrants creation of new courses within curricula, as well as staff development courses for those already in practice. Similarly, advances in technology create needs for continual revision of existing curricula, as well as courses for practitioners.

Instructional Need Indicators

- Expanded scope of practice
- New technology, devices
- Surveys- employers, graduates
- Requests from practitioners
- Clinical incidents

Table 6.5

When a course is likely to generate expense and the need is in question, it may be fruitful to conduct a survey of interested parties to assess need. The interested parties may include the target audience, as well as those who employ them. The results of this survey can be used as an

additional tool to determine cost-benefit for the course. Frequently, need indication arises from the target audience. That is, practitioners may identify areas in which they feel the need for additional preparation. Their requests for education should not go unheeded. Unfortunately, these requests sometimes arise from clinical incidents in which patients did not receive appropriate care. Such incidents usually result in 'crash courses,' which should be avoided through monitoring of the clinical environment and personnel.

An earlier section of this chapter discussed context. The context includes important information relating to the needs for instruction, as well as the available resources. Another aspect of context is the institutional characteristics; information about the organization(s) sponsoring or hosting the instruction. The institutional context factors advises of available resources; also, it provides administrative guidelines and constraints for courses. For instance, a hospital department may verbally support an educational project; but, may not provide financial support or space.

Criterion objectives for a course describe the end-point performance expectations for each major subject matter division. For example, a pediatric advanced life support course addresses skills that include pharmacology and airway management. The list of objectives for the course would include criterion objectives for each of these; such as ,'state the indications and dosages for medications used in pediatric life support;' 'intubate a pediatric manikin within 30 seconds.' These criterion objectives guide development of lessons, with their more specific objectives, which must enable for the course objectives.

Courses that address separable subject matter areas, like pharmacology and airway care, should be subdivided into modules, which address uniform criterion objectives. After these are identified, they should be sequenced in some logical order. Importantly, enabling skills must be acquired first. Modules, in turn, may be further subdivided into units, or lessons. Lesson objectives are identified as those which enable for module objectives. Lessons are sequenced using the same logic as for modules- enablers first.

Resources needed for courses can vary tremendously. A course that consists mainly of lecture requires few resources. On the other hand, a clinical course requires a multiplicity of devices, professional personnel, even patients. Resource identification is addressed further in Chapter Ten. Suffice it to say for now, that one should carefully consider whether the necessary resources are available before trying to implement the course.

The preceding analyses and developmental activities aggregate into the document that describes the course-- the syllabus, which is described in a proceeding section. Using the syllabus as a guide, the course is taught, lesson-by-lesson, unto completion. Then, the course is evaluated, based on student achievement, as well as student and instructor evaluations of the course.

Importantly, the instructor should note any and all shortcomings in the course for future revisions. There is no such thing as a perfect course, so there is always room for improvement.

The Course Syllabus

Analogous to individual lessons, the instructional effectiveness and efficiency of courses depends on planning. Although the plan for a course is on a different scale, and includes different elements, it integrates individual lessons into a whole, which leads learners to achieve a set of interrelated terminal objectives. The plan for a course usually takes the form of a course syllabus, which is defined as a synopsis for the course contents. Although the following discussion generally refers to courses taken for credit in schools, the information applies to courses developed for instruction in all contexts, such as patient education and staff development.

The components required for course syllabi vary from institution-to-institution. However, Table 6.6 lists those that are common. An example of a syllabus for a course on instruction in health professions can be found in the appendix to this text. This particular syllabus is for a course that is taught by both conventional and web-based methods. There are other specific components that can be added, as described in proceeding sections.

Course Syllabus Components

- Course description
- Prerequisite courses, skills
- Administrative data- dates, times, etc.
- Criterion objectives
- Textbooks, references, courseware
- Evaluation and grading procedures
- Course requirements, policies
- Course outline
- Course schedule

Table 6.6

As the name implies, the course description is a brief description of the subject matter covered by the instruction, the setting of the instruction and broad statements concerning the purposes or goals of the course. A prospective student should be able to use this description as an aid to decide whether to take the course, if it is elective. These descriptions also are important in determining whether courses are equivalent, and therefore, transferable between schools. So, the course description should be complete, clear and accurate.

Where applicable, any courses that are prerequisite to the course in question also must be identified by the syllabus. This also is important to a prospective student in deciding whether to take the course or transfer to the program. When there are prerequisite skills or credentials, rather than courses, these should be listed. For example, an advanced workshop in research may identify prerequisite research skills, such as statistics and research design. Also, an advanced cardiac life support course will identify basic life support certification as prerequisite. There may be administrative prerequisites, as well. For example, a staff development program may admit

only employees from the hematology section; a physical therapy school will require admission to their school as a prerequisite.

Administrative data are another component of the syllabus. The required data may include the dates, times, location and credit hours for the instruction. Contact information for the course instructor, such as their office location, telephone number and email address often appears here, as well.

Although many instructors incline to include a long list of instructional objectives in the syllabus, this serves more to lengthen the syllabus, rather than inform anyone. What is needed here is a list of criterion, or terminal, objectives for the course. These often can be identified from the major course divisions, which usually are called, 'modules.' For example, the pharmacology module for an advanced cardiac life support may have an objective like, 'State the indications and dosages for cardiovascular agents used in advanced cardiac life support.' The more specific learning objectives should be reserved for individual lesson plans.

Instructional resources for the course should be stipulated in the syllabus. These include textbooks, important reference sources, laboratory manuals and instructional software. In some instances, it may be necessary to inform students where the resources can be found, or whether they will be made available at class-time.

Evaluation and grading procedures must be carefully considered and stipulated in the syllabus. This is in the interest of fairness to the students and legal protection for the institution. As shown in the example in the appendix to this chapter, the description should include the weight of each examination, assignment, et cetera; also, the total points to receive each grade. Course completion may be either pass or fail. The minimum criteria for a passing grade must be clear to minimize legal risk. For example, one criterion to pass a clinical course could be, 'complete all clinical procedures listed for the course, without error.'

Legal Ramifications of Syllabi

Instructors in formal educational institutions should be cognizant of the legal implications of a course syllabus. This is a document that can be construed as a contract with the students. This implies that once the syllabus has been executed, changes, like grading policies, can be successfully challenged by students.

Course requirements and policies are another component that has provides important information to students and has legal ramifications. This section can describe policies and procedures related to professional conduct, which includes personal appearance, attendance and punctuality. Some institutions and programs have used this section of syllabi to reiterate institutional philosophy and policies. This clearly is inappropriate. However, where a course has specific requirements, these should be clearly and concisely stipulated here. It is not unusual for a student, who has not adhered to a

requirement to challenge the requirement on the basis of its non-publication at semester's beginning. If the requirement is unwritten, it is nearly indefensible.

Course outlines in syllabi are an expansion of the course description. This component informs students in more detail as to the content of the instruction. Also, this section is very useful in evaluating prerequisite skill for additional education and for awarding transfer credit between institutions.

Course schedules are important components of syllabi, for both instructors and students. Ideally, the schedule includes topics for study, assignments and examinations. Considering the legal status of the syllabus, it is important for the instructor to stipulate that the schedule published in the syllabus is TENTATIVE. There are many unforeseen events that can necessitate schedule changes. So, some leeway in the schedule is needed.

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CHAPTER SIX
STUDY QUESTIONS AND EXERCISES

1. List the stages of a lesson, along with the purpose for each stage.
2. Write a lesson plan to teach a cognitive skill.
3. Write a lesson plan to teach a procedure.
4. Develop and deliver one lesson to teach cognitive skills and one lesson to teach a procedure. These should be evaluated by the instructor and class, using the evaluation forms in the Chapter Six Appendix
5. List the components of a course syllabus.
6. Discusses the legal ramifications of a course syllabus
7. Write a syllabus for a continuing education course intended to teach patient education skills to practitioners in your own profession.

CHAPTER SEVEN

COMPUTER-BASED AND DISTANCE LEARNING

Learning Objectives:

- Identify the capabilities of computers that make them useful for instruction.
- Describe specific types of courseware used in computer-based instruction (CBI).
- Describe the applications of CBI in instruction.
- Describe various forms of distance learning technology (DLT).
- Identify the major technical requirements for videoconference and web-based instruction.
- Describe the applications of DLT.
- Explain the advantages and disadvantages of DLT.

The following terms are introduced in this chapter:

- Courseware
- Database
- Videoconference
- Web-based instruction
- Media streaming
- Hypertext markup language (HTML)

Educators have a longstanding love-hate relationship with 'high technology.' On one hand, high technology has been loved because it can assume some of the drudgeries of teaching, while keeping students quiet and entertained. On the other hand, a lot of the technology requires learning and changing on the part of teachers. Also, it has threatened to replace teachers, time-after-time. In the late 19th century, Thomas Edison predicted that his motion pictures would replace teachers. In the early 1970s, it was Skinner's teaching machines. Then, many thought that the computer would be the ultimate teacher and eliminate many teaching jobs.

Obviously, high technology has been neither the predicted boon nor bane to instructors. Currently, most instructors have computing power on their desks that twenty years ago would have required several rooms full of computing hardware. Our computers have awesome speed and storage space, and we communicate with the other side of the world in seconds. But, the high technology has not really changed instruction that much. We develop more sophisticated handouts and use computerized presentations in the classroom. These are the most pervasive changes with regard to computing and instruction. Why? Probably because technology advances much more rapidly than human capabilities and inclinations.

That is, instructors have not taken advantage of the capabilities of high technology for augmenting and improving instruction. This chapter focuses on two major areas of technology, as applied to instruction. These are computer-based instruction (CBI) and distance learning

technology (DLT). We will explore the capabilities, applications, advantages and disadvantages of each technology, beginning with CBI.

COMPUTER-BASED INSTRUCTION

Capabilities of Computers

Table 7.1 lists some of the important capabilities of computers that are particularly important to instructional use. First and second among these are capabilities to store and provide rapid access to large quantities of data. As hardware and software technology progresses, these are two capabilities that increase very quickly.

Important Computer Capabilities

<Store large quantities of data

<Provide rapid access to data

<Interactivity

<Accept input from various sources

<Control and coordinate various outputs

Table 7.1

In the early 1980s, many people had computers with 5.25" floppy drives, where each diskette contained about 360 kilobytes of storage space. At the same time, they purchased computer hard drives that stored between 20-40 megabytes, and many thought that they would not require more storage. In the intervening years, both storage space and storage requirements for software grew tremendously. Now, we can buy hard drives that store gigabytes of data, as well as recordable CD-ROM drives and diskettes. Each of the CD-ROMs can store all of the information in a set of encyclopedias, or in two or three hundred books. Therefore, students can have the information in the texts of a library on their desktops.

Besides information that is stored on hard-drives, CD-ROMs and diskettes, there's a wealth of additional information available via Internet. Many professional organizations and educational institutions have established websites that sometimes provide databases that are not locally available. For example, local search capabilities may not include Educational Resources Information Catalog (ERIC). But, this database can be accessed over the Internet.

Furthermore, innovative software has made this information much more accessible for everyone. For example, modern search terms, such as hypertext links, have made finding needed information in a virtual haystack, much easier. Instead of finding a bunch of books and journals, then searching through their indices to find relevant data, we can sit at a computer to do most of the work. The hard part is finding the time to read all of the sources after they have been located. These information storage and access capabilities assist instructors and students in a number of ways. First, instructors have nearly instant access to the latest information on their subject matter. So, there is very little excuse for teaching outdated information. Students benefit because accessibility of information increases their own capabilities to conduct thorough research.

The second capability of computers that is important to instruction is 'interactivity,' which means that the computer will vary its output, based on learner input. Interactivity may be the most important instructional capability of computers. A common example of interactivity is called 'context sensitive help,' which is a feature of many current software programs. Content sensitivity refers to a limited capability of the software to identify the general area where the user has difficulty and offer suggestions for solution.

Interactivity permits a computer program to give feedback to users and to guide them to content areas in response to their input. This feature is particularly useful in applications like clinical simulations, where students are placed in simulated clinical situations. Then, students can be confronted with various problems that require them to gather information and make decisions based on the information. Some of these simulations are quite realistic, and may include real time audiovisual displays.

Accepting input from various sources is yet another useful capability of the computer. Some instructional computer systems permit students to manipulate devices that are connected to the computer, which senses those students' manipulations. For example, the Actronics® (Pittsburgh, PA) Advanced Cardiac Life Support system has an intubation manikin that is connected to the computer. Sensors in the manikin relay information to the computer, which uses the information to evaluate intubation skills. The computer's capability to control an array of peripheral devices allows a wide array of interaction between the computer and user. For instance, the computer can control CD-ROM drives, videodisc drives and other devices as part of multimedia simulations.

CBI Courseware

This chapter refers to **instructional software as 'courseware.'** This term includes any and all program components, like diskette-based code, CD-ROMs or videodiscs. Table 7.2 categorizes major types of courseware by their instructional intent.

Courseware Types

- Database
- Tutorial
- Drill
- Simulations
- Examinations

Table 7.2

Databases

'Database' is a generic term that refers to a collection of related information. The term also applies to the type of computer software that is used to assemble and organize information into a database. For example, Lotus 1-2-3® and Microsoft Excel® are spreadsheet programs for desktop computers that have database capabilities. MEDLINE and CINAHL are databases that reside on large computers. We access these databases via networks.

As discussed in a previous section, the main instructional applications of databases involve teaching students research skills involving access to information. Also, students learn by using database software to create their own databases. For years, students have used index cards as a

database for their studies. A computer database represents a way to accomplish the same organization of information, but with additional capabilities for editing and sorting the data. Also, creating a database on a subject might teach students about the structure of knowledge in a selected area. Finally, learning to use databases and spreadsheets gives students skills that will likely apply to future professional situations.

Tutorials

In Chapter 4, which described instructional platforms, tutorial was defined as instruction for individuals. Ideally, a human tutor offers complete interactivity with students, sensing and probing to diagnose and solve problems with the learning situation. Although a computer cannot compete with human insight and communications for instruction, some very good computer-based tutorials have existed for years.

Computer-based tutorials can be developed to teach nearly any cognitive skill. They may incorporate multimedia to present text, animation, graphics, audio and video. Simple tutorials are included with many software programs to instruct user on how to use the software. There is a wide variety of courseware for health professions, too. Among these are tutorials on auscultation of breath sounds and interpretation of electrocardiograms.
Although it would be difficult to assemble all the tutorials needed to teach an entire course, units or modules of instruction can be taught effectively with this platform. Because tutorials usually intend to stand alone for instruction, it is important that their design and implementation include all of the elements of a lesson plan, as described in Chapter 3 of this text.

Advantages of computer-based tutorials are that they have unlimited patience and accessibility, which human tutors may lack. Also, current computer-based tutorials are relatively easy to use. The disadvantages largely center on expense. The student must have access to a computer, which represents one expense. Also, some computer-based tutorials are rather expensive. Considering the time and expertise required to develop a multimedia program, the expense usually is justified.

Drill

The preceding section mentioned the unlimited patience and accessibility of the computer. These attributes make cognitive drill a worthy application for computer courseware. These drills can take the form of test banks that permit a student to drill on content area with the computer providing corrective feedback. Ideally, the item bank for the drill is large enough to present a variety of questions to the learner. Tutorials should incorporate some kind of drill for learners to apply their newly-learned skills and verify that objectives have been met.

Simulations

A preceding section described some of the unique capabilities of computers for instructional simulations. With the capabilities for multimedia, virtual reality and interfacing with various devices, computers can teach all domains and levels of skills. Computer simulations can be simple text and graphic programs that present scenarios, as described in a preceding section; or they can be incredibly sophisticated learning systems.

Probably, the most elegant of these simulations are those used by the National Aerospace Agency to teach and test astronauts. The simulations place astronauts in every conceivable scenario, using mockups of equipment and a variety of environmental situations. Anyone who has seen the movie 'Apollo 13' will have a concept of the degree of sophistication of these simulations. The objectives of these simulations are to prepare astronauts to recognize and solve problems. They would be impossible to accomplish without computers.

Computers have enabled instructional designers to create simulations that would be very difficult to replicate by other media. Multimedia courseware has replaced many college laboratories that were formerly 'wet' labs, that required expensive and hazardous materials. Computer simulations even exist to teach surgical skills to physicians. Therefore, computer simulations can provide learning that parallels reality, but at less expense. Furthermore, simulations provide more safety to practitioners, as well as patients.

Examinations

Anything that can be taught using CBI also can be tested by the medium. As mentioned in the section on computer-based drill, test banks exist for many subject matter areas. Some textbook publishers even provide these to accompany textbooks, as an inducement for instructors to adopt them. For typical classroom situations, computer-based tests confer no major advantages over the paper-and-pencil exam. However, health care professionals will experience more examinations by computers in the future.

One type of examination for which the computer excels is that which uses simulations to test clinical judgmental skills. One example of this type of exam is the Advanced Respiratory Care Practitioner Clinical Simulation Examination, which is a credentialing examination for respiratory therapists. Currently, this examination is administered using a latent imaging format, but it will be replaced with computer-based testing. The computer format will be less cumbersome for examinees and they will know their results in minutes, rather than months.

The advent of credentialing examination by computer has one important implication for instructors and students. That is, students should be prepared to take computer-based examinations before they are faced with them for their credentialing examinations. This means

that allied health programs should use computer-based examinations within their curricula. These should be of the standard multiple-choice variety, as well as clinical simulations.

Using CBI Courseware

The first issue regarding any courseware considered for instruction is whether to use it and to determine its instructional purpose. Courseware should be adopted to fill a need, as opposed to finding a need for courseware that one finds. In other words, courseware should not be adopted just because it exists. Instructors should consider the objectives of the planned instruction, decide whether the courseware will help students attain those objectives, and how the courseware will help.

Guidelines for Using Courseware

- Use courseware to fill a need
- Use courseware within a lesson plan
- Review courseware thoroughly
- Ensure that students can use courseware
- CBI may not work for everyone
- Comply with license agreements

Table 7.3

Reconsider the five-stage lesson plan described in Chapter Three. If courseware intends to stand-alone, it must include all of the elements of a lesson. Otherwise, the instructor must prepare students and materials to furnish the elements not included in the courseware. Most frequently, the instructor will need to supply the preparation stage, which informs students why they are using the courseware, as well as their intended objectives. Also, the instructor may need to provide the summative evaluation of the learning.

Regardless of the purpose of courseware, instructors must review it thoroughly before using it for instruction. Although most commercial courseware is very good, there are some programs with poor design and inaccurate content. Even a good CBI program may contain some surprises for an instructor who has not reviewed it. It could take a different approach to a topic, use different terminology or different standards for parameters. This could create confusion, both for students and the instructor.

Although most students currently are computer literate and most courseware is user-friendly, some programs may be have special requirements to run them. For example, passwords may be needed, or the program may need installed on a specific system. So, students may need an introduction to the courseware, as well as instruction on its use.

The instructor needs to ensure that the courseware is available and accessible to the students. Furthermore, there must be hardware accessibility, as well. Ideally, courseware is purchased so it can be used on a network, so multiple students can access it in a computer laboratory. Like any other instructional platform intended for independent learning, CBI has its pitfalls.

Without entering a discussion on learning styles, suffice it to say that people have preferences when it comes to learning. Early research on stand-alone CBI found that it was more effective than lecture-based instruction for those who completed courses, but the attrition rate was much higher. For one thing, many students need the perceived discipline imposed by a human

instructor. For another, some students may dislike CBI. Although they may learn just as well from it, they do not apply themselves to the learning situation. Therefore, the instructor should be attuned to students' preferences concerning CBI and follow up on their efforts, rather than assume that it was done because it was assigned.

Finally, anyone responsible for buying and using courseware should be careful to read the license agreement that comes with it and comply with it. If courseware is not purchased with a network agreement, it should not be put on a network. Most courseware cannot be copied legally, except to make one backup copy. Software companies have long been aware of the tendencies among educators to plagiarize courseware, and have prosecuted in several instances. Plagiarism is both unethical and illegal.

DISTANCE LEARNING

As the name implies, distance learning takes place when the instructor is not in the same location as the learner. There are many forms that distance learning can take. These forms can use high technology, like satellite communications, or they can use something simple, such as the mail and text-based materials. Indeed, all correspondence courses involve distance learning. Therefore, distance learning is anything but new to the educational scene. In fact, military personnel have earned college credits from various institutions, even while they were in foxholes. However, distance learning has regained prominence over recent years, and is becoming a focus of activity for many educational and commercial organizations. There are several motivating factors for this trend, which are listed in Table 7.4.

The technology for distance learning has become available to educational institutions, and these institutions have discovered that they have a potential pool of students who would take their courses, if they do not have to be on campus. These are students with family obligations and full-time jobs. These students are a market to tap, both for schools and commercial organizations involved in distance learning. This student population is sometimes called 'non-traditional,' because the members usually are older than the customary college age.

Distance Learning- Advantages

- Convenient for non-traditional students
- Accessibility of courses not locally available
- Shared expertise among institutions
- Reduced travel, traffic

Table 7.4

In addition to making higher education more convenient to non-traditional students, DLT also enables students to take courses that are not offered anywhere near their residence. For example, entire curricula in occupational, respiratory and physical therapy have been extended to institutions in rural areas to provide practitioners for those areas. It is difficult for health care organizations to lure employees into many areas of this country. Therefore, those organizations

can benefit by training practitioners who already live in the area and are likely to stay. A DLT program provides a reasonable solution to the problem, because the distant site does not need to create an entire program. Similarly, DLT has much potential for continuing education of practitioners. The expense incurred by DLT probably is much less than that involved with sending employees out of town for that purpose.

Educational institutions have much to gain by sharing the expertise of faculty among themselves. For example, if a program needs to add a course or units of instruction that demand special expertise, it would be more cost effective to use DLT to obtain that expertise, as opposed to adding faculty. It would be possible for cooperating programs to actually reduce the numbers or teaching load of faculty by using DLT to share teaching responsibilities. Finally, DLT positively affects the environment by sparing students the commute to classes. Although some on-campus activities always will be necessary, every automobile trip that is avoided by using DLT is less gasoline burned, pollutants produced and road-rage.

Table 7.5 lists four of the common forms of distance learning. Although all of these have demonstrated varying degrees of effectiveness, this chapter will focus on teleconference, videoconference and web-based instruction, because these currently achieving prominence in higher education. There is no convincing evidence, however, that these two media are any more effective than those which are less technologically based. Perhaps the electronic media are more appealing to the current generation of students and instructors.

Distance Learning Media

- Printed matter
- Teleconference
- Videoconference
- Web-based

Table 7.5

Teleconference

A teleconference is a live, interactive session between students and an instructor. This form of DLT has been in use for over twenty years, and is a relatively inexpensive medium. The only technology needed is a telephone, with conferencing arranged by the telephone company. Typically, the instructor furnishes students with instructional aids, like handouts or slides, prior to the session. Then, the students follow along with the aids while the instructor lectures over the telephone. The only advantage this medium has over an audiotape is that the students can ask questions during the session. Therefore, this is a potentially interactive platform. From the standpoint of an instructor, teleconferencing lacks one important dimension for interactivity; that is, visual contact with students. It is uncertain how important this is to learning, but it makes the teaching and learning experience less enjoyable for some.

Videoconference

A videoconference is a teleconference, with the addition of visual contact between instructors and students. This medium also is known as 'interactive television.' Although this is not a new

medium, it currently enjoys increased popularity due to increased pressure to offer courses by DLT, as well as greater availability of technology.

Requirements for Videoconference

Videoconferencing enables an instructor to present fully interactive instruction, using all kinds of instructional aids, to sites beyond the local classroom. Classrooms at distant sites are equipped with monitors, speakers, cameras and microphones. Therefore, student who are at those sites can be seen and heard by the instructor. The items listed in Table 7.6 are minimal videoconference hardware requirements, which must be present at each instructional site. A standard classroom unit occupies the space of a large video cart. Except for the addition of a computer and camera, the unit resembles a standard classroom video unit.

Videoconference Hardware

- Monitor
- Computer
- Camera(s)
- Microphones
- Communication link

Table 7.6

The communication link can be a satellite link or a telephone line. Because of the expense of satellite downlinks, phone lines are more common for regularly conducted classes. Importantly, the amount of information carried in a videoconference signal requires special transmission lines, which must be installed at all instructional sites. The technical description of these lines is beyond the scope of this manual. However, if the reader ever plans to conduct videoconferences, it is very important to understand that there are critical technical compatibility issues, like bandwidths and access types. Therefore, technical compatibility between all sites must be considered during planning.

In addition to equipment and connections, another issue may need to be settled before videoconference. That is, the political issue. When higher education courses from one institution are taught within the geographic area of another, legal conflicts can arise. The higher education coordinating boards of some states require transmitting institutions to seek permission from local ones. The best way to overcome this problem is to enlist the collaboration of the local institution in the instructional project. Generally, these turf issues are not problematic with non-degree instruction, like continuing education.

Implications for Instructors

Teaching by videoconference does not dictate any drastic changes in classroom behavior for most instructors. However, there are implications of the medium that should be taken into consideration. These are listed in Table 7.7. Personal appearance becomes an issue when the medium is video. For one thing, colors can be exaggerated by video; so, solid, stark colors like white, red, yellow or black should be avoided. Also, glittering jewelry should not be worn.

The hardware used in videoconferences is relatively inobtrusive. So, it is easy for instructors to forget that there is a class at remote sites. Instructors should remember to make eye contact and foster interactivity with all sites by speaking to individual students and encouraging questions.

Implications for Instructors

- Personal appearance- colors
- Eye contact
- Interactivity
- Restrict movement
- Mute portable microphones during breaks
- Plan visual aids
- Allow for equipment setup & testing
- Learn to operate equipment
- Anticipate technical problems

Many instructors habitually move about the classroom and pace during the course of a presentation. Although this does not need to cease, altogether, movement needs to be restricted. Some videoconference systems are equipped with cameras that will follow instructors; others can be preset to focus on multiple locations. Sudden movements need to be avoided, because the slow speed of signal transmission speed will make the movements appear bizarre. Another consideration regarding movement is whether the instructor stays within range and direction of a fixed microphone. Finally, with respect to microphones, the instructor who uses a portable microphone must be sure to turn it off when away from the classroom. Those who have seen the movie, 'Naked Gun,' will relate to the scene where the character takes the portable microphone into the men's room, resulting in embarrassment to all concerned. This could easily happen in real-life.

Any kind of visual aid used in the regular classroom can also be used with a videoconference. But, the audiovisual restrictions need to be taken into account. All components of visual aids, especially text, must be large enough to clearly view on monitors. The cameras and visual aids must be planned in advance, to ensure viewability of all visual aids for all students. This may preclude using the chalkboard, unless the camera is preset to focus on it.

The hourly wage of an audiovisual technician would significantly increase the expense of a videoconference. So, the instructor usually is the person who must set up and test the hardware before class. After a brief training session, most people find the equipment relatively easy to operate, depending on the system.

Videoconferencing a class will add at least fifteen minutes to the class time for the instructor to prepare for class. In addition to checking the equipment for viewability of instructional aids, one also must check the connections to remote sites with a brief audiovisual contact with each site. There is preparation required at each end of the line. Therefore, more sites involve more time for setup and contact. When multiple sites are involved, an hour of setup time is commonly needed.

An important step in the preparation of the equipment is to ensure that the session is being videotaped with the local equipment. The purpose of this step is to create a backup tape, just in case there is a problem with the connection or equipment at a remote site. The tape can then be mailed to the site, so the students there have some experience of the class.

Problems With Videoconference

There are some common problems that accompany instruction by videoconference. Table 7.8 Lists some of these. Although there is the potential for interactivity, this seems to be seldom realized. One issue involves a tendency for an instructor to teach to the local class, at the expense of the distant sites. This is a natural response on the part of the instructor that must be overcome.

Videoconference- Problems

- Instructor preference for local students
- Inattention at distant sites
- Expense of technology
- Technology failure
- Examination security

Table 7.8

One strategy to solve this problem is to have the instructor teach in a studio, with no students present. This forces the instructor to treat all sites equally. Another strategy is to place the local videocamera and monitor in the midst of students there, increasing visual contact between the instructor and distant sites.

A second problem related to distant sites is that students seem to be more likely to become inattentive. Unless they are instructed otherwise, students will position themselves out of the view of the camera, and the instructor may have no control over the camera at the distant site. Despite the fact that the student population consists of adult learners, it seems that some degree of supervision at distant sites is warranted. It is very important to place instructional personnel on-site, to monitor students and ensure attendance and attentiveness. Several distance education efforts have failed for lack of instructors at distant sites.

Expense of the videoconference technology is a major issue. The hardware typically consists of units which are comprised of the components listed in Table 7.7. This list represents only the essential components. Additional hardware, such as document cameras and digital converters are desirable components. A complete unit is needed for each instructional site. Currently (1999), a complete system costs about $40,000. Desktop systems that cost less than $20,000 are available; but, these accommodate individuals or small classes, only.

Communication lines can represent considerable costs. The communications can proceed by either satellite or hard wire, which is usually a telephone line. Satellite linkage is very expensive. Therefore, for regular use, like for college courses, the telephone line is the communication link of choice. But, a standard telephone line is inadequate for videoconferencing because of the amount of information carried in a videoconference signal.

Therefore, the communication linkage requires installation of a special telephone line, which is not an exorbitant expense. Also, there are hourly charges to use the line, which can be quite expensive over long distance. In one instance, a hospital in Texas received a telephone bill for about $1800. for one videoconference, just because a student forgot to discontinue the

connection after a session. Someone at each site must assume responsibility for disconnecting the communication link at the end of class.

An important issue that all DLT courses need to address is that of examination security. Once exam security is breached, the instructor must assume that the examination is no longer usable, which creates an excessive amount of work. Various remedies to this problem have been tried. One remedy is to make all students travel to campus for examinations. If they are not too far away, this may not be a major inconvenience. Another remedy is to hire an exam proctor at the distant site. Although all security measures can be breached, these two approaches to the problem represent reasonable measures.

Web-Based Instruction

Web-based instruction (WBI) is a recent addition to the instructional technology array. Because of the rapid communications and information sources available on a desktop, the World Wide Web has tremendous potential for instructional applications. In fact, the vastness and complexity of the Web make it nearly impossible to conceive of all the possibilities. Furthermore, as the Web grows, and as computer hardware and software technology advances, WBI continues to undergo continuous rapid evolution.

Web Features

- Information sources
- Search capabilities
- Multimedia
- Interactivity
- Global
- Economical

Table 7.9

There are several outstanding features of the Web that make it a useful instructional medium (see Figure 7.9). The Web provides an unlimited amount of information on every conceivable subject. This information also is readily accessible, due to the search capabilities of the various Web browsers and worldwide standardization of Web search language. The kinds of information also vary tremendously. Besides text and graphics, audiovisual messages can be accessed and sometimes downloaded to one's own computer. Therefore, WBI has multimedia capabilities.

Depending on the signal traffic in the Network, communications via the Web usually are quite rapid. There have been many times when I have been able to email back and forth between Texas, London and Sweden within seconds, like an email conversation. Therefore, real time email interactivity is possible. Delayed interactivity, like regular email, more commonly occurs. For the time being, web usage is free. One needs a computer with a network card or modem, the appropriate wiring, and Internet address to use the Web. Home connection requires an Internet connection company, like America Online®, which involves a modest fee. Considering the usefulness of a computer system, all of this is an reasonable investment, particularly when balanced against the expense of automobile travel to attend class or search in the library.

One the other hand, there are some drawbacks and limitations to the Web, whether used for instruction or not. Some of these are listed in Table 7.10. Technical failure can cause a server, or an entire network to fail. This can occur at the worst possible times and can be frustrating for all concerned. Computer viruses that can damage or destroy computer hardware and software have been created by malicious individuals. These can easily find their way into computers of unwary, unprotected people. Even hoaxes that warn of viruses are disturbing.

Web Pitfalls

- Technical failure
- Viruses
- Privacy
- Security
- Misinformation

Table 7.10

Personal and professional privacy and security are additional concerns when connected to the Web. Any information that is transmitted over the Web can be circulated throughout the world. This is important when it comes to private affairs. Similarly, information that instructors want to secure, like tests, are nearly impossible to secure. Finally, the Web is equally powerful in spreading misinformation as it is in spreading information. Therefore, one should carefully consider the sources of any information that is of importance.

Requirements for WBI

A preceding section described the tools needed by the student in a WBI course. Although an instructor can conduct limited WBI using essentially the same hardware, it would not take advantage of all the features WBI should use. The instructor should have a web-server or access to one. Access to a server is preferable, because there will be a webmaster; someone with the necessary expertise to develop and supervise the website. The webmaster can reserve computer storage space and establish an address for the course.

In addition to the server, the instructor will need software to write the courseware. There are several Web authoring languages, like hypertext markup language (HTML) that one can to write courseware. Also, some word processing programs provide the option to save documents in HTML format. Although an authoring language likely will be necessary for some portions of a course, there are alternatives that facilitate development for the instructor.

The first alternative to an authoring language is an authoring tool, which is analogous to courseware authoring programs for CBI. Authoring tools provide a template and navigation tools for a course. Then, the instructor can just enter the subject matter, usually in the form of HTML, into the template. An example of an authoring tool is WebCT®, which was developed by the University of British Columbia. This is an easy authoring system to use, and is quite reasonable.

The second alternative has even greater appeal. There are commercial enterprises that exist to develop and maintain WBI courses for instructors and educational institutions. Then, the instructor merely provides course materials to the company, learns how to interact with the

Website for the course, and instructs by WBI. One company involved in this work is University Online Publishing®, which produces Web courseware for the University of Texas System.

Table 7.11 shows the components of a typical WBI course, although there are additional possibilities. The syllabus should include all of the information about the course, including critical dates; such as those for examinations and assignment deadlines. Student computer access and literacy should be stipulated as a requirement in the syllabus. The instructors are responsible for the course materials and content, but certainly are not responsible for teaching computer skills, nor are they responsible for hardware or software problems at the student's location. This may seem silly to mention, but this author had a student register for a web-based course who did not have regular access to a computer and did not know how to use one. Needless to say, this turned out to be a disastrous experience for both the instructor and the student.

WBI Components

- Student computer access and literacy.
- Syllabus
- Contact with instructor
- Chat room
- Presentations
- Assignments
- Email
- Glossary
- Resource Links

Table 7.11

A critical component of any web-based course is a requirement for regular contact with the instructor. Without this component, learners tend to disconnect from the instructional experience and frequently drop out. Similarly, regular contact with other students in the course should be required. In some courses, team assignments can be completed by students who have never seen one another and live great distances apart. To accomplish student participation and interaction, the syllabus can state minimal requirements for students to participate in chat room discussions.

Then, each unit of instruction should include all of the elements of a lesson plan. Presentations may include any and all elements of multimedia courseware. Early efforts consisted mostly of text-based lessons, web links, assignments, chat rooms and examinations. Current technology enables instructors to add audio presentations to lessons at minimal cost and effort. For example, both Microsoft Powerpoint® and Lotus Freelance® have capabilities for instructors to narrate presentations for the web. RealSlideshow® and RealPresenter®, produced by RealNetworks® permit similar capabilities and have the added feature of a multimedia player that is widely available on the Internet- RealPlayer®.

Media streaming is a technology that greatly increases the multimedia capabilities for WBI. Multimedia files that include audiovisual effects are extremely large. Considering that a single music CD may occupy 300-600 megabytes of memory, an hour of audiovisual presentation will occupy considerable memory. Since the speed at which information can be transmitted across a telephone line is very limited, it would take an inordinate amount of time to download such a presentation to a computer. **Media streaming offsets this problem by enabling a file to be**

played a portion at a time while it is accessed. Therefore, a computer does not need to wait for a large file to download in order to play it.

Assignments are another important component of a web-based course. These serve to engage the learner in applying the information and skills conveyed by the course. Assignments can be submitted by email to the instructor, who can evaluate the assignments and provide feedback by email, as well.

The glossary is an important tool for courses that use jargon or technical terms. The glossary clarified what the instructor means when using such terms. Resource links are another very useful tool for students. By embedding these links in courseware, an instructor can guide students to other websites that provide additional instructional resources. For example, a useful link for an education course would take students to ERIC®, where they could locate publications related to any aspect of education.

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CHAPTER SEVEN
STUDY QUESTIONS & EXERCISES

1. For each of the five general types of CBI courseware, describe one lesson that would use the courseware. The description should reflect the lesson content and a lesson goal.
2. Select, review and evaluate one web-based lesson, as assigned by the course instructor.
3. Describe the advantages and disadvantages of distance learning.
4. Describe the advantages and disadvantages associated with videoconference and WBI, respectively.
5. Describe four implications of videoconferencing for the instructor.
6. Describe the technical requirements to conduct videoconference and WBI, respectively.
7. Describe each of the components of a typical WBI course, and state the purpose for each.
8. Locate another WBI course on the Web and provide a brief, general description of it.

CHAPTER EIGHT

EVALUATION OF LEARNING AND INSTRUCTION

Learning Objectives:

? State the types and purposes for evaluations in education.
? Explain the rationale for criterion-referenced measures.
? Describe methods for evaluating acquisition of cognitive skills
? Compare written examination item types with respect to advantages and disadvantages.
? Describe procedure evaluation techniques and instruments
? Describe techniques and instruments used to evaluate professional behaviors.
? Explain the concepts of validity and reliability, as related to instructional evaluation.
? Describe methods to measure validity and reliability in evaluation of learning.
? Evaluate videotaped procedures and scenarios that portray professional behavior.
? Describe criteria and methods for evaluating performance of instructors in all settings.

The following terms are introduced in this chapter:

?

- Instructional evaluation
- Criterion-referenced evaluation
- Normative-referenced evaluation
- Subjective (testing)
- Reliability
- Internal reliability
- Performance evaluation form
- Item difficulty
- Test-retest reliability
- Discrimination index
- Inter-rater reliability
- Distractor
- Validity
- Stem

So far this text has described some of the theory and processes of instruction. Also, recall the purpose of instruction is to transfer skills to learners. Now, we will concern ourselves with the outcomes of instruction; that is, measurement of instructional effectiveness and efficiency. This process is called **evaluation, which is defined as a formal appraisal of quality of educational processes and outcomes.** Evaluation is a type of research design.

The hallmark of evaluation research is that it generates decisions. Related to instruction, the purpose of evaluation is to reach decisions about the efficacy of instructional programs and the achievement of students. In other words, instructional evaluation examines the quality of instruction and whether students acquire the skills prescribed by the curriculum.
So, we ask these two questions, 'Was the instruction adequate?' and 'Did the students pass?' As the reader will see, we also concern ourselves with the quality of the evaluations, themselves. For example, when we analyze the quality of an examination, we evaluate the evaluation. Furthermore, when we concern ourselves about the quality of those latter evaluations, we evaluate the evaluations of evaluations.

Evaluating Cognitive Skills

An earlier chapter differentiated between two major kinds of evaluation, formative and summative. Formative evaluation generates decisions about student progress, providing feedback for students to correct deficiencies or continue in the same direction. Summative evaluation generates final decisions about whether students have acquired the necessary skills to progress to the next level. Summative evaluations generally are generated from a number of sources. For example the summative evaluation for a course may be computed from several module examinations, quizzes, assignments and a final examination.

Evaluations can use two primary reference points to describe achievement. **First, evaluations may compare the scores of individuals with those of the median score, which is also the 50th percentile. This is called 'normative-referenced,' because the scores are compared with a reference point that has been selected as 'normal.'**

A normative-referenced test is constructed to differentiate among individuals with respect to achievement or aptitude. An example of norm-referenced testing is the Stanford-Binet (IQ) test. The normal score, or norm, on this test is 100. Therefore, persons who score significantly above 100 are considered above average, while those who score significantly below 100 are below average. Another example of a norm-referenced test is any test for which the scores are placed on a curve to determine grades. This method of grading ensures that a certain number of students will receive failing grades, even though they may have high scores. This is because there are students who scored even higher. Normative-referenced test have virtually no place in allied health curricula; so, we will confine the discussion here to criterion-referenced tests.

Out of necessity, allied health curricula are criterion-referenced, because we must ensure that graduates of these programs meet certain standards before they practice. It doesn't matter to employers or patients that a graduate dental hygienist scored better than 70% of the rest of examinees. What matters is that she/he has the required competencies to deliver patient care. Therefore, we set minimal standards of competence for our graduates.

The standards we use are the criteria against which student performances are compared to judge whether students are competent or not. **When individual test scores are compared with absolute criteria for performance, the test is criterion-based.** Competency-based curricula use criterion-based tests. A pharmacology examination for which the minimum passing score is 75% would be criterion-based.

There are several ways, both formal and informal, to evaluate skills. Table 8.1[1] lists some of these.. One can learn a lot about a person's cognitive skills in an informal conversation. In this

[1] Used with permission from: Chang DW, Elstun LJ, Jones AP. The Multiskilled Respiratory Therapist: A Competency-Based Approach 2000; FA Davis: Phila.

context, where there is no perceived threat, students tend to relax and volunteer more information than they might in a formal setting. Also, they may be very receptive to corrective feedback that is offered during conversation.

Oral Questioning and Examinations

Oral questioning , which can be either formal or informal, is another form of evaluation. We discussed the uses and techniques for oral questioning in Chapter Three. It is widely used for informal evaluation; however, oral examination as a formal evaluation method has declined in the United States.

Evaluating Cognitive Skills

- Conversation- evaluate informally, without perceived threat
- Oral questioning & examinations
- Student presentations
- Simulations
- Criterion-referenced tests

Table 8.1

Oral examinations lost their popularity for several reasons. Because they are labor-intense, oral examinations are very expensive. Customarily, several examiners allocate a significant amount of time for each examinee. Also, oral examinations are nearly impossible to standardize; so, their fairness can be questioned. Finally, the stress of the examination may prevent examinees from responding correctly, even when they know the answers. This can be a plus when we intend to evaluate students' performance under stress, but it can confound measurement of cognitive skills.

Student Presentations

Student presentations also are stressful, the student has more control over the situation than in oral examinations. Their presentations can demonstrate their command of a body of knowledge, as well as their abilities to organize, synthesize and evaluate. So, student presentations are used to demonstrate high-level cognitive skills. To evaluate the skills demonstrated by students' presentations, we use some kind of a rating form. Although some subjectivity remains in the ratings, a rating form standardizes the evaluations to some degree.

Simulations

Educators and credentialing agencies use simulations of various kinds to evaluate skills from all domains. We use simulations to place students in artificial situations, so we can test their skills in such things as information gathering, decision making and problem solving. Simulation examinations can take several forms. First, there is the branching logic type, which may be presented on printed matter or by computer. **A branching logic examination causes an examinee to proceed through different scenarios, or branches, in the simulation, depending on their decisions**.

An example of a branching logic simulation is that offered by the National Board for Respiratory Care, as part of the Advanced Practitioner's Examination. Each simulation begins with a scenario, then presents examinees with a menu of information they can request. The information gathering score is based on the appropriateness of their selections. For example, if an examinee chooses to recommend a test that is non-contributory and expensive or hazardous to perform, this is a bad choice, which will cost points. The information gathered by examinees leads them to another scenario, where they make a patient management decision. Examinees are evaluated on their decisions, which lead to new scenarios, information and decisions. These simulations include branches that can put the patient in various degrees of jeopardy or health.

Those who understand computers, especially programming, will recognize that the computer is an ideal medium for this type of testing. Furthermore, computerization of these exams can make the scores available instantly. In fact, there are many computer simulations available from commercial sources for students to prepare for credentialing examinations.

In addition to basic computerization, examinations have been developed that use the capabilities of multimedia, which present real-time audiovisual sequences to examinees. Some of these multimedia tests use laser videodiscs; others use CD-ROMs. For example, the American Heart Association and Actronics, Inc. developed videodisc-based courseware, including tests, for training in advanced cardiac life support (ACLS).

One of the criterion examinations for the ACLS course is Megacode, which puts the examinee in a leadership position during a life-threatening episode. The episode includes numerous scenarios which require information gathering and decision making on the part of the examinee. The simulation even applies stress to examinees with snide comments and reminders from a nurse when the examinee delays too long in responding to the situation.

Obviously, the average instructor has neither the time nor expertise to create simulations such as those described in the preceding paragraphs. This is a task for teams of experts in the subject matter, instructional design and technology. This type of test undergoes numerous formative evaluations and revisions before it is ready to distribute.

Criterion-Referenced Tests

Criterion-referenced tests are the mainstay for evaluation of cognitive skills. **These are also known as 'objective' tests. The hallmark of these tests is that the basis of judgment regarding response correctness comes from a source external to the scorer, who usually is the instructor. If the basis of judgment regarding correctness lies within the scorer (instructor), the test is subjectively scored**. Although there probably are appropriate circumstances for subjective

Test Items Types

- Essay
- Short answer
- Completion
- Illustration
- Matching
- True-false
- Multiple choice

Table 8.2

tests, competency-based curricula are not among them. Therefore, this discussion is confined to objective testing.

The appropriate term for what we usually call a test 'question,' is test 'item.' These can take several forms, which are listed in Table 8.2. The appropriate type of item to measure learning depends on the type of learning to be measured. Each type of item has its uses, strengths and weaknesses. These are discussed in the following paragraphs. Table 8.1 summarizes these strengths and weaknesses.

Essay Items

Essay test items are quite versatile and comprehensive in the levels of skills and subject matter types that can be evaluated. Although essays can elicit factual recall from learners, other item types are better for this, because they can be more easily scored. The essay item requires recall on the part of the examinee. Typically, essays are used to get learners to describe, explain, compare and contrast concepts and principles. Essay questions can be used in reference to audiovisual aids to elicit responses about structure, function and relationships.

Essay items require careful consideration, as well as talent, to construct well. A poorly-constructed item leaves the learner with confusion on how to respond. This can lead to difficulty in judging correct responses, which entails excessive subjectivity in scoring. Filibustering also is a problem with essay items. Frequently, when examinees don't know the answer or understand the question, they volunteer everything they know, even vaguely, on the subject. This can prolong the time to score the item.

Scoring essay items can be problematic. Handwriting can be hard to read. Instructors should stipulate that if a response cannot be read, it is incorrect. One way to circumvent this problem is to administer the exam in a computer laboratory, so examinees can use word-processors. In some cases, the correctness of an examinee's involves whether an item measures the desired cognitive skill or verbal communication skill.

Before administering the exam, a scoring key should be developed for the essay items. The key must include how many points to assign to items, including partial credit. As a rule of thumb, the higher the level of performance required, the more points. An item that requires evaluation should get more points than one that requires application, et cetera. So we would assign more points to a judgment than an explanation and even fewer points to a description. Ideally, another person also reviews the key. Objective scoring is encouraged by eliminating all identification of examinees from the essay items. Essay items cannot be scored by common scanners.

Short Answer

Short answer items are like 'mini-essays,' because, like essays, they require examinees to supply more than a word or number. Usually, a short answer response consists of a definition,

description or explanation, involving a sentence or two. Short answer items are excellent for measuring medium to high level cognitive skills. However, it can be difficult to determine whether examinees are performing at high levels, or whether they have simply memorized explanations, et cetera, without really understanding them. Short answer items can be easy and quick to construct, although good items require creativity on the part of the instructor. The items suffer from the same weaknesses of essays.

Illustration

An illustration item is one wherein the examinee creates or re-creates a visual representation. This may be a drawing of an organ or medical device. It could also be a model of principles, such as physical laws or psychologic paradigms. In terms of level or performance, an illustration resembles an essay item; but, illustrations use images where essays use words. Illustrations may be combined with essays. For instance, an item might require an examinee to draw a schematic of the heart, then explain how the valves work or what happens when the valves fail.

As with essays, illustrations can measure higher cognitive skills. However, it is also possible to measure only simple recall with them. Like essays and short answers, illustration items are easy and quick to construct; but scoring and assigning points can be problematic. As hand-writing confounds scoring essays, artistic talent confounds illustrations.

Completion

Completion items can take many forms. In its simplest form, it is a simple, fill-in-the-blanks. Therefore, fill-ins are recall items. Generally these are used to require examinees to recall and supply responses within sentences. However, fill-ins can be more complex. For instance, examinees can be presented with various types of illustrations, where they supply responses relating to structure or function of organic systems, medical devices, or schematics that represent physical or physiologic principles. Another type of fill-in requires examinees to supply information within tables or matrices. Matrices are particularly useful in measuring skills in demonstrating relationships between concepts.

Completion items are quite versatile. However, they should be reserved for subject matter that specifically call for such items. Simple fill-ins can be easy to construct; but, items that refer to illustrations should be carefully considered. It is important that illustrations used in fill-ins clearly show the items to be labeled as completion items. When requiring examinees to label actual organs or devices, it is extremely important that the entity they are supposed to recognize is clearly indicated. It is not difficult to assign points for completion items.

Matching

Matching items usually place columns of facts or concepts alongside lists of descriptors or labels. Matching items are good to demonstrate identification or classification behaviors; but

they are fairly limited in their usefulness. Matching items are fairly easy and quick to construct, as well as to score. A major problem associated with matching items can be guessing. Depending on the item construction, it is possible for an examinee to eliminate responses as they are used. This increases the chances for correct guesses on subsequent items. This problem can be circumvented by making one list longer than the other, permitting multiple use for responses.

True-false

A simple true-false item consists of a statement about subject matter, which the examinee identifies as true or false. Many instructors will try to make the items more of a challenge by presenting trickery within the passages, like using double negatives. No matter how hard the instructor makes the item, the examinee has a 50% chance of guessing correctly.

Multiple choice

The multiple-choice item is the item of choice for most educators and agencies that develop standardized tests. The main reasons for this include its versatility in measuring skills at all levels and for most kinds of subject matter. Multiple choice items are easy and quick to score. They can be scored by scanners. Multiple choice items enable measurement of a large variety of cognitive skills, at high levels of complexity. The major drawback of MC items is that they are difficult and time-consuming to construct well.

Table 8.3 Comparison of Test Item Types[2]

Item Type	Cognitive task/ level	Strengths	Weaknesses
Essay	Recall- all levels	Excellent for high cognitive levels; short construction time	Difficult & time consuming to score; handwriting, subjectivity; communication confounds response; assigning points; unscannable
Short answer	Recall- all levels	Variety of subject matter, including images; short construction time	
Completion (fill-in, supply)	Recall- all levels	Variety of subject matter, short construction time	Construction can be time-consuming, scoring time, handwriting, unscannable
Illustration (by examinee)	Recall- all levels	Short construction time; only item type for certain subject matter	Subjective & time consuming to score, artistry confounds responses, memorization, assigning points, unscannable
Matching	Recognition- knowledge	Short construction time; easy to score, assign points; scannable	Limited uses- mostly low-level skills; as examinee matches items, the chance of guessing correct answer increases.
True-false	Recognition- knowledge, comprehension	Short construction time, easy to score, assign points; scannable	There is a 50% chance of guessing the correct answer.
Multiple-choice	Recognition- all levels	Short scoring time; objectivity, assigning points, scannable	Difficult & time-consuming to construct

[2] Used with permission from: Chang DW, Elstun LJ, Jones AP. The Multiskilled Respiratory Therapist: A Competency-Based Approach 2000; FA Davis: Phila.

Written Test Construction

The purpose of an objective test is to measure the learners' attainment of the objectives. It is important that each item reflects a stated objective, at the predetermined level of performance. Therefore, to construct a test, one must begin by reviewing the objectives that the test intends to reflect. Table 8.4[3] lists the steps in constructing test items.

Constructing Test Items

- Identify objective to test with item
- Determine cognitive level
- Select type of item
- Write item
- Check item- level, content
- Revise as needed

Table 8.4

There should be at least one item, preferably two, for each objective. The performance demanded by each test item should reflect the cognitive level of the objective. It is unreasonable to test at a higher cognitive level than demanded by the objective. For example, an objective written at the knowledge level should be tested by an item that requires the same level. Such an item would require only recall or recognition cognitive skill.

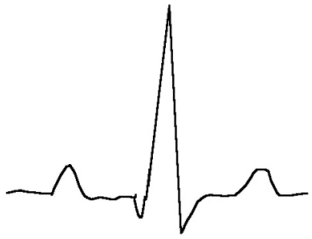
On the other hand, if an objective demands judgment on the part of the learner and one tests at a lower cognitive level, the test will not measure whether the desired objective has been attained. Generally, those who design credentialing examinations for health care professions aim at cognitive skills at the application level and above. So, schools that limit testing to lower cognitive levels do not prepare their graduates for credentialing.

From the objective, one then determines what behavior is required of the learner. Table 8.5 includes some examples of objectives with appropriate items of different types, with increasing levels of cognition. These examples include items from the knowledge level through judgment. Note that the final two items in Table 8.5 are essay items, which reflects appropriate use of that item type. Multiple-choice items also can be written for synthesis and evaluation, as well; but, they are more difficult to construct. Because of the versatility and pervasiveness of multiple-choice items the remainder of this discussion will focus on their construction.

Multiple-choice items come in three major forms. The most familiar type is the single-best response, where there is one best response in a set of possible responses. **The possible responses, which are incorrect, are called distractors. The portion of an item to which a response is made is called the stem.** For example, the stem in item #3 in Table 8.5 is ' Which locations for the positive lead would generate the ECG in Figure 1?' Whereas, responses 'A,' 'C,' and 'D' are distractors, as they do not represent the correct answer to the question in the stem.

[3] Used with permission from: Chang DW, Elstun LJ, Jones AP. The Multiskilled Respiratory Therapist: A Competency-Based Approach 2000; FA Davis: Phila.

Table 8.5 Relating Learning Objectives and Test Items

Objective	Test item
Identify the components of a normal electrocardiograph tracing. (knowledge)	1. Label the waves and intervals on the ECG in figure 
Explain the electrophysiologic events occurring at each point of an ECG. (comprehension)	2. Describe the electrical activity represented by the points on the ECG in Figure 1 marked: A. _____ B. _____
Relate ECG lead position to the shape of the ECG tracing. (application)	3. Which locations for the positive lead would generate the ECG in Figure 1? A. right leg C. right clavicle B. left leg D. left clavicle
Interpret arterial blood gas results. (analysis)	4. Results from a patient's arterial blood gases are as follow: pH = 7.34; PaCO2 = 47 mm Hg; PaO2 = 79 mm Hg; HCO3 = 25 mEq/L. These data represent a _____. A. normal acid-base balance B. metabolic acidemia C. respiratory acidemia D. metabolic alkalemia
Conduct patient assessments. (synthesis)	5. Given these data from a patient's medical history, physical examination and laboratory data, write a SOAP note, including all components.*
Determine the technical quality of a chest radiograph. (evaluation)	6. After reviewing the chest radiograph on the laboratory view screen, decide whether it is of adequate quality for interpretation. Defend your decision.* *data are not included here for brevity's sake.

Another form of multiple-choice item is the multiple true-false item, which consists of a stem and several possible responses, like a simple multiple-choice item. However, any combination of the possible responses may be correct and the examinee selects an answer from a set of responses representing these combinations. Item #3 in Table 8.5 could be converted to a multiple-multiple as shown in the example (See Table 8.6).

Currently, some of the examination items in the credentialing examinations administered by credentialing agencies are of the multiple-multiple type. Therefore, respiratory care educators commonly develop such items for their courses. There is some controversy over the effectiveness and fairness of these items in measuring achievement. Examinees sometimes find the format confusing. My opinion on this controversy is that the multiple-multiple is an effective and fair

item type, when constructed and used for appropriate subject matter. Such an item can evaluate learning of more information relating to a single objective than the simple multiple choice item.

Multiple Choice	**Multiple-choice (true-false**
3. Which locations for the positive lead would generate the ECG in Figure 1? a. right leg b. left leg c. right clavicle d. left clavicle	3. Which locations for a positive lead would generate the ECG in Figure 1? I. right leg II. left leg III. left axilla a. I, II only b. II, III only c. I, III only d. I, II, III

Table 8.6

The third general type of multiple choice item is called the 'situational set,' by the National Board for Respiratory Care. To construct this type of item, one first generates a scenario, which may include permutations of illustrations, data sets and graphs. Then multiple choice questions referring to the situation are written. Commonly, more than one test item will refer to the situation. These items are useful and effective in evaluating learning at high cognitive levels and on clinical subject matter. However, they are difficult and time-consuming to construct well. So, it would be a waste of effort to use situational items that evaluate lower-order learning, like knowledge and comprehension. These are more appropriately reserved to test at analysis, synthesis and evaluation levels.

After identifying the subject matter and level for evaluation, one generally begins construction of a test item by writing the item stem, which can take several forms. The stem may take the form of a question, such as in item #3 in Table 8.5. Another form the stem may take can of the completion type, which includes a space that the a correct answer among the responses will appropriately complete the sentence. Item #4 in Table 8.5 exemplifies a completion type.

Situational stems refer to supplemental materials, like data, graphs, images and scenarios. When constructing items that refer to illustrations or graphs, one should ensure that the reference is accurate and easily discerned by the examinee. This can be accomplished by numbering the referenced materials and including the reference within the item, as shown in item #1 in Table 8.5. Care should be taken to avoid voluminous or extraneous information in stems and scenarios, because such practices increase test-taking time and create unfair distraction within the test.

Table 8.7 lists some guidelines for writing test item stems. Precision and clarity are of utmost importance when writing item stems. Long sentences should be avoided and extraneous information excluded. Stems should be written with simple sentence structure with level-appropriate vocabulary and symbols. Highly educated instructors sometimes make incorrect assumptions regarding the literacy of the examinees. Furthermore, for many students, English is their second language.

When a stem includes qualifiers, such as 'NEVER,' that qualifier should be highlighted in some respect to alert the examinee of its significance. One should avoid negative phrases in stems by alternate phrases. For instance, one can phrase a stem to use the word 'EXCEPT,' rather than 'NOT.' For example, rather than use the phrase, 'which of the following is NOT.....,' it would be preferable to use the phrase, 'all of the following EXCEPT.....'

Formulation of the individual options or possible responses follow the same general guidelines as for stems, with a few additional considerations. One should keep in mind that each option should be a plausible correct answer. Options that are implausible increase the chance for a correct guess for the item, which reduces the effectiveness of the item to measure learning. Indeed, an instructor can manipulate item options to make a test easy, but that defeats the purpose of a test, which is to measure learning. The sentence structure or length should not distinguish the correct response from the distractors. Finally, the correct response should be the accurate, best answer.

Guidelines for Item Stems

- Use simple sentence structure
- Use level- appropriate vocabulary
- Avoid extraneous information
- Underline, capitalize or bold-face qualifiers
- Never use double negative
- combinations
- Avoid negative phrases

Table 8.7

After writing the test items, each one should be critically appraised, first, for a direct, accurate correspondence to a learning objective; then, for readability, clarity and content. It is solid practice to have a peer, who is familiar with the content, read and appraise the test. This is mainly because people tend to infer different meanings, and each item should mean the same thing to as many people as possible.

When assembling items into a test; for instance, a module test, each stated objective should be tested. The total score on the test should reflect the learners' mastery over the content of the module. Conversely, each item missed should reflect a specific area of weakness in instruction or learning that requires remediation.

Evaluating Procedural Skills

The discussion in Chapter Three asserted that performance of a procedure required skills from all three domains. The learners must have knowledge of certain facts and concepts; they must be able to physically manipulate objects and/or patients; finally, they must have certain personal characteristics enabling them to work under clinical conditions.

The criterion test for acquisition of procedural skill is the learner's performance of that procedure, under clinical conditions, at a given level of accuracy (perfection). However, there are intermediary steps to ensure learners' readiness for the final evaluation. First, we can evaluate whether learner has the requisite cognitive skills. We can determine cognitive readiness with oral

or written examinations that require learners to recall the steps, the necessary equipment, pitfalls, et cetera. for the procedure. A learner who does not know the steps of a procedure cannot do it, and requires remediation of cognitive skills before going on the procedure.

The discussion in Chapter Three also discriminated between simple and complex procedures. Complex procedures, being those which contained simple ones. To cite an example, all clinical procedures include hand washing. So, learner should have been taught and evaluated hand washing procedure before going on to complex ones.

Functions of PEFs

- Guide lesson planning for instructors
- Provide study guide for learners
- Provide criteria for evaluations
- Reduce subjectivity in evaluation- increase inter-rater reliability

Table 8.8

Clinical procedures often involve various medical devices. So, familiarity with the devices and their operation also must precede criterion evaluation. Learners who have not had adequate exposure and practice in operating the required devices are not prepared for criterion evaluations. This exposure and practice with devices usually starts in a college laboratory setting under contrived circumstances, although the expense of some equipment precludes this.

Criterion evaluation of procedural skill performance should use a testing instrument as a guide. The instrument usually is a checklist, which is based on a task analysis of the procedure, known as a **Procedure Evaluation Form (PEF)**. Examples of PEFs are in the appendix to this chapter. A PEF lists each critical step of the procedure, along with criteria for its satisfactory completion. PEFs serve several purposes, as shown in Table 8.8.

Evaluating Procedures- Important Points

- Learner must have adequate opportunity to practice, with corrective feedback before undergoing summation
- Each step must be done correctly; e.g.: Determine patient ID==> check wrist band Position patient==> correct technique
- Procedure evaluation often followed by oral questioning
- Passing score ==> mastery ==> learners perform with less supervision==> major responsibility for instructors

Table 8.9

Table 8.9 lists some of important points on evaluating procedures. As a learner proceeds through a procedure, the evaluator observes them, while indicating on the PEF whether each step has been completed. A passing score on a clinical procedure requires all critical steps to be satisfactorily completed. Successful completion of a procedure often represents a landmark in a student's progress. Completion of a procedure in a laboratory enables students to practice on patients. Completion of the same procedure on a patient may permit the student to perform that same procedure without supervision. This is a necessary progression, by which students are 'weaned' from instructors.

Evaluating Professional Behavior/Affect

Chapter Three describe professional behaviors, including the various categories. These are among the most difficult to evaluate objectively. These also are the most difficult skills to impart to students, and the ones that cause the most trouble when they are not acquired. Consider a student who is brilliant in the classroom, excellent with equipment in the laboratory and clinically capable of all procedures. Is this student competent if she or he is also dishonest, rude to patients, consistently late or absent, unable to communicate or lazy? Therefore, evaluation of professional behavioral skills are just as important as those others.

Data Sources for Behavior Evaluation

- Observation and normal conversation
- Clinical conferences
- Learner presentations
- Critical incidents (episodes)

Table 8.10

Evaluation of professional behaviors should be accomplished by several means. Potential sources of these data are listed in Table 8.10. There are several types of standard instruments to use in evaluations. These are listed in Table 8.11. Examples of instruments to evaluate professional behavior are in the appendix to this chapter.

Instructors, especially those in the clinical setting , must provide timely, concise, accurate data regarding students' behavior. It is difficult to declare a student incompetent for failing to behave properly, especially when they are passing everything else. For the protection of the patients and the legal status of the school and instructors, good documentation is a necessity. Unfortunately, it is uncommon for hospital practitioners to give poor evaluations, even when they are deserved.

Professional Behavior Evaluation Instruments

- Anecdotal reports- noteworthy information to be considered during evaluations
- Critical episode reports- information denoting outstanding or seriously deficient competency
- Behavior rating scales
  -Short form- formative
  -Long form- summative

Table 8.11

VALIDATING EVALUATION INSTRUMENTS

Validity

We administer tests to students with the purpose of measuring learning achievement. If we measure that achievement with a bad test, we have no way of knowing whether learning has occurred, or the degree to which it has occurred. Therefore, we must have some means at hand to evaluate our evaluation

Valid- the instrument measures what it intends to measure. It is accurate

Reliable- the instrument measures consistently, regardless of context. It is precise.

Table 8.12

instruments. A test must meet two conditions to measure achievement; it must be: (1) valid and (2) reliable. Refer to Table 8.12.

A valid instrument measures what it is supposed to. Measuring learning with an invalid instrument would be analogous to measuring the distance between two points with an avoirdupois scale, which measures weight. There are various types of validity, which are listed in Table 8.13. For criterion-referenced tests, the most important types are content and face validity.

Types of Validity

- Content validity- pertinence of measurement to domain
- Face validity- verbal accuracy, says what it means
- Concurrent validity- agreement with another test intended to measure the same thing.
- Predictive validity- ability of a measurement to predict future performance.
- Construct validity- ability of a measurement to assess a general trait.

Table 8.13

Content validity of a test relates to its measurement of the content of the intended learning, including the level of learning. For example, if an instructional objective is to interpret a white blood count, the items that test the objective should include elements of the WBC, with required responses that require analysis. A test that is truly based on instructional objectives is content-valid. Although content validity probably is the most important type of validity for objective, criterion-referenced test, there are other types of validity that are important for other kinds of measurement instruments; like those for professional behaviors.

Reliability

Reliability refers to the capability of an instrument to measure consistently. A reliable instrument yields similar results, regardless of the context or time of measurement. Measuring learning with an unreliable instrument is like measuring a board with a rubber ruler. **If an instrument is not reliable, it cannot be valid, either; because it won't consistently measure anything.**

Types of Reliability

- Stability- test-retest, the same test is used on more than one occasion, yielding similar results
- Internal reliability- the items of the test measure the same thing.
- Inter-rater reliability- different examiners yield similar results

Table 8.14

As with validity, there also are various types of reliability. The types of reliability important to instruction. These are listed in Table 8.14. Different types of reliability are more relevant to certain instruments than others. Stability and internal reliability are more important for written cognitive tests. On the other hand, inter-rater reliability is more important for instruments like PEFs, which are more subject to examiner influence.

Evaluating Written Tests

Besides those aforementioned methods for evaluating instructional instruments, there are methods for evaluating individual items in written tests. These are called item analysis methods, some of which are shown in Table 8.15. Most of these analyses are readily available in psychometric software, like Parscore®, which can be used in conjunction with test scanners, like Scantrons®. However, the reader is cautioned that these measures were created to evaluate normative-referenced measures; so, they should be interpreted with caution for criterion-referenced measures.

The biserial correlation identifies items that are inconsistent with the rest of the test. It is important if a module examination intends to measure achievement of a criterion objective. However, if an item intends to measure something that is generally unrelated, it may not correlate well. Good correlation is better than 0.7.

The name, difficulty level, implies its meaning. An item that is scored correct for high percentages of students may be interpreted as too easy. But we must keep in mind that we administer criterion-referenced tests, and we want our students to answer all of the items correctly. This makes it hard for us to tell if a test really measures achievement, or whether the distractors and non-distractors are too obvious. Similarly, those distractors that are never or seldom selected by students may be too obvious to reflect achievement. Regardless, these variables are worth examination.

The discrimination index reflects the tendency of an item to discriminate between those students who do well on the overall test, versus those who do not. Generally, an item that discriminates at greater than 50% is a good one. **A good test item will discriminate between those who have attained an objective and those who have not**. Similarly, good test items no not have non-distractors as possible responses. All possible responses should be plausible.

However, the same advisement about criterion-referenced measure applies to this parameter. Importantly, any item that is missed by more than 80% of a class questionable and considered for omission from scoring. Possibly, an item that is missed by such a majority was not well-constructed or the subject matter related to the material was not

Item Analysis

- Biserial correlation- correlation between correct responses and total score
- Difficulty level- % students finding the correct answer
- Non-distractors- those not selected by learners
- Discrimination index = % (top 27%) - %(bottom 27%)

Example:
100 students took an exam. Of top 27 students, 80% found the correct answer of bottom 27 students, 20% found the correct answer ==>
discrimination index = .80-.20 = . 60

Table 8.15

adequately taught. Of course, this also could indicate that 80% of the class did not exert any effort into the learning task.

Evaluating Performance Evaluation Forms

The parameters that influence the validity of PEFs appear in Table 8.16. Of utmost importance is content validity, which determines the degree to which the PEF reflects correct performance of the procedure. Other attributes of PEFs that are important include face validity, inter-rater reliability and ease of use. That is, whether the instrument is difficult to use under the prescribed conditions.

Evaluating PEFs

- Content validity
- Face validity
- Inter-rater reliability
- Ease of use

Table 8.16

Evaluating Professional Behavior Checklists

Behavior checklists are difficult to create, as well as to validate. We are interested in measuring a person's tendencies to behave along certain lines that are sometimes, 'fuzzy.' The variables that enter into the validity of a behavior checklist appear in Table 8.17. The most problematic evaluation parameters are construct validity and inter-rater reliability. Construct validity is difficult, because we attempt to measure a tendency to behave, with a written item.

Inter-rater reliability is difficult to achieve for an instrument, because of personality differences among raters that influence their perceptions and interactions with students. When students are evaluated by one instructor in a direction that strongly disagrees with others, it represents a situation worth investigation. Finally, it is important that such an instrument is easy to use. If a behavior checklist takes more than a few minutes to complete, clinical instructors tend to complete it without really reading it.

Evaluation of Behavior Checklists

- Face validity
- Construct validity
- Inter-rater reliability
- Ease of use

Table 8.17

EVALUATING INSTRUCTION

Effectiveness & Efficiency

For a given module, unit or course instructional effectiveness is measured in terms of learning achievement, which is measured by the exit level scores of students. If students meet the instructional objectives, the instruction was effective. We measure instructional efficiency with the time required to meet those objectives. Instruction that promotes achievement of objectives in

less time is more efficient. This is important when evaluating instructional media because some may be equally effective, but more or less efficient.

Student Evaluations

Students are an important source of information regarding the quality of instruction delivered by specific courses and instructors, as well. Although students are not always informed of the comparable merits of various instructional strategies, they can provide valuable insight into requirements for improvement of courses. They can inform us as to their perception of the appropriateness of things like the quantity of material, the pace of instruction, the textbook and instructional aids.

Personal likes and dislikes commonly enter into student evaluations of courses and instructors. But, consistent comments regarding an instructor's strategies and behavior can indicate traits of an instructor that may interfere with learning. Robert Mager (1984) pointed out that an instructor should deliver instruction on a given subject in a manner such that students like it at least as much as they did when they started. The appendix to this chapter includes an example of an instrument for students to evaluate instruction for a unit of preceptor training.

Peer Evaluations

Colleagues also can serve as important sources of information regarding instructional efficacy. Although we may hesitate to have colleagues sit in on classes, they can evaluate our course materials. As I pointed out earlier, it's a good idea to have colleagues review our examinations for readability and appropriateness of content. They could also provide valuable feedback by reviewing course syllabi, instructional aids and lecture outlines.

Graduate Success

For allied health educational programs, the ultimate measure of instructional effectiveness probably success of its graduates. Sources of information for graduate success include things like scores on credentialing examinations, as well as reports from graduates and their employers regarding job performance. Although these better reflect the overall curriculum of a program, consistent areas of weakness can point to deficiencies in individual courses and instructors.

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CHAPTER EIGHT
STUDY QUESTIONS & EXERCISES

1. Explain why allied health instructors should use criterion-referenced, as opposed to normative-referenced evaluation scales.
2. Other than written examinations, describe two techniques to evaluate cognitive skills.
3. List four written examination item types and state the strengths and weaknesses for each.
4. Explain the rationale for using performance evaluation forms to evaluate procedure performance.
5. Explain the rationale for using checklists to evaluate professional behavior.
6. Use a performance evaluation form to evaluate a person's performance of a procedure, either in a clinical or laboratory setting.
7. Explain the importance of validity to evaluation instruments.
8. Explain the importance of reliability to evaluation instruments.
9. Refer to the list of behavioral objectives below. Construct one test item for each objective. The item should be the best type for the objective, and must be on of these types: essay, multiple-choice, short answer, fill-in.
    a. Describe the factors that generally influence selection among instructional methods.
    b. Describe the advantages and disadvantages of the common instructional platforms.
    c. Identify the primary structures involved with memory.
    d. Describe the processes of encoding and retrieval.
    e. Describe the importance of learning transfer.

Appendix 8.1
Patient Communication Performance Evaluation

Criterion Behavior	Yes	No
1. Was concise, to-the point	___	___
2. Spoke clearly	___	___
3. Used correct terms	___	___
4. Used appropriate level of terms	___	___
5. Made eye contact with patient	___	___
6. Took time to listen	___	___
7. Asked questions of patient	___	___
8. Took time to ensure patient understood	___	___

Overall performance: ___Satisfactory ___Unsatisfactory

Criterion: Satisfactory performance requires a **"YES"** for all items

Comments:

Appendix 8.2
Vital Signs Performance Evaluation

Criterion Behavior	Yes	No
1. Washed hands	___	___
2. Checked medical record	___	___
3. Observed patient privacy	___	___
4. Observed infection control procedures	___	___
5. Identified patient	___	___
6. Introduced self, department	___	___
7. Explained procedure	___	___
8. Confirmed patient understanding	___	___
9. Positioned patient	___	___
10. Palpated artery	___	___
11. Counted pulse for 1 minute	___	___
12. Counted respiratory rate for 1 minute	___	___
13. Repositioned patient	___	___
14. Recorded data in patient record	___	___
15. Notified appropriate personnel	___	___

Overall performance: ___Satisfactory ___Unsatisfactory

Satisfactory performance requires a **"YES"** response for ALL items.

Comments:

CHAPTER NINE

INSTRUCTIONAL PROBLEMS

Learning Objectives:

- Describe the problems involving student motivation.
- List and explain Keller's strategies for motivating students.
- Describe problems associated with physical disabilities among learners.
- Describe problems associated with teaching learners with the following characteristics:
  - -illiteracy
  - -audiovisual sensory loss
  - -non-English speaking
  - -aphasia
- Describe solutions to problems associated with teaching learners with characteristics previously listed.

Teaching is a creative undertaking that is often made more interesting by encounters with any of a number of possible barriers to instruction. Although these barriers tend to be frustrating, they can also be regarded as challenges for the instructor to accept, endure and sometimes prevail over. Such encounters are opportunities for instructors to exercise their creative talents to solve real-life problems.

This section is about some of the more common problems encountered by allied health personnel as they engage in instruction. Herein, I describe some of these problems, as well as plausible solutions. I caution the reader that no guarantees come with these solutions. Also, the readers may have their own, even better, solutions.

STUDENT MOTIVATION

The first thing the reader needs to understand about motivation is that it is simply a matter of personal choice. That is, a person who is motivated, chooses to behave in a certain manner. When students are motivated to learn, they attend classes, complete assignments and study.

Motivation is an instructional problem that can be very difficult to face, because we value our professional practice very much, and it dismays us to realize that some of our students do not have the commitment to learning as befits a professional. That is, we expect our students to view learning from the viewpoint of adults, who have been characterized as internally motivated. Operating under the assumption that students are adults, then, an instructor does not need to motivate students, he/she just needs to avoid demotivating them.

Although we cannot imbue professional attitudes and values in all of our students, there are

strategies to increase the odds of their learning from instruction. We can appeal directly to the affective dimensions of students through role-modeling, simulations, discussions. We can apply negative reinforcements, as well.

Motivation becomes an even greater problem when we attempt to deliver instruction without benefit of a charismatic orator in the classroom, who can read faces and minds, then adapt instruction to motivate the most resistant students. Computer courseware, which usually has the charisma of an anvil, is a medium that can be quite demotivating. For media like CBI courseware to stand alone, they must engage both the affective and the cognitive domains of the learner. If the affect of learners is not engaged, they may dislike the lesson so much that they quit trying.

ARCS Model for Motivation

- Attention- gaining and maintaining
- Relevance- perception by the learner
- Confidence- 'can do' beliefs
- Satisfaction- sense of gain from learning

Table 9.1

Fortunately, there are ways to include motivational features in the design of instruction, regardless of the medium. The design must engage both the affective and the cognitive domains of the learner. We will explore a model to include motivational strategies in the design of instruction. The model comes from an expert in the field, John M. Keller. His model is called the 'ARCS' model, which is an acronym (see Table 9.1).

Attention

The first component of the model is that of attention gaining and maintaining. Remember that gaining attention means to get the student to look at, or listen to a message; whereas, maintaining attention means to keep students focused on instructional messages and select them for processing. Table 9.2 shows Keller's strategies for attention.

Strategies for Attention

- Novel, incongruous, paradoxical events
- Anecdotes to arouse emotional interest
- Opportunity to learn more
- Analogies to make the strange familiar, vice-versa
- Guide students to question generation, inquiry

Table 9.2

Strategies directed at gaining and maintaining attention are an interesting mix. It is important to realize that some of these can be overdone. When overdone, they can actually demotivate. For instance, attention can be gained by presenting students with the unexpected; things that they have not thought of before, or that run contrary to their present understanding. These strategies gain attention by arousing curiosity in students. Presenting information that runs counter to present beliefs causes a phenomenon known as 'cognitive dissonance,' the sensation that something just isn't right. Cognitive dissonance stimulates a need for closure by resolving the problem.

Emotional interest is yet another dimension of a student's makeup. One can gain and maintain attention by getting a student emotionally involved in subject matter. In the health sciences this is can be done by telling 'war stories,' or anecdotes, that relate to the human dimension of health care. One can tell students of situations in which patients were injured because of mistakes made by clinicians, or situations in which insightful actions on the part of clinicians averted disaster. For example, a laboratory instructor might tell of an error in conducting an examination that led to a wrong diagnosis and loss of an organ.

Opportunity to learn is an effective motivator in many instructional situations. When students are partially interested, we can increase their interest by showing them that they have yet more to learn about a subject. If they know very little about a subject, we can show that we can open new vistas for them. Another strategy is to present analogies that make things that are familiar seem strange, and vice-versa. For example, we could compare the cardiovascular system to the fluidic of an oil drilling rig, which is a likely comparison. Or, we could liken spontaneous breathing to the operation of an iron lung, which is another likely comparison.

Among the most important accomplishments for instructors is to arouse them to question subject matter and to inquire into its veracity and accuracy. This is a special form of curiosity. Although previous strategies for attention arouse curiosity, it is of a different type. Keller refers to the two types of curiosity as 'perceptual,' and 'epistemic.' Where some attention gaining strategies will arouse perception, which involves relatively shallow processing, others arouse epistemic curiosity, which involves deep, semantic processing (remember shallow, vs. deep processing?). Another way to look at the comparison is to think of epistemic processing as more intellectual, or involving the search for greater understanding.

One of the best things an instructor can do for students is to stimulate epistemic curiosity, because it tends to be a self-perpetuating process. Once started, the inquiry process tends to generate even more questions, which stimulate more inquiry. Instructional models that have sought to generate such inquiry are discovery learning, which was a public school model from the sixties, and problem-based learning, a current modality.

A general process to stimulate inquiry involve confronting students with some kind of loosely defined problem, then mentoring them as they seek data to solve the problem, develop hypotheses, generate and test possible solutions, then arrive at conclusions. Specifically, an instructor could provide students with general information on a real or simulated patient, then guide them as they inquire into the patient and attempt to solve clinical problems. There are many ways to develop instruction aimed at stimulating inquiry and problem-solving for all of our instructional settings: Classroom, teaching laboratory and clinic. However, , students often find this form of instruction uncomfortable.

Relevance

Relevance of instruction refers to the perceived likelihood that acquiring a skill will result in some kind of personal gratification; such as satisfying a basic need, motive or value. Relevance for the material motivates students by answering the question, 'why learn this material, or what is in it for me?' Generally, instruction that integrates the goals of students with the goals of instruction establishes relevance. A list of strategies to increase relevance appears in Table 9.3.

Providing students with opportunities to achieve excellence can motivate them by demonstrating that they can gain personal satisfaction through their own efforts in learning. There are many students to whom examination and course grades mean more than all of the knowledge in the world. On the face of it, this may seem undesirable; but when course and examination grades truly reflect achievement, grades can be effective motivators. The worst-case motivational scenario is a student who cares only for a 'C' grade to pass a course and doesn't care about acquiring any skills.

Strategies for Relevance

- Provide opportunity to achieve excellence
- Provide opportunity for choice, responsibility, influence
- Support trust and cooperative interaction

Table 9.3

Similarly, instruction that empowers students is likely to motivate. One can empower students by giving them choices over their instruction that are tied to responsibilities on their own part. It is important for students, especially adults, to know that they have a role in shaping their curricula and instruction; that their opinions and efforts are meaningful.

Specific examples include giving them a voice in program affairs, acknowledging their ideas and accommodating their collective needs, when feasible. Empowerment can involve something as simple as rescheduling an examination in response to students' requests. This can also result in developing trust and cooperativeness in the instructional setting, which also are motivating.

Confidence

Confidence is about students' perceptions of their likelihood for success. Students who have low expectations for success are be less likely to try, because they feel defeated from the start. Therefore, efforts to motivate students should include building and maintaining their confidence. Strategies to increase students' confidence appear in Table 9.4.

Strategies for Confidence

- Provide experience with success
- Clarify requirements for success
- Show that student has control over success
- Show connection between success, effort, ability

Table 9.4

A goal in motivation is to ensure that the learner has the belief that success is probable, and that it is worthwhile. This concept also is called 'expectation,' and has been studied in social sciences as 'expectancy theory.' In the framework of expectancy theory, the force (F) on a person to decide in a given direction is some function of both the probability (P) that the decision will result in a certain outcome and the desirability, or valence (V) of that outcome (see Table 9.5). This is a useful model to use when examining the confidence aspect of student motivation, because expectations largely influence confidence.

Expectancy Theory

The force (F) on a person to choose in a given direction is some function of their perceived probability (P) that the choice will result in a given outcome, the perception that the primary outcome will lead to a secondary outcome (I = instrumentality) and the value (V) of valence if that outcome.

Table 9.5

People who have failed at every attempted academic endeavor have good reason to lack confidence in their academic prospects. Furthermore, confidence in the prospects for future academic efforts will be non-existent, unless they happens to be delusional. Therefore, instructors ought to provide students experience with success to enforce their expectations for further success. Instructors can accomplish this by making the first examination of the semester fairly easy. Also, we can support confidence on examinations by locating the easier items at the beginning. These are reasonable efforts on the part of instructors. However, one should not compromise academic standards to give students false confidence.

Once students are aware that they can succeed in achieving worthy goals, there is a need to further sustain their expectations. Clear instructional objectives are important in this respect, so students know what is expected of them; that is, the requirements for success. They should perceive these as achievable and instrumental to their own goals.

It also is important for students to believe that they have some control over their success. When their efforts are not rewarded with indications of achievement, they will likely lose confidence. Although this is only good instructional practice, when we base our evaluations on the instructional objectives, students know that they have control over success by doing what is necessary to reach the objectives.

Furthermore, when instructors consistently base evaluations on objectives, success clearly results from student ability and effort. Therefore, one can see that clear instructional objectives, coupled with fair, objective evaluations of achievement, play a major role in motivating students. Conversely, lack of clear objectives and unfair evaluations can wreck confidence and compromise achievement.

Satisfaction

Satisfaction is the final component in the Keller model. This involves providing the learner with a sense that the outcomes of their efforts to learn are consistent with their expected outcomes, and the sense that this success was contingent on their own efforts. The general idea is that students are further motivated when their work produced results that make them feel good.

Strategies to support satisfaction include rewarding learners with things that are endogenous, or related, to the task, rather than those which are not. An example of an exogenous, or unrelated reward would be things like tokens, money or food. These are not related to learning in health professions. Endogenous rewards involve things like informing them that they have reached closure on a given skill and advancing them to another level. For example, we reward a student who successfully performs a procedure in the teaching laboratory by telling them that they have completed that phase of instruction and are ready to perform the procedure on real patients in the clinic.

Strategies for Satisfaction

- Task endogenous rewards
- Unexpected, exogenous, non-contingent rewards
- Verbal praise, informative feedback
- Motivating feedback
- Corrective feedback

Table 9.6

Notwithstanding, exogenous rewards have their place in instruction, too. Research has shown that when learners are rewarded, at random, with tokens that represent achievement, they tend to increase their efforts. This kind of reward seems to have its greatest effects on learning skills that tend to be tedious or boring. A plausible scenario would be an instructor commending a student for trying to answer a question, whether they found the correct result or not.

One of the most important things an instructor can do is to give students timely, appropriate feedback on their work. Feedback can be motivating, informative or corrective. All of these are appropriate for given circumstances. Verbal praise for performance is an important way to reward performance. This praise is more effective when the instructor informs the student of the reason for the praise. This is informative feedback, which also is a type of motivating feedback. For example, an instructor might say to a student, 'You did a great job on that assignment. You followed the instructions, and went above and beyond by going to MEDLINE and finding some additional research on the subject.'

Corrective feedback is formative evaluation. It intends to provide the student with information about what they need to do to improve their performance. Corrective feedback is hard to give without having some demoralizing and demotivating effects, as well. It is probably best to praise on the performance immediately after the student's completion of the task, then advise them of corrective actions some time later. It is easy to overdo it with motivational efforts, and overdoing it can have negative consequences. For students who are internally motivated, some motivational efforts may be a waste of time, and they could demotivate them.

PROBLEMS RELATED TO PROFESSIONAL BEHAVIOR

This section deals with some of the most difficult problems faced by instructors. Professional conduct is rather ill-defined, and it is easier to identify what is unprofessional than it is to say what is professional. Most professionals would consider the behavior of the student described in Table 9.7 as unprofessional. We have already looked at methods for teaching such conduct in chapter three, and evaluating it in chapter seven. The main problem lies in what to do about it when students fail to measure up in this area.

On the face of it, we ought to summarily dismiss students who consistently or blatantly conduct themselves unprofessionally. However, the present state of the legal system makes this unwise. While lawyers and judges will generally stay away from academic dismissals, they look differently at dismissals due to charges of misconduct. This has caused educational administrators to err on the side of caution in this regard. Therefore, faculty are often placed in uncomfortable and frustrating situations.

Sociopathic Student†

Our program faculty are presently dealing with a student with what we consider an "anti-social" personality. The characteristics of this behavior pattern are:

ss, as indicated by repeated lying, conning others for personal profit or pleasure.
or failure to plan ahead.
nd aggressiveness.
irresponsibility, as indicated by repeated failure to have consistent study, classroom or clinical behavior.
norse, as indicated by being indifferent to or rationalizing non-conformance to rules/policies.

He is the perfect "victim" in all dealings with the program. All his problems are because the faculty doesn't like him or he never received a syllabus or student handbook. He couldn't remember that absences/tardiness were part of his grading in clinicals, etc. He is presently starting to appeal a failing grade in clinicals because he did not agree with our absence/tardiness policy. Not because we counted more than the actual number of absences/tardies but because he feels that he had a good reason for his 7 absences/tardies within a 12 week period.

Our best example is that during the first few weeks of clinicals he wore a lab coat with the AARC student member patch on it. We knew he wasn't a student member since he never had the materials we used in class that the AARC would have sent him (e.g. the new asthma treatment guidelines). When asked about the patch he said he had bought the coat from a previous student. When asked again about the patch he said he was a member. When we checked with the AARC they had never received an application from him. When we counseled him on this he said it wasn't any big thing. So what if he wasn't a student member. We asked if he thought that holding himself out to be something that he wasn't was a violation of the AARC code of ethics and the school's conduct code. He said he didn't think it was any of those things and that he could wear any patch that he wanted.

Given the above information, have you had dealings with similar cases? We have spoken with our dean and counseling service but we would be appreciative of hearing from our peers out there.

†McGee, R. AARC Education Section Digest (Internet email) April 26, 1999.

Table 9.7

Ideally, we seek to correct undesirable behavior through counseling. If this does not lead to any correction, all parties involved must ensure that the school has full documentation of all incidents involving the student. This documentation must include facts, such as what, when, where, etc.

DISADVANTAGED LEARNERS

Disadvantaged learners represent a major challenge to the skills of an instructor. These challenges may stem from physical limitations, such as sight or hearing; psychological challenges, such as dyslexia; or socioecononmic challenges, such as illiteracy and ignorance of health care practices. The challenges presented by disadvantaged learners present themselves in several arenas. College instructors commonly are faced with learners who require special accommodations. Even more frequently, practitioners find themselves confronted with various barriers to instruction when they attempt to teach patients or families.

Legal Aspects of Disabled Students

In the college setting, disadvantaged learners have become a legal challenge, as well as an instructional one. The Rehabilitation Act of 1973 and Americans With Disabilities Act of 1990 (ADA) have had noticeable impact on American life. As evidence of this, we see ramps for wheelchairs instead of just stairways and curbs. Where once the disabled were virtually exiled from public education, there are now provisions for them. The spirit of that law is to permit individuals to capitalize on their ABILITIES, despite their disabilities, by providing real access and equal opportunity to higher education.

The Rehabilitation Acts of 1973 and 1990 provide impetus to promote equal access for the disabled. Section 504 dictates that all higher educational institutions receiving federal funds must provide equal educational opportunity for the impaired, whether physically or mentally. Because federally-funded student loans qualify as receipt of funding, it seems that nearly all colleges, universities, and trade schools would fall under federal law. According to Section 504 of the 1973 Law, a person is eligible for protection is they meet the following criteria:

1. The person has:
   a. a physical or mental impairment that substantially limits one or more major life functions.
   b. a history of such impairments, or
   c. is regarded as having such an impairment; and
2. If the person with a disability meets the academic and technical standards requisite to admission or participation in a college or university's programs or activities, then the student must be ensured equal educational opportunity, not a free, appropriate education.

Therefore, the school must address three questions in responding to the disability laws: (1) is there a disability? (2) is the person otherwise qualified for the school? (3) how can the school accommodate the disabled person for equal access?

A disabled person must self-identify, and request special consideration for admission and for persistence in a school. A school may not deny admission, nor fail a student based on disabilities unless it can show that it has considered accommodations, finding them unduly burdensome, of a

personal nature, or such that they attenuate essential competencies of graduates. Importantly, attenuated competencies for those preparing for health professions pose risks to patients.

The list of afflictions recognized as disabling grows ever longer, with learning and emotional disorders presenting especially complex problems for educators, as well as lawyers. The parameters of ADA law currently are being defined through litigation, which can be costly for both schools and faculty. Most educational institutions have had experience with accommodating students with disabilities. The trend is for more requests to be made, and consequently more claims will be filed by students who believe their disability has not been accommodated.

Unique challenges are presented in the educational arena when considering accommodations for students with disabilities. For example, schools have obvious concerns regarding the integrity of examinations. Caution must be exercised so that an examination is not jeopardized when accommodating students by changing the exam date, format or location. Reasonableness should be the key. Consider whether the requested accommodation truly jeopardizes the integrity of the examination or whether it will involve only an inconvenience.

When determining whether an accommodation is reasonable, cost will be a primary consideration. If the only accommodation that will satisfy the special needs of a student is cost-prohibitive, then the accommodation is not reasonable. Bear in mind, however, that the reasonableness of the cost is measured against the budget of the entire organization. The law does not, however, require that the most expensive accommodation be utilized, nor does it require the institution to permit a student to select among alternative accommodations. For instance, if a school receives a request for a sign language interpreter to sit through lectures and sign for a hearing impaired student, it is acceptable to explore less costly methods.

Currently, one of the more challenging issues in this area is how to accommodate a student with a mental disability. Consider the case of the student with bipolar disorder who has selected a very stressful field of study in a health care profession. Is it reasonable to expect that a student be given a lighter course load or a less stressful clinical rotation to accommodate her/his disability? Consider the ramifications to a school that accommodates such a student, then grants her/him a diploma. The diploma signifies that she/he is academically prepared for professional practice.

Should the school be concerned about the rights of the future patients assigned to that person's care? Of course! Does that mean that the school has the right to automatically refuse accommodations to students preparing for health care professions? Absolutely not. No definitive answers are available yet, but educators may expect to grapple with these complicated situations with increasing frequency.

Despite the difficulties associated with the ADA, its intentions are noble. Moreover, it is the law; the only appropriate response is to develop proactive measures in preparation for disabled applicants and students. Table 9.8 contains a list of proactive measures concerning the ADA.

This is not to imply that readers obtain counsel in anticipation of lawsuits. Rather, it is wise to have an attorney with some expertise in ADA review school policies and procedures governing admissions, grading, dismissal and graduation to ensure that these are consistent with the law. Also, the advice of an attorney ought to be sought before administrative actions on ADA matters.

As part of the admission process, all students should be informed of the demands placed on students as part of the educational process. These include cognitive, psychomotor, and behavioral (affective) demands. This information can be communicated as a student job description, which can be enclosed with other admissions materials.

Proactive ADA Measures

- Obtain legal counsel
- Publish expectations for students
- Ensure that required competencies are necessary for practice
- Be flexible in thoughts, words, deeds
- Inform affiliates of the implications of ADA guidelines for clinical training
- Prepare affiliates for students requiring accommodations
- Document all conversations regarding ADA

Table 9.8

Disabled or not, a student dismissed from a school for failing a competency that was not essential to professional practice would have a valid argument for readmission. So, it's important that our course requirements culminate in, or enable for, essential competencies. Fortunately, most professional associations serve us well by identifying and publishing the essential clinical competencies, which can be used to validate course requirements. In the event that any student fails to meet such requirements, a school has the right and the duty to delay or prevent that student's graduation. Courts generally will not challenge such actions on the part of schools.

Before denying admission to an otherwise-qualified disabled student, it is wise to consider a wide range of options available to accommodate the student. Possibly, flexible thinking could find a reasonable accommodation. We must be prepared to act with flexibility, as well. It makes no sense to stubbornly adhere to old policies because of tradition or resistance to change.

One might ask, "Does this have any impact on clinical departments?" The answer lies in the fact that the students receive their clinical training in patient care sites. So, clinical affiliates must adhere to the same ADA guidelines as the schools. A worrisome thought is that some affiliates may choose to cancel affiliations instead of accommodating disabled students. Allied health schools should assist clinical affiliates by ensuring that they are aware of how the ADA impacts decisions involving students and by assisting with any accommodations for students.

This final advice applies to situations surrounding the disabled, just as it does in any situation that conceivably could lead to litigation: Document all conversations and retain all written communications, with and concerning disabled students, as they relate to ADA issues. The

purpose of this is obvious- one cannot fully trust human memory. This measure it to protect oneself in the event of a lawsuit.

Communication Barriers

Physical communication barriers are common to patient education situations, especially among the elderly. The primary barriers result from loss of hearing and/or vision. Aging results in hearing loss due to deterioration of receptor cells and neurons, vascular changes in the inner ear and changes within the inner ear membranes. Other sources of hearing loss come from wax buildup, prolonged exposure to noise and tennitus, which reduces auditory acuity by masking over certain sounds. Those suffering from hearing loss also tend to develop a sense of isolation, which may lead to emotional distress; possibly even severe psychoses, like paranoia.

Practitioners who are trying to instruct patients commonly find that they have wasted a lot of time and energy by delivering eloquent presentations to patients who didn't hear or understand a word they said. Therefore, an initial step in overcoming communications barriers it to first, detect them. We can easily establish whether a patient understands instructions by having them demonstrate that they do, in speech or action.

After determining that hearing loss is a barrier to communication, practitioners can try several means to improve communications. First, the solution might be as simple as handing the patient their hearing aid. Regardless, one needs to take care in facing the patient when speaking, so they can take visual cues, and speak to firmly and clearly. In some cases, it may be necessary to communicate complex ideas in writing or in sign language, through a translator.

Visual acuity is another barrier that practitioners frequently encounter when teaching patients and families. Aging causes deterioration of the visual apparatus, such as the lens, retina and eye muscles. Pathologic processes, like cataracts and glaucoma also are common. So, visual acuity should be considered when developing instruction for elderly patients and families.
A learner's visual acuity is most important when instruction is accompanied with printed material. This problem can be palliated by large, bold print in instructional materials.

Another kind of barrier to communication is the patient's ability to send messages. Practitioners commonly encounter this problem with patients who have had strokes, as well as those who have intra-tracheal tubes of some type. This is a situation that is extremely frustrating to both patients and care givers. Patients are frustrated because they cannot make their simplest requests or needs known. Care givers are frustrated because of the additional time required to understand.

Various devices can be used to promote communications by patients. Among these are alphabet boards, artificial larynxes, laptop computers and speaking tracheotomy tubes. Despite the availability of these devices, the most effective tool in overcoming this barrier is the patience and

empathy of the care giver. A list of guidelines to promote effective communication with aphasics appears in Table 9.9.[1]

Cognitive Barriers

Physical communication barriers represent a difficult set of problems. Cognitive barriers are even more imposing, because the communications take place, but are not understood. These barriers can result from organic brain conditions, such as stroke, dementia, head injuries and substance abuse. They also may arise from developmental disorders, like that due to trisomy-21. An entirely different set of cognitive barriers include those due to culture, ethnicity and socioeconomic status. As with the other kinds of barriers, it is most important that these are recognized as early as possible, to avert unnecessary effort and expense. For instance, it would be rather wasteful to give a handout, written in English, to someone who is either illiterate or non-English speaking.

Communicating With Aphasics

- Provide a positive environment to encourage speech
- Avoid behavior that makes the person feel guilty about aphasia
- Accept the person at his/her level of function and build on it
- Point out any progress that occurs
- Do not answer for the aphasic
- Do not pretend to understand
- Ensure the aphasic's attention before speaking to them
- Speak according to the person's ability to understand
- Don't speak loudly, unless they are hearing impaired
- Avoid long sentences and rapid speech
- Augment oral communications with written ones

Table 9.9

After recognizing the barriers, one can deal with them in several ways. Instructional materials have been developed for illiterate patients; for instance, booklets that use pictures, instead of words, videotapes and audiotapes. More and more, our instructional materials are being translated to Spanish to help overcome that barrier. Finally, when a patient is unable to comprehend instruction, it is necessary to instruct family members or other care givers on the subject matter at-hand.

[1] Marshall CE. Geriatric and gerontological issues for respiratory care (unpublished course materials) University of Texas, Health Science Center at San Antonio 1997.

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CHAPTER NINE STUDY QUESTIONS & EXERCISES

1. Briefly explain each of the components of Keller's ARCS model for motivation.
2. Using each of component of Keller's ARCS model, describe how you would provide learner motivation within a CBI tutorial on universal infection control precautions.
3. Consider a person with hearing impairment. Describe the responsibilities of that disabled person who seeks admission to an allied health program.
4. Describe the responsibilities of the administrator and instructors in an allied health program to which the hearing impaired person (1) applies for admission, then (2) is accepted for admission.
5. List four common barriers to instruction, particularly as it relates to patients and families. Briefly describe an instructional strategy to overcome each of these.

CHAPTER TEN

CURRICULUM PLANNING AND DEVELOPMENT

Learning objectives:

- Define curriculum
- Describe the four major elements of curricula.
- Describe the relationships between curriculum and instruction
- Describe sectors and levels of influence on curricula
- Describe the general processes of curriculum development
- Describe the general processes for curriculum evaluation
- Explain the implications of specific problems for curricula in health professions.

In Chapter One, we defined and contrasted curriculum with instruction. To reiterate, instruction involves transfer of skills to students. Instructional matters include things like course syllabi, lessons, media and examinations. So far in this book, all of the chapters have concentrated on instructional matters. Now, we address curriculum, which is the 'big picture.' Where instruction relates to courses and lessons, curriculum relates to programs, such as medical technology or dental hygiene programs.

The word, 'curriculum,' derives from a Roman word for a chariot race course. Curriculum has been defined in many ways. One definition is "a plan for instruction.' This is a tidy definition that falls short of the mark, because curriculum encompasses much more than instruction and plans. A better definition is '**the total effort of a school to bring about desired outcomes in and out of school situations**.'[1]

Curricular Components

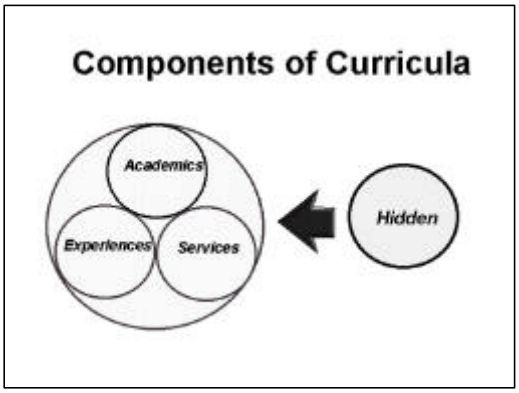
In adopting the comprehensive definition of curriculum, we assert that a curriculum includes instruction, as well as every other element that is relevant to the goals of an educational program. One could replace the term, 'curriculum,' with 'program,' to produce a clearer meaning. A curriculum, or program, includes four basic components, which appear in Table 10.1.

The academics program includes all of the instructional elements within a curriculum. Some individuals and texts consider academics as the entire curriculum, rather than a part of it. This is curriculum in its narrow sense. Under the present definition, academics includes instruction, as well as logistics and administration of instructional elements; such as schedules, supplies,

[1] Saylor JG, Alexander WM. Planning Curriculum for Schools. (1954)

teaching assignments, et cetera.

The program of experiences includes the program's efforts outside the classroom, lab and clinic, to influence student development. For example, we attempt to cultivate the notion of community service by organizing and recruiting students to volunteer for activities. These activities include conducting diagnostic testing at health fairs, participating in blood drives and counseling at asthma camps. Besides community service, we try to cultivate student involvement in professional organizations.



Services refer to the elements that support other elements. This component includes services, such as academic records, counseling, admissions, food service, student health service, et cetera. Although these services usually are shared by individual programs in a college or university, they are components of individual curricula, as well. Each individual curriculum also includes methods to articulate with the service elements of the parent organization.

Hidden curricula may be rather hard to identify and even harder to define. These reflect the biases of the program, school and college or university. Although the name, 'hidden,' sounds arcane, or even evil, the intentions of this component may be honorable and benevolent. For an allied health program, the hidden curriculum can include biases that favor certain aspects of practice, specific devices, research and management paradigms, or professional organizations.

Components of a Curriculum

Academics
- Instruction
- Logistics for instruction
- Administration of instruction

Program of experiences
- Community service
- Professional service

Program of services
- Shared facilities & services
- Programmatic services; e.g., counseling, clerical.

Hidden curriculum

Table 10.1

Curriculum & Instruction- Relationships

Now that we have a better idea of what curriculum and instruction are, we will look at how these two articulate with one another. One important point to make about this relationship is that instruction is the implementation of a curriculum. The curriculum is the plan and the support for instruction- instruction is the work of the organization.

Since the curriculum also is the plan for instruction, it would seem that development of a curriculum must come before the instruction. Then, we develop instruction from a top-down view. Despite proceeding from a top-down view, this is not to say that there is no bottom-top interaction. There must be bidirectional adaptation between curricula and instruction for

programs to remain efficacious. Significant changes in instruction indicate a need for curricular changes and significant changes in curricula may motivate changes in instruction.

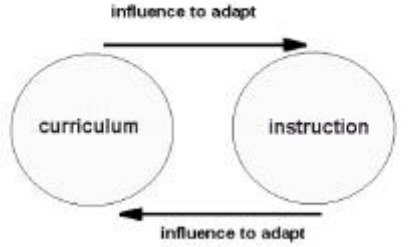
Relationships- Curriculum & Instruction

- Curriculum- plan, support for instruction
- Instruction- implementation of curriculum
- Curriculum precedes instruction
- Curriculum & instruction are interdependent

Table 10.2

Adaptations between curriculum and instruction occur for many reasons. To cite an example of how curriculum can influence instruction, consider an occupational technique that requires costly equipment to teach it. In this situation, the school is unable to purchase the equipment, which is a curricular concern. Therefore, the instructor must find a way to teach this technique without the equipment; perhaps using a visual aid.

On the other hand, consider an instructional situation where, in a laboratory, students must perform a procedure under the guidance of an instructor. Limitations imposed by the size of the classroom or the availability of resources may cause the program to schedule more than one laboratory, or even reduce the number of students per class. Therefore, an instructional concern influences curricular change.



External Influence Over Curricula

Curriculum development is an enormous task, which takes many variables into consideration. Most of all, a curriculum developer must consider the major sources of influence for the process. The curriculum will not arise or exist in a vacuum. There are sources of influence external to the program that are important to decisions in the ongoing process of curriculum, or program, development. A program that is not open to changes will inevitably cease to exist. Therefore, those in charge of educational programs must be able and willing to motivate programmatic changes as changing times and conditions dictate.

Influence over curricula arises from agencies at different levels and sectors. The strength of their influence may come about from funding, accreditation or licensure sanctions. Levels of influence range from programmatic to the highest level to which the program developers must consider. The text box at right shows this hierarchy. The program is the lowest influence level, followed by the division or school, college, university, university system (state level) and the national level. The

Levels of Influence

Federal Government
State Government
University System
University
College
School
Program

Table 10.3

Federal government regulates programs on the basis of entrance admissions for minorities and accommodations for the handicapped. The power of the government comes from its ability to determine whether schools are eligible for Federal funding.

Agencies at succeeding levels may have their own particular concerns about curricula, as well as authority to influence curricula. Therefore, curriculum developers must be aware of the specific requirements at each level. For example, ignoring a state requirement for specific course work could interfere with graduation of students or loss of state funding. Failure to meet the requirements of a national accrediting agency may cause program closure.

Sectors of influence refers to entities that are outside the levels hierarchy, but also exert influence on curriculum development. These include the professional community, accrediting and credentialing agencies, the business community and other possible sources. Although sectors may exert varying degrees of influence over curricula, they are not hierarchical. Also, the magnitude of influence for specific agencies changes over time. Table 10.4 lists sectors of influence.

Sectors of Influence

- Professional community
- Geographic community
- Healthcare provider organizations
- Medical industry & technology

Table 10.4

The reader should note that the agencies at sectors and levels are not responsible for curriculum development. Rather, they have influence over, and interests in, healthcare education. Therefore, a program developer must be familiar with the interests and requirements of these agencies. It would be a major mistake to develop a program, then find that a state law prohibits some of its elements.

Curriculum Development

So far, we have discussed some of the theory related to curricula, including its components. Now, we will explore how curricula are born. Imagine yourself put in a position where you are assigned or employed to create a program to prepare practitioners for your own profession. What steps do you need to take to complete the task? The steps in curriculum development appear in Table 10.5.

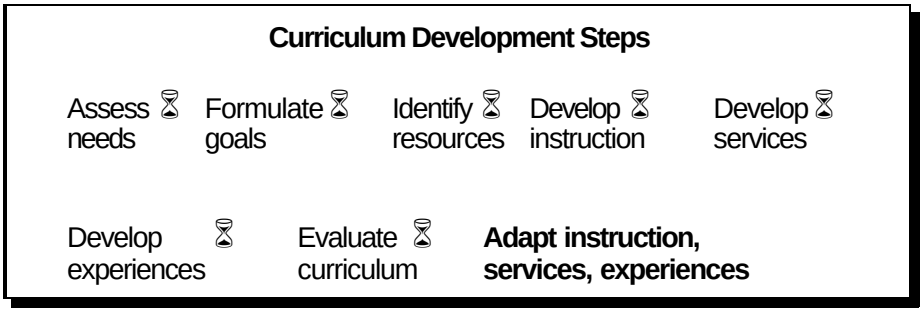


Table 10.5

Needs Assessment

A needs assessment must be conducted before developing a curriculum. The purpose of this assessment it to determine the quality and quantity of the product of the program, its graduates. That is, how many students should the program graduate, and what should they be able to do when they complete the program? The answers to these questions will provide information that will be used to formulate curricular goals and to develop all of the components of the program: instruction and services. The hidden curriculum may arise from this inquiry, as well. However, it may arise at a later stage of development or implementation.

Information about needs can be solicited from health care providers in the expected geographic service area for the program graduates. To gather this information, one could inquire at hospitals, clinics, nursing homes and other providers, as the potential employers of the program graduates. These institutions can provide information about how many graduates they can employ over the years, as well as any specific performance requirements.

In addition to the needs determined by the prospective employers, one must inquire into the needs as dictated by the parent organization; such as the college or university, and those required for accreditation of the program and credentialing of its graduates. The data from these sources will include information like what courses must be included and what competencies must be ensured.

Fortunately, professional accrediting and credentialing bodies provide a wealth of information to guide development of educational programs. Often, model curricula are available from them, which can be modified to create a curriculum that will fulfill local requirements. Where model curricula are unavailable or unusable, credentialing bodies, the agencies that develop and administer registry and certification examinations, can provide matrices for the examinations to guide curriculum development. Credentialing agencies base their examinations on job analyses that identify the competencies measured by the examinations.

In the event that the program under development is unique, with no pre-existing curricula or job matrices, program development becomes more ponderous. In this case, the developer must do an occupational analysis to identify the end-point competencies needed for program graduates. This will require investigating the sites where graduates will be expected to perform and asking employers exactly what they will need to do on the job. Ideally, this investigation includes all of the prospective job sites, as well as all of the interested parties, like administrators.

Formulate Goals

Curricular goals represent the end-point objectives and intentions for the entire program. Therefore, the curricular goals guide development of the instruction, services and experiences. Table 10.6 lists several typical curricular goals for a respiratory care program. One can see that those goals touch on more than ordinary academic activities. Goal One restricts it's intentions to instruction; so, the majority of instructional development intends to achieve this goal. Goals Two and Three, on the other hand, reflect the services and experiences portion of the curriculum. Although leadership and service can be addressed in the classroom, it is not where the skills are acquired and practiced. So, we provide student services, like libraries, to support leadership. And we provide experiences, like professional meetings and seminars, to encourage professionalism.

Curricular Goals

- Program graduates will be competent in all respiratory care practices
- Program graduates will demonstrate professional leadership qualities
- Program graduates will serve the professional and local communities

Table 10.6

Formulating curricular goals is not such a difficult process. However, there are important considerations concerning curriculum evaluation. That is, the goals should be reinforced with statements of objectives or standards that are measurable. This is the hard part. Goal One can be measured by a number of methods; but, unless the other two goals are supported by objectives for measurement, they stand only as lofty goals. Therefore, their attainment cannot be evaluated.

Identify & Develop Resources

The information gathered about the requirements for numbers and competencies of program graduates will feed into identifying the resources that are necessary to educate them. The first step informs us as what the program is expected to accomplish.

Factors That Determine Needed Resources

- Area of education (discipline)
- Level of education (degree)
- Number of students

Table 10.7

The number of students provides information about the number and of faculty needed, the amount of classroom, laboratory and clinical space, and ancillary services to support the program. Ancillary services include things like administrative and secretarial services, library, living and information services.

Kinds of Resources

- Faculty
- Clerical
- Medical direction
- Advisory committee
- Physical resources
- Clinical sites
- Administrative
- Financial
- Student services

Table 10.8

Information about required competencies will identify logistical requirements for instruction. In the health professions, this commonly involves medical equipment and supplies, which can be costly. At this juncture, one should attempt to determine the minimal requirements for these, to implement instruction.

Additional resources for the program might include medical direction and cooperation of other physicians, health care providing organizations willing to serve as training sites and clinical personnel who are willing to assist with training. Importantly, affiliates and personnel must be available to provide the scope, quality and quantity of experiences needed to enable for students' competencies. Finally, one must determine whether the parent institution has, and will commit the necessary financial resources to the program. This will determine whether the faculty, equipment, supplies and other elements can be obtained to implement and continue the program.

Develop Instruction

End-point Expectation

- Practice independently in an intensive care unit

Required Competencies

- Manage artificial airways
- Manage mechanical ventilation
- Participate in emergency life support
- Perform as a critical care team member
- Organize work and perform efficiently

Table 10.9

Operating under the assumption that the curriculum under development is competency-based, one begins developing the instruction by identifying all of the competencies required of the graduates. As mentioned earlier, sources of these competencies can be matrices from credentialing examinations. For example, if the curriculum intends to prepare Registered Respiratory Therapists, the National Board for Respiratory Care (NBRC) publishes an examination matrix for advanced respiratory care practitioners, which is the NBRC Registered Respiratory Therapist (RRT) Examination. Such matrices are excellent sources of competencies.

Although credentialing examinations usually are paper-and pencil tests of cognition, competencies for professional practitioners inevitably derive from all three domains of skills: cognitive, procedural and professional behavior. It is important to consider this when preparing instruction.

Unfortunately, the matrices obtainable from credentialing agencies will not identify competencies from the procedure and professional behavior domains. Therefore, these may need to be generated by the curriculum developer or borrowed from another source Here is where model curricula can be very useful. Regardless of the origin of the list of competencies, we need to identify all of the things a program graduate should be capable of doing; that is, all of the exit or end-point expectations.

After the end-point expectations have been identified, they should undergo some kind of validation. This could be cross-validation with another competencies from other curricula, or review by a number of interested professionals. Ideally, the people who review and endorse these are members of an advisory committee, who oversee the operation of the program.
Therefore, we have a list of competencies that include a mixture of the domains. A reasonable end-point expectation for a respiratory care practitioner is, 'practice independently in an intensive care unit.' Although this may seem simple, the curriculum developer must identify all of the skills needed to practice in an intensive care unit.

The subsequent process for developing instruction involves identifying all of the required skills needed for the required competencies. The resultant list of skills become instructional objectives. These are grouped by type of content, where possible, which results in courses. The courses are divided into modules, and the modules into units. Each level has its goals or objectives, which become more specific as we get into individual units. Instructional development should proceed in a manner that ensures that all skills needed for all competencies are taught by the program, as well as when they are taught.

Develop Services

Services for program students include things like admissions procedures and policies, space for student activities, like lounges, lockers and eating areas. Other services include library services and computing centers. These generally are available for the student population at the parent institution, although programs need to ensure that their specific needs are available. Importantly, this includes the clinical education sites, which tend to be overlooked with regard to services.

Develop Experiences

An earlier section described the experiences as those elements of the curriculum that concern the student, but may not relate directly to instruction. Beyond the classroom and laboratory, students are developing professionals and it is incumbent on the educational program to foster this development. The kinds of experiences that a program can provide to develop leadership and service are things like attending professional meetings and service activities as a class exercise. Programs have been known to substitute certain activities for classroom and clinical work.

Evaluate the Curriculum

Over the years, there has been a major dichotomy of viewpoints in curriculum evaluation in allied health (see Table 10.10). This dichotomy pervades to the level of national accrediting agencies for allied health. One viewpoint focuses on curricular processes; the other focuses on outcomes, or products. Those who are process-oriented prescribe every element of a curriculum, including the number and qualifications of faculty, hours of clinical and classroom work, etc. Those who are product-oriented focus on the success of the curriculum in reaching its goals.

Using the product orientation, evaluation of curriculum is similar to evaluation of instruction. Just as instruction is appraised largely on its success in accomplishing instructional objectives, curricula are evaluated on their success in accomplishing curricular goals. Those who favor the product oriented evaluation argue that there are alternate paths to success; what matters is reaching the goal.

Curriculum Evaluation Models	
Process Oriented	Product Oriented
Focus- processes	Focus- product
Curricular details are prescribed	Curricular details NOT prescribed
Evaluation criteria	Evaluation criteria
• courses/hours	• graduate success
• faculty credentials	• employer satisfaction
• clinical sites	
• student/instructor ratios	

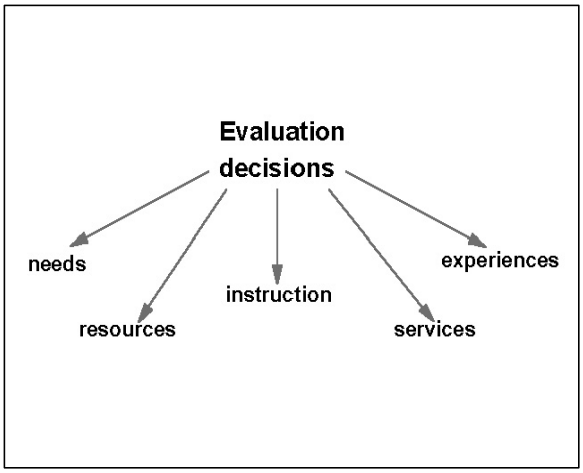
Table 10.10

In contrast, the process-oriented evaluation model compares specific elements of the curriculum to some criterion, model curriculum. The model curriculum specifies nearly everything for a program, including hours of instruction for all subjects, number of books and journals in the library, hours and kinds of clinical rotations, etc. Some educators are more comfortable with this type of evaluation because it provides guidelines, which many people really need. On the other hand, adherence to guidelines does not ensure success for the curriculum. That is, we may be teaching the wrong things; but teaching them very well.

Those who favor the product orientation to evaluation would argue that specific curriculum requirements may not work at all locations and circumstances. Furthermore, model curricula in the past have placed fiscal hardships on schools with their requirements. Both evaluation methods have their merits. Therefore, the ideal curriculum evaluation would combine some of the attributes of each method.

Adapt Elements of the Curriculum

Educators must always attend to the fact that curriculum development is a reiterative, ongoing process. An educational institution is, by nature, an open system that requires constant input from the environment. An institution that behaves otherwise cannot survive, because conditions in the surrounding environment is in constant flux. For example, a school that ignores technologic changes in the practices of its profession cannot graduate competent practitioners. Therefore, it will at some point be forced to change or close. Similarly, environmental conditions that affect resources available to the school will influence its operations; therefore, its curriculum.



Problems in Curriculum Development

Scientific & Technologic Advances

Health care practice is caught up in an accelerating whirlwind of scientific advancement and technological expansion. Casual verification of this can be made just through observing the numbers and varieties of new publications arriving on the periodical shelves each year to disseminate the new material. The influx of this new knowledge is accompanied by some important challenges for curriculum developers:

Curricular Problems

- Scientific and technologic progress
- Scope- identifying subject matter boundaries
- Sequencing subject matter
- Correlating and articulating subject matter
- Redundancy- appropriate amount

Table 10.11

- In the face of expansion and change in the knowledge base of the disciplines, deciding what material must be included, and what can be excluded from the curriculum.
- Designing curricula and instruction such that advances can be integrated without necessitating major reconstruction of existing systems.
- Preparing students to integrate and apply the scientific and technological advances they will encounter as professionals in the work place.

This area represents one of the greatest challenges to developing and maintaining curricula in the health care sciences. On one hand, new information cannot be ignored; on the other hand, there are only so many hours allotted for each course. How does one teach additional information without adding time to courses and curricula? Part of the solution for this problem probably lies in making some hard decisions about what not to teach in a curriculum.

Another part of the solution involves teaching students about the fundamental structure of the discipline. Each discipline has its internal structures comprised of substantive and syntactical components. Substantive structure includes the operational concepts of the discipline, as well as current facts. Syntactical structure includes the means and methods for verification of inquiry. One represents current truths; the other, a map to future truth. Students educated on the disciplinary structure are prepared with the operating principles of the discipline, as well as the means for verifying and integrating new information into their knowledge base.

Scope

Scope refers to the subject matter boundaries of a curriculum; what is included, what is excluded. For any particular allied health program, the inclusiveness is determined by the competencies required to practice the profession. Exclusivity is partly determined by licensure restrictions of the profession, as well as of other professions. For example, a nurse practice act typically reserves administration of narcotics and blood products to registered nurses. Therefore, administration of these products would not be part of a respiratory care curriculum.

There is considerable overlap in patient care duties among the professions. For example, nearly all clinical professionals must be prepared to take patients' vital signs. There is a movement afoot in health care to educate multi-competent professionals who could do respiratory care, nursing, radiography and laboratory studies. Obviously, this would require a curriculum with a very broad scope, as well as considerable barriers. One barrier is that of licensure restrictions; another is that the breadth of the curriculum would preclude depth. Such a program likely would train people to do many different things without knowing why.

Correlating, Sequencing and Articulating Subject Matter

Correlation and articulation of subject matter is about how the courses and information integrate to achieve the goals. For a program in allied health, there are many discrete items of information that lead to the terminal objectives, which lead to curricular goals. Sequencing should be dictated by the principle of enabling skills. That is, before a subject is taught, the students should have acquired the skills necessary to learn it. To correlate and articulate subject matter, one must generate an overview of the objectives for each course to determine how the instruction from different courses relates, and whether important information is omitted from the instruction.

Redundancy

Although redundancy may appear wasteful and boring, it seems to be necessary. Students in allied health programs are confronted with an enormous amount of new information at each turn. Initially, the response to this overload is to study like crazy to memorize stuff; then forget it. So, as educators we must respond to this situation be frequent 're-vaccination' with information. We do this re-vaccination to refresh and rehearse substantive information. But, we can capitalize on this opportunity for students learn the information at a higher cognitive level.

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CHAPTER TEN STUDY QUESTIONS

1. In addition to traditional classroom and laboratory instruction, describe four specific actions by which an allied health instructor can support the curriculum of a program.
2. Describe the kinds of external factors that influence curriculum development.
3. Explain the importance of needs assessment to curriculum development.
4. Contrast product and process curriculum evaluation procedures.
5. Describe the problems associated with scope of allied health curricula.
6. Describe the implications of scientific and technologic advance for allied health curricula.

CHAPTER ELEVEN

LABORATORY AND CLINICAL INSTRUCTION

Learning Objectives:

- Describe the relationships between classroom, laboratory and clinical instruction.
- Describe the types of skills that are developed in instructional laboratories.
- Describe laboratory exercises and instructional strategies to develop specific skills.
- Develop laboratory exercises intended to develop specific skills.
- Describe the role and functions of the laboratory instructor.
- Describe the methods for evaluation of laboratory skills.
- Describe the types of skills that are developed in the clinical setting
- Describe the organization and progression of clinical instruction to develop clinical skills.
- Describe instructional strategies for the clinical setting.
- Describe the role and functions of a clinical preceptor
- Describe the methods for evaluation of clinical skills.
- Explain the importance of accurate and fair evaluation of clinical skills.
- Develop an instructional plan for a clinical assignment.
- Describe errors commonly committed by preceptors.

Ultimately, the goal for all allied health curricula is to prepare competent practitioners. This means that upon graduation from a given program, the graduates have demonstrated all of the skills needed for practice. In other words, allied health instructors are engaged in a constant effort to wean their students from themselves until the instructors are no longer needed. This weaning progress has a natural progression, which relates to the concepts, enabling and terminal objectives.

The terminal objective for an allied health student is to practice their profession with competence. Therefore, the elements of an allied health curriculum must combine to enable for this professional competence. Generally, skills developed in the classroom enable for further development of laboratory skills, which enables for clinical skills.

Laboratory Instruction

Instructional laboratories apply the cognitive and affective skills acquired in the classroom and develop additional skills, like procedures, to prepare for instruction in the clinical setting. Although instructional laboratories cannot provide the rich experiences found in the clinical

setting, it is an excellent setting to practice equipment operation and procedures to develop techniques without risk to patients.

Laboratory Skill Types

Students can develop various kinds of patient assessment skills in the laboratory. Physical assessment can be practiced, although this practice usually is limited to the physical examination of healthy, fellow students. This situation can be somewhat palliated with audiovisual or computer-based media, which can present abnormal findings to the students, as well. Many additional diagnostic techniques, such as electrocardiography, pulmonary function testing and radiography are routinely practiced among students in the various professions.

Laboratory Skills

- Patient assessment
- Equipment operation
- Equipment troubleshooting
- Procedures

Table 11.1

Laboratories are the ideal setting to provide students with experience in operating medical devices. Although budgetary considerations may limit the capability of a program to expose students to all of the equipment that is in current use, it is important for students to manipulate examples of each major type of device. Also, there are options available for programs when a device is unaffordable.

For example, it would be unrealistic for a college to purchase a magnetic resonance imaging device. One option is to use the equipment in a hospital when it can be made available. Another option is to ask vendors to loan equipment. Clearly, simple operation of equipment is inadequate preparation for a health professional. It is critical that students also learn how to troubleshoot any equipment they will use in the clinical setting. Therefore, laboratories that involve equipment also must include exercises in problem-solving. Finally, the laboratory setting is where most procedures are learned by Healthcare Professionals. For invasive procedures, manikins and other physical simulators are used for practice. For those procedures that are innocuous and non-invasive, fellow students can serve as the patient.

Laboratory Exercises and Strategies

This section describes laboratory exercises and strategies that can be used for each of the major types of skills described in the previous section. Although laboratory manuals are available from commercial sources, it has been this author's experience that these frequently are inadequate. One source of inadequacy is scope; that is, a given manual may not include all of the laboratories desired for a course. A second source of inadequacy is that the author of a manual selects the specific equipment for the exercises, which means that some of the desired equipment for a course is not included. Finally, few laboratory manuals have addressed clinical problem-solving, including trouble-shooting of equipment. Given the shortcomings of these manuals, laboratory instructors ought to be prepared to develop at least some of their own labs.

General Guidelines for Laboratories

Table 11.2 lists some general guidelines for conducting laboratories. First, laboratories should be well-planned, in advance. The instructor should ensure that the objectives of the lab are clear and appropriate, that all of the exercises needed to reach the objectives are included and feasible, and that there are mechanisms for evaluating student learning.

General Guidelines for Laboratories

- Develop exercises and activities
- Prepare the setting and devices
- Practice procedures before lab
- Students prepare for lab

Table 11.2

If a published lab manual is used, the instructor should be familiar with all of the elements contained therein. Some of those elements may not be possible for the specific lab, because of lack of equipment or time. If a lab manual is not used, the instructor should develop all of the necessary lab elements.

For a lab to proceed effectively and efficiently, it is important that the instructor set up and test all of the equipment and ensure that all of the necessary supplies are present. It is a waste of time and energy to discover, after a lab is scheduled to begin, that an ECG machine is malfunctioning or that there are no ECG lead pads. Similarly, some lab exercises described by manuals sometimes do not work with all brands of devices.

Chapters Three and Four of this manual describe demonstration lessons. A cardinal rule for the instructor who conducts a demonstration is to practice the procedure before the lesson. Even skilled practitioners tend to slip from perfection when they do not perform a procedure on a regular basis. Because it is important for students to observe a procedure done to perfection, the instructor should be able to deliver it. Videotaped demonstrations provide a viable alternative to live performance, and provide the advantage of being the same every time.

Laboratories are more effective and efficient when students prepare for them, as well. Specifically, students should be required to review the cognitive components of a lab before the scheduled time. Also, if they will be evaluated on procedures, they should practice them in advance. This should include their assurance that they are familiar with any devices that they will use. Student preparation is sometimes difficult for instructors to ensure. However, making it a practice to begin labs with oral questions or written quizzes may encourage student preparation.

Exercises for Patient Assessment

Patient assessment includes physical examination, history-taking, various diagnostic procedures and synthesis of the information gained from all of these. Each health care profession has its special foci for patient assessment, as well as diagnostic procedures. However, there are elements that all professions involved in patient care have in common. Examples of these are basic physical examination, including measuring vital signs.

Students can perform physical examination and take medical histories from each other during labs; but as previously mentioned, there is a limitation here. The limitation is that they usually get to examine and take histories from healthy individuals, although there may be the occasional student with an asthmatic wheeze. Regardless, students can develop their techniques, procedures and professional behavior skills by practicing on healthy students and writing a history and physical. Computer-based labs can provide effective simulations for students to develop the skills.

Laboratories to develop assessment skills should provide structure for students to follow. This structure should include forms or checklists for taking histories and for physical examination. The forms used for this purpose should be similar to those the students will use in their clinical training. The overall assessment method generally accepted across professions is the Subjective, Objective, Assessment, Plan (SOAP) format. Therefore, students should practice writing SOAP notes from their findings in the lab. The appendix of this chapter includes a patient assessment form that is useful for developing and evaluating overall assessment skills, both in the laboratory and clinical settings.

Patient Assessment Exercise

Student is presented with patient AB (fellow student) and the data sources, with the assignment of assessing the patient.

Objective: Given the following sources of data, complete a patient assessment for Patient AB with 95% accuracy on the patient assessment form, which includes SOAP notes (Plan may be omitted)

Data sources:

- Patient AB, who provides history, suggesting congestive heart failure
- ECG simulator, which reflects atrial fibrillation
- Lung sound simulator, which reflects basilar crackles
- Radiograph, which reflects cardiac enlargement and interstitial edema
- Laboratory data

Evaluation method: Before the laboratory, the instructor conducts the required assessment, and develops a key for the evaluation, which includes the essential elements and scoring procedure.

Table 11.3

As with other types of skills, physical examination and history-taking should be demonstrated by the instructor before students practice the skills. In addition to teaching the processes involved, this give the instructor the opportunity to demonstrate appropriate professional behaviors; such as clear communications, empathy and respect for privacy. A best-case scenario for such a laboratory is to enlist a person with an abnormal history and physical signs to serve as the patient. Medical schools sometimes pay subjects for this service, but this would generally exceed the budget of most allied health programs.

Various types of simulations can be used to teach patient assessment. For example, CD-ROM courseware and audiotapes are available to teach breath sounds. Furthermore, CD-ROM courseware and cardiac rhythm generators can simulate ECGs. An imaginative instructor can simulate a sick patient by combining simulations with medical records and role-playing by healthy individuals. An example of such an exercise appears in Table 11.3. This exercise does not require the student to complete the Plan component, because this exceeds the objective of teaching assessment.

Equipment Operation & Troubleshooting Labs

Ultimately, healthcare professionals ought to be able to safely operate every device for which they are responsible in the clinical setting. Safe operation involves more than making adjustments by turning dials, pressing buttons and inserting samples. Rather, they must be capable of recognizing when a device is malfunctioning; then, what actions to take. To reach this ultimate goal, instruction must progress through stages, as shown in Table 11.4. Table 11.5 lists the general types of lab equipment exercises. The first three steps in equipment operation need not take place in the laboratory. Initially, a student needs to know the purpose of a given device, be able to describe it, and explain its principle of operation.

All of this can be learned in the classroom, with visual aids, including the actual device, if it is available. Ideally, these cognitive enabling skills are confirmed before progressing to hands-on laboratory exercises, because valuable laboratory time will be reserved for hands-on exercises that take considerable time.

Take corrective action

8

Isolate malfunction

8

Recognize malfunction

8

Operate during normal function

8

Develop familiarity with device

8

Explain operating principle

8

Describe device

8

Describe purpose and rationale

Table 11.4 Progression of medical devices laboratories

Then the instruction can proceed to basic familiarization with the equipment. Although it is tempting for an instructor to display the equipment and instruct students to familiarize themselves, experience has shown that this does not work. Students do not have the skills to select the information they need by just looking at the equipment, so they need to complete some kind of structured exercise. The instructor should determine what components the students should recognize, then direct them to draw the equipment or label a diagram of it. In other words, they should not just look; they should do something to show that they have acquired familiarity. Table 11.6 shows some examples of lab exercises intended to develop familiarity with equipment.

Types of Equipment Exercises

- Familiarization
- Normal operation
- Troubleshooting
- Evaluation

Table 11.5

Table 11.6 Examples of Laboratory Exercises to Familiarize with Equipment

Exercise

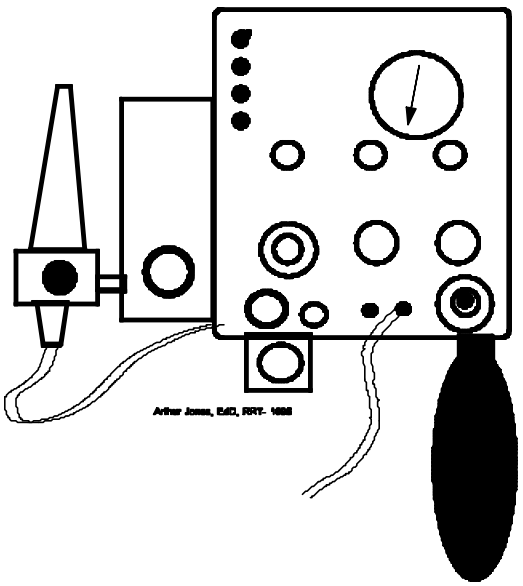
An assortment of endotracheal tubes is in the emergency cart in the lab. Locate and examine a high volume, low pressure endotracheal tube. Diagram the tube, including the following:

a. Murphy eye
b. Pilot balloon
c. Pilot balloon valve
d. Radio-opaque line
e. Length markers
f. Diameter markers

Exercise

On the following diagram of the Newport E100i® ventilator, draw and label each of the following:

1. Pressure control
2. Power switch
3. Flow control
4. PEEP control
5. Airway pressure gauge
6. Rate control
7. Inspiratory time control
8. Pop-off valve
9. FIO2 control



After gaining familiarity with a device, the student should learn to operate it, which includes being able to assemble the device for operation. This requires a demonstration by the instructor, as described in Chapter Three. After the instructor demonstrates assembly and operation, each student also should assemble and operate the device.

Some students are reluctant with equipment, and tend to avoid new devices. Therefore, it is a useful strategy for the instructor to include a space in the laboratory exercises to verify

completion of the assembly and operation by each student. Table 11.7 shows some examples of laboratories intended to teach assembly and operation of certain devices.

Table 11.7 Examples of Laboratory Exercises for Assembly and Operation of Equipment

Exercise: Assembly and Adjustment of the Nasal Cannula

The instructor will demonstrate assembly and adjustment of the nasal cannula.

Each student will assemble and adjust the device. The instructor will verify correct assembly and will sign the exercise.

The student has correctly assembled and adjusted the nasal cannula

_____
Evaluator signature

Exercise: Assembly and Adjustment of an Intravenous Administration Set

The instructor will demonstrate assembly of an intravenous administration set.

Each student will assemble an intravenous set. The instructor will verify correct assembly and will sign the exercise.

The student has correctly assembled the intravenous infusion set.

_____
Evaluator signature

Exercises for Equipment Troubleshooting

After the students are able to operate a device, and recognize its normal function, they should be exposed to various malfunctions. There are two general approaches to this instruction. One approach involves the instructor inducing or simulating malfunctions, beginning with the most common, proceeding to the least common. The instructor identifies the signs of the malfunctions, and explains their effects. The alternative approach is for the instructor to induce the malfunctions without explanation and require the students to identify and solve the problem. Both approaches provide the necessary instruction, although the former probably is more efficient.

Regardless of which approach is taken for the initial instruction, laboratory exercises should require students to identify and correct malfunctions without the assistance of the instructor. Importantly, students also need to know that they cannot repair many malfunctions, and that they may need to exchange the device for another. This knowledge may help them avoid future patient injuries, as well as legal entanglements. Students' troubleshooting skills should be evaluated and documented as part of the exercise. Table 11.8 includes some examples of laboratory exercises intended to develop troubleshooting skills

Table 11.8 Laboratory Exercises for Equipment Troubleshooting

Exercise: Troubleshooting an ECG monitor
The instructor will demonstrate and explain signs and causes of ECG monitor malfunctions, then induce the malfunctions.
Each student will be confronted with three scenarios that involve malfunction, then will identify and correct the malfunction.
Exercise: Troubleshooting tidal volume loss for a patient with a volume ventilator.
The instructor will demonstrate and explain signs and causes of tidal volume loss, then induce the malfunctions.
Each student will be confronted with three scenarios that involve malfunction, then will identify and correct the tidal volume loss.

Exercises for Equipment Evaluation

Because of advances in clinical practice and technology, new medical devices appear on the market continually. Therefore, practitioners commonly find themselves in a position where they have some voice in the acquisition and utilization of new devices in practice. The teaching laboratory presents a good opportunity to provide students with both motivation and skills to critically appraise medical devices. Where actual devices are used for the exercises, it would be rather difficult to compare large items, such as magnetic resonance imaging devices. However, these can be simulated on paper, or by computer.

Before evaluating any devices, learners should be thoroughly familiar with their function and desired capabilities. They should have prerequisite knowledge about malfunctions and their consequences to patient care, as applied in troubleshooting. Then, they can be confronted with different types or brands of devices that are intended to achieve the same purpose and test their function, for comparison. During these kinds of exercises, students acquire skills in research and measurement, in addition to acquiring knowledge about devices. Table 11.9 shows an example of a laboratory intended to teach equipment evaluation skills.

Exercises for Procedures

Whenever possible and safe, students should practice procedures in the laboratory before performing them on patients. Where invasive procedures are involved, simulations can be used. For example, manikins and simulated limbs can be used for procedures like endotracheal intubation, venipuncture and injections. Although this may not be quite the same as doing the procedure on a patient, at least the student can develop the necessary psychomotor skills and learn the steps in the procedure.

As described by the demonstration lesson plan in Chapter Three, the instructor should demonstrate the procedure, then provide guided practice for the students. A performance evaluation form (PEF) must be provided for students to use as a study guide and to serve as an

evaluation instrument. Procedure evaluation usually takes considerable laboratory time, much of which can be saved by students studying the PEF before the lab, so they are familiar with the steps. The reader will find an example of a PEF in the appendix to Chapter Seven of this manual.

Table 11.9 Equipment Evaluation Exercise		
Objective: Evaluate two types of manual resuscitators, by comparing their operating characteristics listed in the following table. Directions: Inspect each manual resuscitator, then connect to an oxygen flowmeter adjusted to 15 L/min, with an oxygen analyzer and respirometer at the patient outlet. Then, test each resuscitator as shown on the table.		
Resuscitator Brand		
TV- one hand		
TV- two hands		
FIO2- slow ventilation		
Minute volume where FIO2 -decreases		
Pop-off (yes/no)		
PEEP adaptable (yes/no)		
Valve type		
Positive attributes		
Negative attributes		
Overall evaluation-score on scale of 1-5, with 5 = perfect		

When the students have had time to practice and indicate that they are prepared for evaluation, each student should be checked-off on the procedure, using the PEF. Students who make critical errors should undergo remedial guided practice until they are prepared for another evaluation on the procedure. When a course includes evaluation on several procedures, the instructor should develop a master list of all of the required procedures. Then, as each procedure is completed, the instructor indicates it on the list. This will provide a quick reference for the instructor and students as to which procedures have been completed. Also, it provides documentation for accrediting agencies.

Clinical Instruction

Clinical education represents the culmination of a student's skill development. It is in the clinical arena where students apply all of the skills they acquired in the classroom and laboratory. Also, it

is the last stop for students on their way to professional practice. Therefore, it would be difficult to overemphasize the importance of the role of the clinical instructors. This section refers to clinical instructors as 'preceptors,' rather than instructor, because frequently this person is in the employ of the health care organization, and functions in several capacities.

Preceptors generally are responsible for all instruction that occurs in their clinical area. These are practitioners who teach students, colleagues from other professions and new employees to practice in their area. Table 11.10 lists some of the roles of a clinical preceptor. As the reader can see, the preceptor is a practitioner and teacher, who also serves as a liaison between their charges, departmental management and other professionals. The preceptor also must serve as a role model and mentor to assist in developing the professional behaviors of their charges, in addition to their clinical knowledge and procedural skills. Finally, the preceptor needs to facilitate learning in the clinical area by serving as a resource for many kinds of information.

Preceptor Roles

- Practitioner
- Teacher
- Liaison
- Evaluator
- Role model
- Mentor
- Resource
- Facilitator
- Co-worker

Table 11.10

Skills Acquired in the Clinical Setting

When they arrive on the clinical scene, one assumes that students have already acquired a set of skills that enable them to further their education. These should include all of the enabling cognitive, procedural and professional behavioral skills needed to enter their new setting. In this setting, they apply those skills under conditions that are new to them, as well as very real. Also, students must acquire a new set of skills for which the learning opportunity was unavailable in the classroom and lab, which result from a richness and variety of experiences.

Before entering the clinical setting, students do not interact with patients, families and other health care professionals. Therefore, it is in the clinical setting that they develop their abilities to interact with all of these people. Also, the clinical setting often is their first encounter with serious illness and death. Clinical experiences confront them with actual problems that must be resolved to preserve the patients, including emergency situations. In addition to learning about the responsibilities of working with real patients, students also must acquire skills associated with employment. Among these are development of work ethics, organizational skills and institutional policies and procedures. An overview of clinical preceptorship topics are shown in Table 11.11.

Clinical Instruction

Topics

- Patient care
- Equipment
- Personnel
- Institutional policies & procedures
- Institutional geography
- Communications
- Job responsibilities
- Organizational skills
- Coping skills

Table 11.11

It is rather easy for an experienced practitioner to forget the first days on the clinical scene. The clinical setting initially overwhelms the senses with unknown, sights, sounds, activities and people. As previously mentioned, the clinical setting is the students' initial exposure to serious illness from the standpoint of a care giver. Their initial reaction to this typically is confusion and fear. The preceptor should be aware of this initial trepidation and be prepared to ease the student into the situation. Furthermore, even an experienced practitioner feels some anxiety when introduced to a new setting or institution. So, orientees also require some mentoring.

The primary goal of clinical instruction is to prepare students to perform the diagnostic and therapeutic procedures for which they will be responsible upon graduation. This involves learning about patient assessment, procedures and communications with patients and families. It is in this setting that the knowledge acquired in the classroom and lab should crystallize. Here, they should find out why they had to learn the things they did. So, it is important that preceptors remind students of elements of the knowledge base for practice.

Also, students must be prepared to function as an employee at a clinical setting. So, they must learn about the specific policies and practices of the institution; that is, how thing are done therein. They need to learn how to find their way around and where to find needed resources. They must become acquainted with personnel in the institution and, importantly, how to communicate with them about their patients. Eventually, the student must be able to function independently in the setting. Therefore, they also must learn organizational skills, such as time management and prioritization.

Last, but not least, students must acquire skills to cope with the stress that arises in patient care settings. The situations that create stress may be things like a sudden influx of stat laboratory or radiographic orders, interpersonal conflicts, clinical errors, clinical emergencies and patient deaths. Students must be enabled to cope with these, because they are part of the job.

Progression of Clinical Learning

Considering that preceptors function as guides for students, they must first be aware of the students' entry level skills, then they need to be aware of the expected exit skills. Where students are involved, it usually is the responsibility of the school to inform the preceptors on both counts. The school should provide the preceptors with specific information on what courses have been completed, as well as their exposure to equipment and procedures in the lab. Specific clinical objectives also should be provided to the preceptors. It is their responsibility to target these for instruction.

Progression With Procedures

- Student observes
- Student describes how
- Performs with supervision
- Criterion evaluation
- Independence

Table 11.12

Initial instruction should involve familiarization with the institution, its geography and personnel. For students who are new to clinical practice, preceptors

should start by functioning as role models. That is, students can follow them, observe, and ease into the setting and patient interaction. Besides following and observing, students should be encouraged to familiarize themselves with all aspects of the setting and to read patients' medical records for comprehension.

After the student has gained familiarity and a certain degree of comfort with the setting, they should be ready to do things under the supervision of the preceptor. We will use measuring a patient's pulse as an example of a basic procedure. Before entering the patient's room, the preceptor should ask the student if they feel prepared to take a patient's pulse. If so, they should have the student describe how they will proceed. If the student succeeds in the description, they are permitted to take the patient's pulse while the preceptor watches.

After the student completes the procedure, the preceptor gives corrective feedback about the performance and verifies the student's command of cognitive aspects of the procedure. This is accomplished by asking oral questions about such things as the rationale, complications, effects, devices, et cetera, pertaining to the procedure. This oral questioning not only ensures the student's command of cognitive aspects, it also integrates the cognitive and procedure skills.

Depending upon the complications and complexities of the procedure, students should perform them under supervision until they are prepared for criterion evaluation on the procedure. Usually, students are permitted to perform procedures under less supervision after they are evaluated. So, the criterion evaluation is an important step.

Students should not be rushed into this evaluation, as prematurity here can result in hazards to the patient, anxiety for the students and legal risk for the preceptor. Although students require less supervision after criterion evaluation, preceptors should be cautious and continue to monitor the student's practices. One cannot assume that a person who practices to do something to perfection for a show (evaluation) will continue to perform at the same level.

Clinical Instructional Strategies

Clinical preceptorship presents opportunities to develop and apply unique instructional strategies that are not available or feasible in the classroom. Every patient, clinical area and device is an opportunity for teaching and learning. As previously stated, the clinical setting is where students refine and crystallize their cognitive, procedural and affective skills. The preceptor must be attentive to reinforcing and developing all three kinds of skills for the students, as all are essential to professional practice. Table 11.13 lists several useful instructional strategies for clinical preceptors.

Knowledge gained in the classroom is quite vulnerable to forgetting in the clinical setting, unless it is reinforced. Therefore, it is very important for preceptors to maintain their own knowledge base as current and comprehensive. Although this setting does not lend itself well to formal

lecture, other instructional platforms are even more available to the preceptor. Furthermore, an important function of clinical instruction is to integrate knowledge from the classroom into the clinical picture. Even something as simple as the presence of a patient with medical record presents a rich opportunity for learning.

Clinical Instruction Strategies

- Chart reading
- Socratic instruction
- Student patient presentations
- Student instruction of colleagues
- Clinical conferences
- Debriefing
- Simulations
- Role playing
- Role modeling

Table 11.13

Every patient's chart is replete with information that can be used to teach about patient assessment, a tremendous variety of therapeutic techniques and clinical documentation, itself. So, a student can be given a chart to read, with instructions to read for comprehension every word in every section. They should research every drug, diagnostic result, surgical record, anesthesia report, et cetera. Then, the student can be required to give a written or oral report of what they read. It is helpful for the preceptor to look over the student's shoulder and ask questions, because beginning students sometimes are so overwhelmed by the new information, that they do not know what information to select.

Preceptors have the advantage over classroom instructors in terms of the numbers of students they teach at a given time. So, the preceptor can use instructional strategies like tutorial and Socratic methods. A second advantage of preceptorship is the opportunity to spend time with students under circumstances that are less formal and more relaxed than the classroom.

Oral questioning has a special place in clinical instruction, because so many things happen in the setting that make such questions arise. For example, a student who has just interviewed a patient as part of a neurologic assessment might be asked about what they found, the implications of those findings for the patient's physical and mental health and their recommendations for therapy. Affective issues also can be addressed over the same situation asking questions to elicit expressions of empathy, ethics, et cetera.

Conferences with students can take several forms and serve several purposes. Conferences can be used as opportunities for tutorials and Socratic methods, but they also can be used to develop students' presentation and communication skills. For example, students can present patients to the preceptor, peers and personnel from other disciplines during clinical conferences. Students need to learn how to interact with physicians and nurses, in particular. So, they should be required to develop effective professional communications with them. For example, a physical therapy student could be required to teach nursing staff about the why's and wherefore's of electromyograms.

Debriefing is another effective application for clinical conferences. At the end of a clinical day, or especially, after significant clinical event, a conference should be conducted to review the day or event. An important event opens the door to asking questions like why things happened, what-if

another step had been taken, and importantly, how the students feel about the event. Every event is an opportunity to mold students' cognitive skills and professional behaviors.

To cite an example for debriefing, a patient experiences a cardiac arrest in an intensive care unit and does not survive. Students could be asked to review and critique the steps that were taken to resuscitate the patient. They also could be asked to talk about their feelings, during and after the event, and how they feel about the demise.

Simulations of several types also are applicable in the clinical setting. For example, students can assemble, calibrate and apply devices. Also, the preceptor can create malfunctions, then require students to correct them. Role-playing is another form of simulation. For example, and instructor may ask one student to play the role of a mother who just delivered a premature infant who is very sick, while another plays the role of a respiratory therapist who encounters the mother at the infant's bedside. There are many ways these roles can proceed. The possibilities for instruction in the clinical setting are mostly limited by the creativity and desire to teach on the part of the preceptor.

Role-modeling is yet another instructional strategy for preceptors to use; one they cannot escape. The performance and demeanor of a preceptor can have tremendous positive influence on a student. By setting an example of professionalism, a preceptor can give a student a lofty goal as an aim; that is, to emulate the professional who seems to know everything, can solve every problem, perform every procedure and to whom colleagues show respect.

Unfortunately, improper role modeling by preceptors often causes 'unlearning' of cognitive skills, sloppy procedural skills and inappropriate professional behavior. It is unrealistic and unreasonable for a preceptor to expect greater skills from a student than they, themselves demonstrate. This holds true for all domains of skills.

Evaluating Clinical Skills

Valid, reliable and equitable evaluation of skills in the clinical setting is difficult, as well as important. The evaluation is important, because the clinical setting is a student's last stop before independent clinical practice. Therefore, inaccurate evaluation can disrupt the student's professional career, on one hand; on the other, it can endanger the safety of patients who would come under their care. Both options represent an undesirable state of affairs.

Chapter Seven of this manual describes the instruments that are applicable to clinical evaluation. Examples of the instruments are in the Appendix to Chapter Seven, as well. Cognitive skills usually are evaluated with oral questioning, conferences and student presentations. Performance evaluation forms are instruments to evaluate procedure skills. It is important for preceptors to become familiar with these forms and how to use them. Furthermore, preceptors should use these religiously, to provide evidence of objectivity in the evaluation.

Because attitudes and values are nearly impossible to measure, to evaluate that domain, we use professional behaviors, which are observable. Still, some of the parameters included under the heading are difficult to objectively evaluate accurately and equitably. Therefore, good instruments and documentation are important to evaluation of these skills, as well. Chapter Seven also includes a behavior rating scale, which is used by preceptors to rate professional behaviors.

There are several important points preceptors should heed regarding the evaluation of professional behaviors. First, preceptors should fully understand the purpose and importance of the evaluation. For example, a student who is dishonest or irresponsible is just as dangerous as one with inadequate knowledge. Second, they should use the evaluation instruments, like the rating scale, assiduously, because they add objectivity to the evaluation. Finally, preceptors should adopt the viewpoint that these professional behaviors are, indeed, skills. Therefore, they can be taught and learned. Also, there is usually room for improvement. The implication for this is that preceptors should seriously reconsider before rating a student with the greatest possible score.

Clinical Lesson Plan

Each day of clinical training should be considered a lesson, which proceeds from a plan. Table 11.14 outlines a clinical lesson plan. These stages do not happen in sequence as in the classroom or laboratory. Rather, elements of various stages are interspersed throughout the day.

Stage one of the lesson is preparation of the student to receive the instruction. This stage should take the form of a conference with students to prepare them for the forthcoming instruction. The preceptor should confer with students to determine where they are in terms of progress and where they should be at the end of the day. That is, the objectives for the day should be stated and the students attuned to what is expected of them.

For example, a dental hygiene preceptor in a clinic could determine that a student has observed enough in the clinic to begin working on patients. So, the plan for the day is for the student to see their first patient, under close supervision. The preceptor would review the procedures with the student, have the student review the records of the patients who will be seen, discuss the likely outcomes and signs of any complications that might occur.

Clinical Lesson Plan

Preparation- preclinical conference

- Determine entry skills
- Establish goals
- Describe likely events

Presentation

- Discuss patients, etc.
- Demonstrate new procedures
- Role model desired behaviors
- Clinical conferences

Application

- Observe, correct skills
- Simulations
- Role-playing
- Student presentations

Verification

- Evaluate cognitive skills
- Evaluate procedures (when appropriate)
- Evaluate professional behavior

Summary, review (post-clinical conference)

- Provide feedback
- Discuss events, patients

Table 11.14

As previously mentioned, elements of the stages may be interspersed throughout the day. In the clinical setting, presentations take many forms and occur when opportunities arise. As shown in Table 11.14, preceptors present by demonstrating, role-modeling (throughout the day), conducting conferences, discussions, et cetera. Every event in the clinical setting is an opportunity for preceptors to present in some fashion. Of course, common sense must rule the timing. For example, it is likely to be inappropriate for a preceptor to explain a procedure or answer questions about it, while performing it. Both preceptors and students must be conscious of the need to discuss patients in appropriate times and places.

Much of a clinical day is devoted to guided practice- the application stage. This involves students doing all of the things they are supposed to be doing at their level. During this stage, preceptors must be aware of their own responsibilities in this stage. That is, they should closely observe students to ensure that their practices are correct, guiding them to perfection in all ways.

In addition to guided practice of procedures, the application stage can involve students practicing their cognitive and affective skills. Students can apply their skills by presenting patients, role-playing various kinds of scenarios and discussing all aspects of clinical practice. This is an excellent opportunity for students to reinforce their knowledge and affect, which should not be ignored. Such exercises help to develop the students' confidence in their skills, as well as metacognition, which ought to motivate them to remediate any weaknesses.

In the classroom, verification mostly involves satisfactory completion of final examinations. In the clinical setting, it involves formal evaluation of the requisite clinical skills. So, preceptors verify by applying the criterion tests for cognition, procedures and professional behavior by using the evaluation instruments previously mentioned. Although a given clinical day may not involve verification on a procedure, at least the cognitive and professional behaviors should be verified.

Summary and review take place during conference at the end of the day, as discussed in a previous section as debriefing. During the conference, the students and preceptor should discuss their patients, procedures, significant events and what specific skills were developed. It is important for each student to end each day with a feeling of accomplishment; that they gained skills. Sometimes students are not entirely aware of this and it is helpful for the preceptor to point out a student's progress.

Common Preceptor Errors

Many preceptors are practitioners without the benefit of any formal preparation as instructors. Therefore, they sometimes make mistakes that can have considerable negative impact on students. Table 11.15 lists some of the common, important errors committed by preceptors.

Development of cognitive skills often seems to take a back seat in the clinical setting, because some preceptors become procedure-oriented after years of clinical practice. This is an unfortunate state of affairs, because the clinical setting is where the cognitive base should be integrated with

other types of clinical skills. Reminding and tutoring students on cognitive skills not only assists them, it helps the preceptor maintain their own knowledge base.

Several common preceptor error pertain to the evaluation procedures. When evaluating students on procedures, preceptors frequently do not use the evaluation forms while they observe the student. This can lead to evaluations that are haphazard; therefore invalid. A second problems pertaining to evaluating on procedures is for preceptors to evaluate students before they are truly prepared for the evaluations. Students need time to practice before the evaluations. Also pertaining to evaluations, some preceptors tend to grade students too easily. This particularly holds true for evaluations of affect, or professional behavior. Objectivity is the key to valid evaluations.

Common Preceptor Errors

- Failure to integrate cognitive skills
- Failure to use performance evaluation forms
- Premature procedure evaluation
- Easy grading
- Poor professional role modeling
- Clinical shortcuts

Table 11.15

Preceptors always should remember that they serve as role models for students. So, it is critical that their own conduct is worthy of emulation. Sometimes, preceptors will take clinical shortcuts that may be safe when taken by an experienced clinician, but not for novices. Preceptors sometimes are inclined to say thing to students, like, 'this is how we do it in the real world.' This kind of behavior only confuses students and should be avoided. The professional conduct of a preceptor also is subject to scrutiny by students. When preceptors demonstrate behavior that is less than professional, they provide students with a poor example, which does not support development of professional excellence in students.

CHAPTER ELEVEN
STUDY EXERCISES AND QUESTIONS

1. Develop a laboratory exercise intended to familiarize students with a device common to your practice of your profession.
2. Develop a laboratory exercise intended to teach students to describe the function of a device common to the practice of your profession.
3. Develop a laboratory exercise intended to teach students to troubleshoot a device common to the practice of you profession.
4. Develop a laboratory intended to teach students a procedure common to the practice of your profession.
5. List the roles of a preceptor
6. Describe common clinical instruction strategies.
7. Describe the recommended progression of a student with respect to procedure performance in the clinical setting.
8. Describe the elements of a clinical lesson plan.

GLOSSARY

Advanced organizers-	Instructional materials given to learners before the instructional presentation, intended to direct attention and prepare for encoding of to-be-learned (TBL) information.
Affective (domain)	Attributes and skills related to morals and values.
Aid (instructional)	An instructional medium used to support learning within a platform; for instance, a slide would be an aid to support a lecture.
Attention	Cognitive process that regulates the selection of environmental. information for memory processing.
Cognitive (domain)	Skills in information processing; those related to knowledge.
Competency	Set of skills needed to perform a task or job
Competency-based education (CBE)	Education based on acquisition of competencies. Generally, CBE permits many opportunities for learners to master the skills.
Context (instructional)	The setting in which instruction occurs. Includes the physical setting, instructor and learner attributes
Criterion-referenced (evaluation)	Based on an absolute, measured performance to a specified level.
Cuing	An instructional strategy to direct attention to specific elements of a visual display. Cuing strategies include pointing, highlighting, boldfacing, et cetera.
Distractor	A possible response to an examination item that is an incorrect answer for the item.
Domain	A general area of skills: affective, cognitive, psychomotor
Drill	Rehearsal of cognitive skills.
Enabling objective	An objective that must be attained before a more complex objective can be attained
Encoding	Conversion of information from the environment into mnemonic code.

Elaboration	Cognitive process, requiring active rehearsal of information, wherein multiple connections are made with information resident in memory.
Episodic memory	Memory pertaining to events- memory of sensations.
Executive controller	Process that controls other cognitive processes.
Evaluation	Process of inquiry that leads to a decision. In instruction, usually decisions about student achievement or instructional effectiveness.
Formative evaluation	Evaluation intended to provide feedback for improvement of processes.
Game	Instructional platform that employs competition as a motivator.
Instructional need	The difference between the entry-level skills of learners and the desired skills.
Interactivity	Reciprocal communication between instructor or instructional medium, such as a computer. When a computer-based tutorial includes variation of presentation in response to learner input, it is interactive. When a lecturer asks and answers questions, the lecture is interactive.
Learning objectives	Descriptions of behaviors desired as a result of the instruction
Levels of processing	Theoretical construct implying that different types and intensities of rehearsal lead to longer-lasting and/or complex learning.
Long-term store (LTS)	Memory that is inactive at a given point in time.
Metacognition	Knowledge about one's own cognition on a topic. Also called 'comprehension monitoring.'
Mnemonic	Pertaining to memory structures or functions.
Multimedia	Computer-based programs that output various permutations of stimuli, including text, graphics, sound and video.
Normative referenced evaluation	Evaluation based on comparison with scores of other learners.

Occupational (job) analysis	Identification of all tasks or competencies necessary to succeed at an occupation.
Pedagogy	The science of teaching. Pedagogical- related to teaching.
Platform (instructional)	The primary medium used to present a lesson.
Practice	Rehearsal of psychomotor skills
Preceptor	A person responsible for instruction in the clinical setting. Applies to instruction of students, orienting new employees and inservice instruction of peers.
Problem-solving	Creating the solution to a problem that has previously been unencountered.
Professional behaviors	Set of non-cognitive, non-psychomotor skills that are expected within personnel practicing a profession; such as communications, integrity, empathy, responsibility.
Psychomotor	Skills demonstrated by physical performance.
Reliability (of instruments)	Capability of an instrument to measure consistently, as between different measurers and times of measurement.
Retrieval (of information)	Activation of information residing in the long-term store. Also known as remembering.
Short-term store (STS)	Working, or active memory.
Semantic memory	Memory pertaining to concepts, meaning, comprehension.
Sensory register	The component of brain where information from the environment is initially processed for memory; that is, perceived.
Schema (schemata- plural)	Framework for information in memory.
Short-term store (STS)	Also called working memory. That portion of memory that is active at a given point in time.
Simulation	Instructional platform or evaluation that employs a representation of reality.

Socratic instruction	Instructional platform consisting of oral questioning and corrective feedback.
Spreading activation	Process by which information is retrieved. Initial information node is accessed; then, search for 'best' information proceeds from there to related nodes.
Stem	The component of a multiple-choice examination item to which a response is made. The first part of the item.
Summative evaluation	Evaluation that results in a final decision; e.g., whether a learner passes a course.
Syllabus (course)	A synopsis of course content, which includes specific elements, usually prescribed by individual institutions.
Task analysis	Identification of all behavioral elements of a task, including domains and levels for each element.
Taxonomy of learning	Hierarchical organization of tasks within a skill domain, in order of the complexity of the tasks.
Transfer of learning	The application of a skill beyond the context in which it is acquired.
Tutorial	Instructional platform that involves individualized, interactive instruction to a small group of learners.
Validity (of instruments)	The capability of an instrument to measure what it is intended to measure.
Videoconference	Distance learning instruction by live, interactive television. Also known as interactive television.

APPENDIX ONE

Syllabus- Instruction in the Health Professions

COURSE DESCRIPTION:

This course intends to develop instructional skills of healthcare professionals. The learners will acquire fundamental knowledge and practical skills in developing lessons, courses, instructional aids and course syllabi for instruction in the classroom, laboratory and clinical areas. Also, learners will gain knowledge in dealing with instructional problems and in developing and evaluating curricula.

HOURS: Two semester hours during the Senior year.

PREREQUISITE: Permission of the instructor

Instructor:	Arthur P. Jones, EdD, RRT
Office:	School of Allied Health, #4.104
Phone:	888-555-1212
email:	prof1@hooryu.edu
Office hours:	MW 2-4 PM

LEARNING OBJECTIVES:

1. Develop and present lessons intended to teach cognitive and procedural skills, respectively.
2. Evaluate student achievement from lessons.
3. Develop instructional aids and demonstrate their effective use.
4. Develop a course syllabus.
5. Describe strategies to overcome cognitive and sensory barriers to instruction.
6. Describe the various ways and means for evaluating program curricula.
7. Develop laboratory exercises to teach patient assessment, medical devices and clinical procedures.
8. Develop a lesson plan for clinical instruction.

TEXTBOOKS AND REFERENCES: Jones AP. Instructional Skills for Healthcare Professionals, 2000.

TEACHING AND LEARNING METHODS:

- Videotaped lecture
- Student projects and presentations
- Reading assignments
- Internet communications and resources

EVALUATION:

Evaluation is based on exams, presentations, and assignments. Grades are computed as follows:

Exam (1)	20%
Final Exam	30%
Projects, presentations	45%

The grading scale follows:

90-100%	A
80-89%	B
75-79	C
70-74	D
<69%	F

COURSE OUTLINE

I. Principles of instruction
- A. Instructional paradigms
- B. Information processing
- C. Domains and levels of skills
- D. Goals and objectives

II. Instructional methods
- A. Instructional platforms- lecture, discussion, etc.
- B. Instructional aids
- C. Lesson and course development
- D. Computer-based and distance learning
- E. Evaluation of learning and instruction
- F. Laboratory and clinical instruction

III. Instructional problems
- A. Motivation
- B. Behavioral problems
- C. Communication barriers

IV. Curriculum development and evaluation
- A. Task analysis- job analysis
- B. Course development
- C. Curriculum development
- D. Curriculum evaluation

Description of Course Projects

Project 1 Locate two journal articles on education topics, which have been published since 1993. For each of these, write a one-page paper that consists of a synopsis of the paper and its implications for allied health education. Also, state how the articles were located. (5%)

Project 2,3 Each student will develop and present two lessons, one informational and one demonstration, on topics that require the instructor's approval. (10% each)

- In addition to the lesson presentations, each student must submit the following:
  - lesson plan- includes learning objectives
  - bibliography (1-3 information sources)
  - information lesson- multiple-choice test items (3), based on objectives
  - procedure lesson- procedure checklist, based on task analysis

Project 4 Locate two journal articles on distance education or computer-based instruction, which have been published since 1995. For each of these, write a one-page paper that consists of a synopsis of the paper and its implications for allied health education. Also, state how the articles were located. (5%)

Project 5 Each student will develop a student assignment based on computer courseware.
- A classmate will complete the assignment, which will be graded by the student-instructor.
- The student-instructor will submit the original assignment, as well as that completed by the classmate.

Project 6 Given instructional context and goal, each student will develop a course syllabus.

Course Schedule

Week	Topic	Assignment
1	Introduction to education- paradigms of instruction	MIHP†, Chap. 1
	Information processing	MIHP, Chap. 2
2	Developing learning objectives	MIHP, Chap. 3
3	Instructional platforms, Instructional aids	MIHP, Chap. 4, 5
4	Lesson and course development	MIHP, Chap. 6
5	**Student presentations- information lesson**	
	Student presentations- demonstration lesson	
6	**Examination #1 (up to and including Chap. 6)**	
7	Computer-based instruction, distance learning	MIHP, Chap. 7
8	Evaluation of learning	MIHP, Chap. 8
9	Instructional problems	MIHP, Chap. 9
	Curriculum development and evaluation	MIHP, Chap. 10
10	Laboratory and clinical instruction	MIHP, Chap. 11
11	**Final Examination (comprehensive)**	

†Instructional Skills for Healthcare Professionals

Information Lesson Evaluation		
Presenter:	Topic:	Date:
Criterion	**Comments**	**Points**
Preparation stage		
Gained attention		
Established relevance		
Stimulated recall		
Clarified objectives		
Presentation stage		
Organized logically		
Presented clearly		
Emphasized important points		
Explained adequately		
Covered topic thoroughly		
Maintained contact with learners		
Used appropriate aids		
Used aids effectively		
Application stage		
Answered questions adequately		
Asked objective-based questions		
Gave corrective feedback		
Summary stage		
Summarized lesson		
Reviewed important points		
Suggested further study		
Scoring: 1 = satisfactory; 0 = unsatisfactory or absent		**Total score:**
Additional comments: Evaluator:		

Demonstration Lesson Evaluation		
Presenter:	Topic:	Date:
Criterion	**Comments**	**Points**
Preparation stage		
Gained attention		
Established relevance		
Stimulated recall		
Clarified objectives		
Presentation stage		
Demonstrated at normal speed		
Demonstrated slowly, explained		
Emphasized important points		
Demonstrated competently		
Organized logically		
Presented clearly		
Maintained contact with learners		
Application stage		
Answered questions adequately		
Provided guided practice		
Gave corrective feedback		
Summary stage		
Summarized lesson		
Reviewed important points		
Suggested further study, practice		
1 = satisfactory; 0 = unsatisfactory or absent		**Total score:**
Additional comments: Evaluator:		