Chapter 1 Introduction

In this chapter, we will first briefly examine the dimensions of teaching model, advanced by Cashin (1989); this will serve as our conceptual framework as we examine active teaching and learning Next, we examine the Teaching/Assessment Cycle as "assessment informed" instructional design and instruction are essential to effective active teaching and learning. Thirdly, we will examine the nature of knowledge and learning. Fourthly, we will turn our attention to learning styles, given their centrality to involving learners in learning; instruction must be designed so that learners may "naturally" engage their learning. Finally, we briefly examine specific active learning models.

I. The Dimensions of Teaching Model

A. After carefully reviewing the work of Centra (1977, 1979) and Arreola (1986, 1989), Cashin (1989) advanced a seven dimensional model of effective teaching, which is:

1. Curriculum development entails the writing of new academic programs, e.g., majors, minors, concentrations, etc. and the integration and sequencing of courses to achieve specific program level learning outcomes and performance standards.
2. Within subject matter mastery is content knowledge depth and breadth as well as the ability to successfully and effectively apply such knowledge.
3. Course design includes the development or revision of a course with a focus on instructional goals or learning standards, content coverage, teaching methods, and assessment methods employed within a course.
4. Delivery of instruction involves the impact on student learning of an instructor's (1) body and voice behaviors; (2) presentation and instructional media management; (3) explanations, examples, and question management; and (4) class management.
5. Included in the assessment of student learning is the assessment and evaluation of course assignments, exercises, tests, papers, projects, field experiences, practicum, and grading policy, etc. upon student learning.
6. Availability to students considers the keeping of office hours, formal and informal professional student contact, and electronic access.
7. The academic administration dimension regards a faculty member's compliance with institutional policies and procedures which support the other six dimensions of teaching. Examples include timely book orders, having syllabi on file, turning in grade reports, and the holding of classes on time and as scheduled, etc.

B. While defined separately, each dimension is mediated by one or more of the others. For example, "curriculum design" is directly influenced by "subject mater mastery" as the more an instructor knows and can do, usually the greater is his or her teaching effectiveness. The "course design" dimension would be similarly influenced.

C. While Cashin's theory is attractive, it is underdeveloped. There were no formal definitions proffered for any of the dimensions. However, he did offer suggestions as to the types of data which may be collected and which then could be used to help frame definitions. Given this scenario, Feldman's (1986, 1989a, 1989b) attributes were integrated, based on logical analysis, into each dimension of the Cashin's model to develop operational definitions and indicators. The Dimensions of Teaching Model is discussed more thoroughly in Chapter 2.

D. The Teaching/Assessment Cycle

1. Assessment informed instruction requires the educator (teacher, trainer, planner, instructional designer or administrator) to plan, deliver, and adjust instruction based on students' or trainees' evolving mastery of learning and skill standards until the desired mastery is achieved.
   a. We avoid the phrase, "test-driven instruction," which suggests that instruction is based only or primarily on test results.
   b. The authors prefer, "data-informed instruction," which acknowledges that instruction involves more (e.g., values, preferences, developmental levels, etc.) than just test data.
2. The Teaching/Assessment cycle is outlined in Figure 1.1.
   a. Based on learning standards, teaching is conducted.
   b. Once teaching is launched, continuous formative assessment is engaged as is re-teaching based on assessment results.
   c. The assessment/re-teaching cycle is repeated until suitable mastery is demonstrated via summative assessment. Then a new teaching/assessment cycle begins.
   d. The teaching/ assessment cycle assumes that instruction and assessment are planned and executed in conformance to articulated learning and performance standards.
3. Next, we will examine the nature of knowledge and its relationship to learning.

II. Knowledge, Learning, and Intellectual Skills

A. Definition of Knowledge

1. Alexander (1996, p. 89) writes that knowledge "is a scaffold that supports the construction of all future learning." Greeno, Collins, & Resnick (1996, p. 16) argue that the cognitive view of knowledge "emphasizes understanding of concepts and theories in different subject matter domains [e.g., reading or science] and general cognitive abilities, such as reasoning, planning, solving problems, and comprehending language." This suggests that there exist general divisions of knowledge:
   a. Domain specific knowledge: Knowledge required to complete a specific task (e.g., using the telephone) or subject (e.g., the history of the Spanish-American War).
   b. General knowledge: Knowledge that may be applied across differing situations, e.g., problem solving skills are required to diagnose why the computer may not be running correctly or why the faucet still leaks after

two hours of home repairs. The same essential problem solving skills are required to resolve the problem, regardless of the problem situation.

2. Knowledge Classifications
   a. Knowledge can also be broadly categorized according to use, as declarative, procedural, or conditional (Paris & Cunningham, 1996; Paris, Lipson, & Wixson, 1993).
      (1) Farnham-Diggory (1994, p. 468) defined declarative knowledge, "knowledge that can be declared, usually in words, through lectures, books, writing, verbal exchange, Braille, sign language, mathematical notation, and so on." Declarative knowledge can be simple facts, generalities, rules, personal preferences, etc.
      (2) Woolfolk (2001, p. 242) defines procedural knowledge as "knowing how to do something such as divide fractions or clean a carburetor. Procedural knowledge must be demonstrated." Other examples of procedural knowledge include translating languages, classifying shapes, reading, or writing. In intellectual skills taxonomies proposed by Bloom, Engelhart, Frost, & Krathwohl (1956) and Gagne (1985), the levels beyond knowledge, are procedural knowledge.
      (3) Woolfolk (2001, p. 243) defines conditional knowledge as, "knowing when and why to apply…declarative and procedural knowledge." Conditional knowledge involves judgment. Examples of conditional knowledge include how to solve various math problems, when to skim or read for detail, when to change strategies when confronted with a perplexing problem, etc.

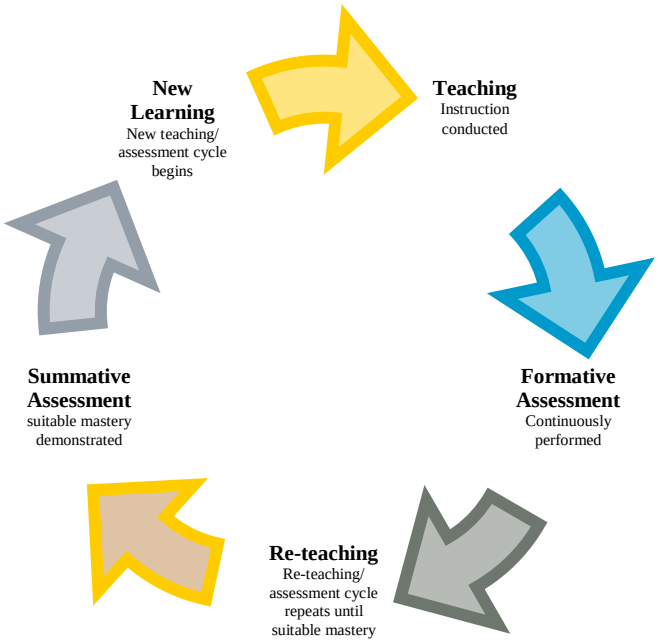

Figure 1.1 Teaching/Assessment Cycle

b. When measuring the effectiveness of instruction or an instructional program, the instructional designer or examiner may use traditional classroom testing strategies or direct performance assessments. Regardless of the strategy or mix of strategies selected, declarative knowledge, procedural knowledge, and/or conditional knowledge will be assessed. Thus, it is important to know which type of knowledge is being assessed in order to frame test items or construct direct performance assessments that will yield the information sought.
   (1) When examinee answers a multiple choice or true false item correctly, he or she displays declarative knowledge.
   (2) When an examinee answers an item which requires the listing of steps to bake cookies, according to a particular recipe, he or she displays procedural knowledge.
   (3) When examinee is required by an item to solve an algebraic expression, he or she displays conditional knowledge. When the circumstances surrounding a business opportunity change, one must decide on whether to pursue the same strategy or change the strategy in order to win a business contract. Remember, conditional knowledge requires judgment and relies on declarative and/or procedural knowledge.

B. Learning

1. The process of acquiring knowledge (declarative, procedural, and/or conditional) is called learning. In order to assess instructional effectiveness, learning must be measured. Kimble defined learning as, "a relatively permanent change in behavioral potentiality that occurs as a result of reinforced practice" 1961, p. 6). In other words, a learner must display his or her knowledge through behavior (e.g., answering a test item, repairing a car engine or modeling a particular attitude). Hergenhahn and Olson (1997, p. 2) have pointed out
   a. Leaning must be exhibited through behavior.
   b. Learning is a consequence of experience (e.g., life, schooling, training, practice, observation, etc.).
   c. Only reinforced (positively or negatively) experience, practice, etc. is learned. Reward is only one type of reinforcement.

2. Hergenhahn and Olson (1997, pp. 5-6) offer a slightly different definition of learning than Kimble, "learning is a relatively permanent change in behavior or in behavioral potentiality that results from experience and cannot be attributed to temporary body states such as those induced by illness, fatigue, or drugs." Instructional design and teaching strive to provide experiences and reinforcement which enables one to learn, which results in a permanent behavior change (or the realistic potential for behavior change). It is this behavior that is measured and then based on that measurement, inferences are made about what has been learned, how well it has been learned, and how adroitly it may be applied. For example:

a. The first grade student, who does not know how to read, learns to read. This is a permanent change in behavior. The teacher knows the student can read because the student read a story.
b. The worker, who lost her job due to changes in technology, learns new job content and skills by going to a vocational-technical school. An employer can determine whether or not the applicant can repair small engines, by watching her diagnose and repair a broken lawnmower motor.
c. A college freshman can demonstrate his knowledge of history by correctly answering several test items on causes of the Great Depression.

3. So one may ask, "How do we measure learning?"
   a. An instructional designer or teacher specifies the knowledge (declarative, procedural, and/or conditional), skills, or attitudes (KSA's) which need to be learned in order to accomplish a specific purpose.
      (1) These KSA's are then expressed as learning targets, learning outcomes, learning standards, or learning objectives. (These terms mean the same thing.)
      (2) Next, a learning target is "broken down" into its component parts (often called benchmarks) which a learner must know in order to meet or master the learning target. So, when a learner is able to accomplish all benchmarks, we infer that he or she has met or mastered the learning target.
   b. Once the learning targets and benchmarks are written, essential declarative, procedural, and conditional knowledge is further specified and sorted into modules or units. This sorting is an iterative process that often leads to changing the learning targets and benchmarks so that a "cleaner" alignment between them and the modules or units is achieved.
   c. Specific instructional strategies are then devised in order to facilitate and ensure learning.
   d. Since knowledge must be measured through learner behavior (e.g., answering test items, writing a paper, or completing a work product), formative and summative assessments may be devised and administered to learners in order to measure teaching or instructional design effectiveness.
      (1) Based on formative assessment results, instruction may be adjusted to assist those who are not learning as intended or to accelerate learning if learners exhibit mastery faster than anticipated.
      (2) At the conclusion of the learning experience, learners are usually given a summative assessment in the form of a traditional classroom test or a direct performance assessment (Chapter 5) to measure their learning. From these summative results, inferences are made about the effectiveness of the instructional design of the program, instruction, and learning.

4. As indicated in step 3d, above, learning is measured using a combination of formative and summative assessment tools.
   a. The most critical component of either a formative or summative assessment are the test items to which students or examinee's must respond.
   b. Test items are written to match the learning target benchmarks in order to determine if the examinee met (or mastered) the learning target benchmark, provided he or she knew the correct answer.
      (1) A test or instructional designer must be able to identify the mental (or intellectual skills) a learner must possess in order to meet the learning target. Bloom and colleagues (1956) have has classified "knowledge" into six intellectual skills: knowledge, comprehension, application, analysis, synthesis, and evaluation; a detailed discussion follows. Ideally, the intellectual skill written into a learning target benchmark will match test items written to specifically measure or assess learner mastery of that benchmark. In short, the learning target benchmark and test item must match on the specific intellectual skill of interest.
      (2) The test item writer must know the type of knowledge being assessed, and the specific intellectual skills an examinee must possess to answer the item correctly, provided he or she actually knows the answer.

C. Bloom, et al.'s Intellectual Skill Taxonomy

1. Bloom, et al.'s Taxonomy (1956) of Intellectual Skills
   a. Bloom, et al. (1956, p. 201) defines **knowledge** to include the recall of facts, methods, processes, patterns, structures, settings, etc. Knowledge is stored in the brain; the purpose of measurement is to present a response which will clue the examinee to recall of the stored knowledge. Kubiszyn and Borich (1996, p. 60) say knowledge is what students must remember.
      (1) Writing performance standards (also called learning targets, or objectives) at the knowledge level is the most common practice in education and training. This is done perhaps too much.
      (2) Knowledge that is memorized tends to be forgotten rather quickly. It is essential for learners to have this level of declarative knowledge as it is the basis for higher order intellectual skills.

   b. **Comprehension** is the lowest of the higher order intellectual skills in the taxonomy. Students use the knowledge largely within the context in which it was taught or learned. Students are expected to translate knowledge from one form to another without losing its essential meaning; interpret knowledge so as to identify its central elements or ideas, and then make inferences, generalizations, or summaries but within the original context or application; or based on the knowledge learned, to extrapolate trends, implications, consequences, etc. but again within a defined context.

   c. **Application** is the use of the newly learned information in either an extension of the learning situation or a new but related context. Neither the

test item nor the context should clue the examinee or student as to what prior learning is to be applied. Procedural rules, technical principles, theories, etc. are examples of what must be remembered and applied.

(1) Predicting a probable change in a dependent variable given a change in the independent variable or diagnosing an automobile starter problem given prior experience with the same problem but with a different vehicle are examples.

(2) The key distinction between application and comprehension is that examinees or students are required to perform what is or was comprehended in a "new" environment. They may apply abstract procedural knowledge to new or marginally related prompts, problems, or other stimuli.

d. **Analysis** is the breakdown, "deconstruction," or 'backwards engineering" of a communication, theory, process, or other "whole" into its constituent elements so that relationships and any hierarchical ordering is made explicit. Such an analysis reveals internal organization, assumptions, biases, etc. of an argument, thesis, or interpretation.

(1) Performance standards at the analysis level contribute to the development or refinement of a student's or examinee's critical thinking skills. Tasks or questions built to the analysis level will take time and perhaps even have more than one plausible answer or skill demonstration. To respond to analysis level questions or simulations, the student or examinee must:

(a) Deconstruct an argument, recognize unstated assumptions, separate fact from conjecture, identify motives, separate a conclusion from its supporting evidence, and identify logical contradictions or inferences;

(b) Once the constituent parts of a communication, e.g., argument, evidence, or simulation, have been identified, relationships between those parts must be assessed. It may be necessary to revise or delete elements which are less critical or less related to the intent of the communication; or

(c) The student or examinee may need to analyze how the communication was structured or organized, i.e., identify the organizing principles and techniques (e.g., form, pattern, etc.).

(2) Care should be taken so as not to confuse analysis with comprehension or evaluation. Comprehension centers on the content of the communication, regardless of form; analysis considers both. Evaluation involves a judgment as to merit or worth, given content and form as measured against either internal or explicit criteria.

e. **Synthesis** is embodied in the production of a unique communication, a plan or proposed set of operations, theory, etc. In effect, different elements are combined into a new "whole."

(1) Synthesis differs from comprehension, application, and analysis, in that synthesis tends to be more substantial and thorough, respecting the task. There is greater emphasis on creativity (uniqueness and originality) than in the other levels. Comprehension, application, and analysis tend to focus on a "whole" for better understanding whereas synthesis requires the student or examinee to assemble many different elements from many different sources so as to construct a "whole" that was not there before. Operations at the synthesis level rarely have more than one correct answer. Assignments or tasks that require the student or examinee to function at the synthesis level enhance creativity, but to be effective a thorough knowledge of the content or skill domain is required.

(2) Producing a unique communication: This type of synthesis requires an original communication to inform an audience or reader about the author's ideas, feelings, experiences, etc. Influencing factors to such communications are the desired effects, nature of the audience, medium of communication, conventions and forms of the medium selected to convey the communication, and the student or examinee him or herself. The student is fairly free to craft whatever content he or she wishes, subject to the above influencing factors; this makes the product unique.

(3) Production of a plan or proposed set of operations: Students or examinees are required to construct a plan or order of operations (i.e., a procedure for doing or accomplishing something). The plan or procedure is the product, which must satisfy the requirements of the task, usually specifications or data which become the basis for the plan or procedure. What is produced must meet the specifications and/or be consistent with the data. Typically, there is room for the student or examinee to include a "personal touch", so that the product is unique.

(4) Derivation of a set of abstract relations: The student or examinee must construct a set of abstract relationships. There are two tasks usually associated. First, the student starts with concrete data or phenomena and must explain or classify what he or she started with. Examples include the periodic table, biological phyla, developing taxonomy of intellectual skills, positing a theory or hypotheses. Secondly, the student or examinee starts with basic propositions, hypotheses, or symbolic representations (as in math) and then deduces other propositions or relationships. The student must reason within a fixed framework. Examples include theory formulation, positing hypotheses based on data or other knowledge, modifying theory or hypotheses based on qualitative or quantitative data. The difference between the first and second tasks is that in the first the task starts with concrete, typically quantitative, data and in the second, qualitative.

f. **Evaluation** involves the application of criteria and/or standards to methods, ideas, people, products, works, solutions, etc. for the purpose of

making a judgment about merit or worth. These judgments are predicated upon internal and external criteria.

(1) Judgments from internal evidence: The evaluation focuses on the accuracy of the work, regardless of form (e.g., idea, solution, methods, etc.). Attention is given to internal (i.e., within the work) logic, consistency, and lack of internal flaws. Indicators include consistent use of terminology, flow, relationship of conclusions or hypotheses to the material presented, precision and exactness of words and phrases, reference citations, etc. Considered together, the indicators influence perceptions of accuracy and quality.

(2) Judgments from external criteria: The work must be evaluated in light of criteria drawn from its discipline, trade, or other appropriate source. A work on nursing must be evaluated in terms of nursing criteria; art or literature in terms of the genre and governing conventions; or an assignment in light of its scoring rubric.

2. Operationalizing Bloom's Taxonomy for Assessment
   a. For select response items (e.g., true/false, fill-in-the-blank, matching, and most multiple choice items) simple verbs (concretely operationalize or require the examinee to demonstrate the intellectual skill. Simple verbs which enable an examinee to demonstrate each level of Bloom, et al.'s Taxonomy are presented below.
      (1) Knowledge: list, name, recall, state, underline, write, record, count, recite, draw, find, match, choose, etc.
      (2) Comprehension: compare, describe, restate, identify, contrast, express, explain, outline, paraphrase, summarize, report, etc.
      (3) Application: apply, complete, demonstrate, interpret, illustrate, perform, operate, produce, role-play, distinguish, etc.
      (4) Analysis: compare and contrast, diagram, deduce, differentiate, debate, analyze, critique, disassemble, distinguish or discriminate between, characterize, etc.
      (5) Synthesis: construct, combine, assemble, compose, formulate, organize, plan, prepare…., propose, research, etc.
      (6) Evaluate: judge, assess, appraise, justify or defend, support, score (as in applying a rubric), conclude and support, prove and support, rank and support, select or recommend and explain, etc.
   b. Using the most precise verb in writing the specific test item, will ensure that the intended intellectual skill is demonstrated by the examinee. Appropriate test reliability and validity will also be established.
   c. There has been a revision of Bloom's Taxonomy advanced; see Anderson and Krathwohl (2001).

3. Higher Order Intellectual Skill Clusters or Specific Thinking Skills
   a. To design reliable and valid discussion prompts or task descriptions, an instructional designer or examiner must specify the higher order skill cluster or clusters required of the examinee to successfully negotiate the

test item or complete the assigned task. These higher order intellectual skill clusters must match those written into a learning target or its benchmarks.

(1) Higher order intellectual skill clusters may also be referred to as specific thinking skills (Ennis, 1987). Specific thinking skills include:
   (a) Creative thinking is closely associated with writing fiction, plays, short stories or creating new and innovative procedures or processes. Michalko (1991, 2001) offers specific strategies to improve creative thinking. De Bono (1999) provides differing perspectives on creative thinking.
   (b) Problem-solving involves problem analysis, generating solution alternatives, and applying the selected alternative to resolve the presenting problem. Hurson (2008) provides guidance on innovative problem solving. Zeitz (2007) presents a detailed treatment of problem solving.
   (c) Decision-making is the process one goes through in order to make a decision. March (1994) provides a good primer on decision-making. Hoch and Kunreuther (2001) offer a thorough discussion.
   (d) Reasoning is use of deductive or inductive reasoning to arrive at a conclusion. Royal (2010) provides an analysis of various reasoning skills. Holyoak and Morrison (2012) offer a substantial treatment of thinking and reasoning.
   (e) Critical thinking will typically involve the use of analysis, synthesis, and evaluation in order to carefully critique the logic of an argument, the validity of a political or economic position, or the practicality of an idea. Brookfield (2012) and Fisher (2001) offer excellent explorations of critical thinking.

(2) Three specific thinking skills are examined in detail (reasoning, critical thinking and decision-making) in order to show that their definition, combination of higher order intellectual skills, and suitability depends on the purpose of the test item, project, or work product used to assess learning target or benchmark mastery. Extended response items (e.g., essay items) and task descriptions are likely to require examinee's to display multiple specific thinking skills.

(3) There are numerous books and articles written on each of the specific thinking skills enunciated above; the reader is advised to become expert in those specific thinking skills routinely employed in his or her discipline or job in order to adroitly design relevant specific thinking skills into an educational or training program and associated assessments.

b. <u>Reasoning</u>

(1) Suppose a class assignment or end of course project requires learners to use "reasoning." What is meant by "reasoning" must be defined by the instructional designer, instructor, and/or assessor, who might be one person discharging each role. The point being is that "reasoning"

must be consistently defined across course or module design, delivery, and assessment. Let's examine a framework developed by Quellmalz and Hoskyn (1997) as an example.

(2) After reviewing the literature on frameworks for conceptualizing reasoning, Quellmalz and Hoskyn (1997) concluded that each presented four reasoning skills: analysis, comparison, inference and interpretation, and evaluation.

(a) Analysis is much the same as described by Bloom, et al. (1956). When a whole is divided into its component elements, relationships among and between those parts and their whole emerge. McMillan (2004, p. 172) points out that examinees, who are able to analyze, can "break down, differentiate, categorize, sort and subdivide."

(b) Comparison entails the identification of differences and similarities. The learner compares, contrasts, or relates between and among explanations, data, arguments, assertions, or other objects of interest.

(c) Inductive and deductive thinking gives rise to inference making (e.g., hypothesizing, generalizing, concluding, and predicting) and interpretation. Interpretation is based on the inferences drawn.

(d) Evaluation according to Quellmalz and Hoskyn (1997) is very similar to critical thinking. See Paul and Elder (2010) for an easy to digest, practical discussion.

c. Critical Thinking

(1) Ennis (1987, p. 10) defined critical thinking as "reasonable reflective thinking that is focused on deciding what to believe or do." Critical thinking is the ability to evaluate information, evidence, action, or belief in order to make a considered judgment as to its truth, value, and relevance. To assess critical thinking skills, interactive multiple choice exercises, extended response essays, and performance assessments are most suitable.

(2) An adaptation of Ennis' (1987) framework is:

(a) Clarify the problem, issue, or opportunity. Formulate an inquiry (e.g., proposition or question) within a relevant context. Ask questions or collect information which helps to clarify the problem, issue, or opportunity.

(b) Collect more information. Assess the veracity of facts and claims made by information sources, including the sources themselves. Distinguish between relevant and irrelevant information, arguments, or assertions. Detect bias in explanations, facts presented, arguments, or assertions made by information sources.

(c) Apply inductive and deductive reasoning to the information collected. Identify logical inconsistencies and leaps in deductive and inductive reasoning from, within, between, and among the

explanations, facts presented, arguments, or assertions made by information sources.

(d) Analyze and synthesize the collected information. Search for implied or unstated assumptions; vague or irrational explanations, arguments or assertions; stereotypes; or name calling. Determine the nature of potentially critical relationships (e.g., coincidental, cause and effect, or spurious).

(e) Make a judgment. Formulate alternative answers, solutions, or choices. Within the most suitable mix of costs, values, beliefs, laws, regulations, rules, and customs, consider each alternative and its anticipated consequence. Make a judgment, but be prepared to justify, explain, and argue for it. See Paul and Elder (2010) for an easy to digest and practical discussion.

d. Decision Making

(1) A decision-making process may be diagramed as found in Figure 1.3. This is an example of procedural knowledge. Following the sequenced steps in a recipe is another example of procedural knowledge.

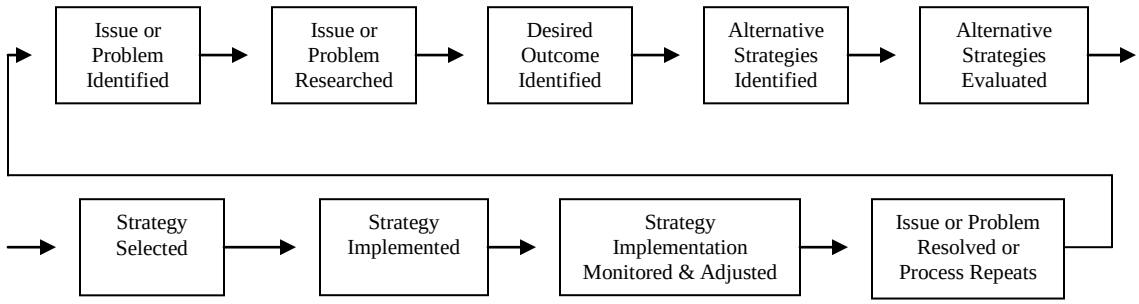

Figure 1.3 The Decision-Making Process

(2) Decision-making Process

(a) The first two stages of the decision-making process require the decision-maker to identify the existence of an issue or problem, and then research its causes, reasons for persistence, and impact.

(b) Next, the decision-maker identifies his or her desired outcome.

(c) Several strategies for attaining it are identified and evaluated as to its likelihood of success in producing the desired outcome.

(d) Once alternative strategies are evaluated, one may be selected and implemented. If it is determined that no feasible corrective solution strategy exits, the decision-maker may stop the process.

(e) Assuming a feasible corrective strategy is found, it is implemented, monitored and adjusted, as necessary.

(f) After some predetermined time, cost, or other criteria, the issue or problem is declared resolved. If not resolved, the decision-making process repeats.

III. Learning Style Theories

A. Introduction

1. Student learning styles have been the subject of significant research in education (Alspach, 1995; Billings & Halstead, 1998; Burke, 1997; Claxton & Murrell, 1987; Davis, 2001; Dunn & Griggs, 1995; Felder, 1996; Griggs & Grigs, 1998; Oddi, 1986; Soloman, 2006) given its relationship to improving teaching and student achievement.

2. Griggs (1991) defines learning style, "as the composite of characteristic cognitive, affective, and physiological factors that serve as relatively stable indicators of how a learner perceives, interacts with, and responds to the learning environment." Griggs includes cognitive styles, which she defines as "intrinsic information-process patterns that represent a person's typical mode of perceiving, thinking, remembering, and problem-solving." Griggs' definitions are drawn from Keefe, 1979.

3. Claxton and Murrell (1987, pp. 8-55) have organized several theories into four clusters; these groupings and their analysis form the basis of the present discussion.
   a. Personality models, posited by Witkin (1954) and Myers (1976).
   b. Information Processing models as advanced by Pask (1975, 1976), Siegel and Siegel (1965), Schmeck (1983), Kolb (1984), and/or Gregorc (1979).
   c. Social Interaction models as described by Grasha (1972), Reichmann & Grasha (1974), or Fuhrmann & Grasha (1983).
   d. Instructional Preference models as outlined by Hill and Nunnery (1973) and Canfield (1980).

4. Curry (1983) used an onion as a metaphor for describing the relationships between the various learning style theories. See Figure 1.3.
   a. According to Curry (1983),
      (1) The most stable, and hence difficult to change, characteristics are at the core or personality level.
      (2) Next, are the information processing models which explain how a person acquires and processes information.
      (3) The third layer, social interaction, describes student classroom behavior and interaction.
      (4) The fourth or outermost layer, instructional preference, details students' preferred teaching style.
   b. Individual student attributes, moving from the core towards the outermost layer, influence each other across the layers. Preferences closer to the outside are the least stable and most susceptible to change.
   c. The volatility of students' social interactions and instructional preferences make constructing valid and reliable measures and matching teaching and learning styles difficult.

B. Personality Theories

1. Field Dependence-Independence Theory
   Witkin's field dependence-independence theory is based upon perception research in psychology, using the rod-and-frame, body-adjustment, and embedded figures tests (1954, 1976).
   a. Witkin (1976, p. 43) wrote, "[t]he person who, in the laboratory, is strongly influenced by the surrounding visual framework in his [or her] perceptions of an item within, it is also likely, in social situations, to use the prevailing social frame of reference to define his [or her] attitudes, his [or her] beliefs, his [or her] feelings, and even his [or her] self-view from moment to moment."

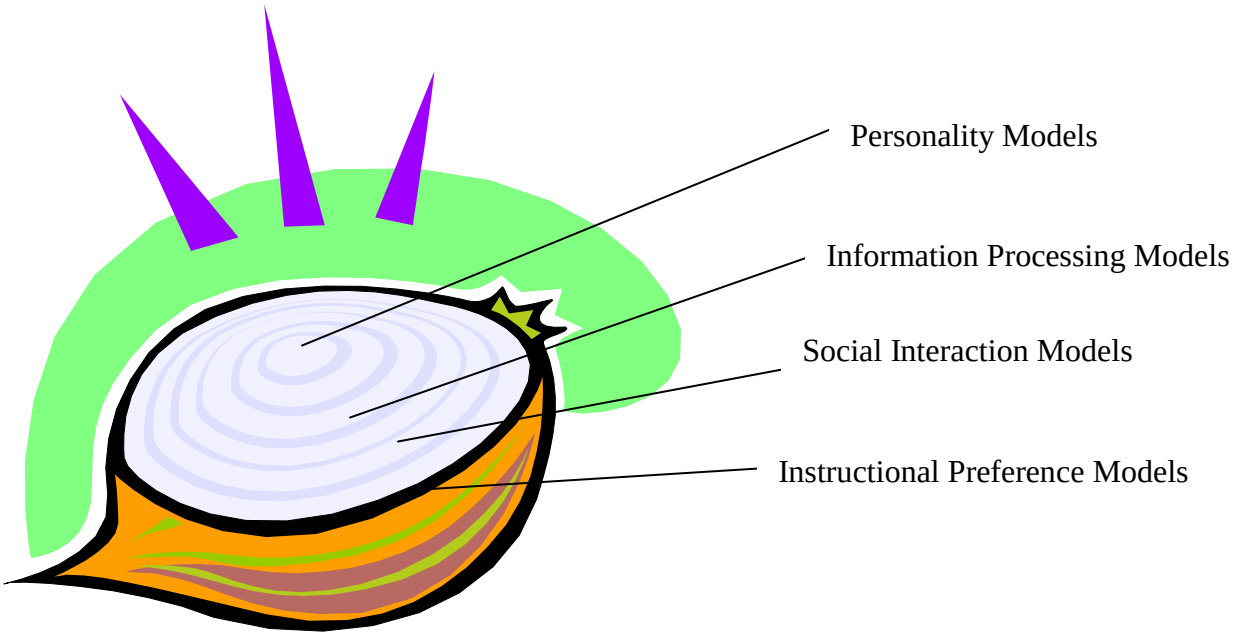

Figure 1.3 Relationships among Learning Style Theories

   b. Factors which influence degree of field dependence or independence include genetics, socialization, and child-rearing experiences. Children, who were raised to be more self-directed than other-directed, tended to be field-independent. Peer groups and authority figures exert greater influence on field-dependents than independents. Field-independents are more likely to choose analytic disciplines, e.g., science, mathematics, etc. Field-dependents are more like to select social sciences, e.g., humanities, helping professions, or sales, where greater emphases are placed on interpersonal skills (Witkins, 1976).
   c. Field-dependent teachers prefer discussion based (i.e., class discussion, simulations, work teams, etc.) teaching styles and more student centered classrooms, whereas field-independent teachers prefer lecture-centered styles and instructor actively managed classrooms.

d. In terms of perception, field-dependent students rated field-dependent teachers, more highly than field-independent teachers. Teachers rated students similarly.
e. The research on improvements in learning by matching learning style to teaching style is mixed at best. The study results are contradictory.
f. Recently, the terms, "field-dependent" and "field-independent", have been replaced with "field-sensitive thinking" and "field-independent thinking."

2. The Myers-Briggs Type Indicator (MBTI)
   a. Introduction
      (1) In type theory, "perception means becoming aware of things, people, events, or ideas", i.e., the free flow of information to the individual (Myers, McCaulley, Quenk, & Hammer, 1998, p. 24). There are two ways to perceive, the sensing or intuition functions.
      (2) Recognizing that humans must sort data for use according to the laws of reason, Jung identified two strategies or judgment functions, thinking and feeling.
      (3) The functions of perception and judgment, where one is dominant and one is auxiliary, are exercised within the context provided by two sets of attitudes or orientations.
         (a) The first pair of attitudes considers the flow of mental or psychic energy from the individual to the external environment (extraversion) or the flow of energy from the external environment to the individual (introversion) as well as the application of that energy, internally or externally to the individual.
         (b) The second pair is the Judging or perceiving attitude. This dichotomy is used to identify which function is dominant and which is auxiliary. Its second application is to identify how individuals react to the outside world.
      (4) Type is presumed to be stable over a person's adult life. But one can and frequently must learn behaviors associated with other types. An introvert can learn extraverted behaviors and become a successful sales person or public speaker.

   b. The Four Functions
      (1) Sensing or Intuition (S or N): Jung posits that we perceive along a continuum with opposite anchors, sensing or intuition. S and N are also referred to as the perceiving functions.
         (a) Sensing is perception based on one or more of the five senses. "Sensors" tend to be practical, oriented to the present, realistic, and detail oriented.
         (b) Intuition is perception drawn from inference or insight, excluding the five senses. A "hunch", "recognition of a possibility", "associations" or "possible meanings", are examples. Those who prefer intuition, tend to be creative, theoretical, and look toward the future.

(2) Thinking or Feeling (T or F): Jung believes that judgments are made along a continuum anchored by thinking or feeling strategies. T and F are referred to as the judging functions.
   (a) One who makes judgments impersonally based upon a logical analysis of the evidence and/or consequences is said to rely on the thinking dichotomy. Thinkers tend to be analytical, objective, fair, critical, dispassionate, and linear concerning time (i.e., past, present, future).
   (b) One who makes judgments based upon a rational linkage of personal or social values relies upon the feeling end of the dichotomy. Judgments or decisions made tend to be more subjective but arrived at by "weighing the relative values and merits of issues" (Myers, McCaulley, Quenk, & Hammer, 1998, p. 24). "Feelers" tend to be linked to and understand feelings and values; are humanistic; consider a decision's consequences on the people involved; and seek harmony. Feeling is not emotional decision making; it is a rational judgment rendering or decision-making process relying largely upon qualitative data.

(3) In type theory, one of the four functions is dominant. The other three functions are inferior and serve the objectives of the dominant function.

c. The Four Attitudes or Orientations
   (1) Extraversion/Introversion (E or I)
      (a) We all have psychic or mental energy, which we invest in either an extraverted or introverted manner, according to Jung (1923, 1971).
      (b) Extroverts focus on the outer world of people, behaviors, actions, things, and objects. The mental energy flows from within the individual to the external environment. Extroverts tend to be stimulated by the external environment, anxious to interact with others, open to new experiences, communicate easily, out going, talkative, and sometimes impulsive.
      (c) Introverts draw energy from the external environment into the internal one, i.e., towards the inner world of ideas, personal experiences, and concepts. Introverts tend refine and clarify ideas, theories, abstractions, etc.; rely more on traditional concepts and ways of knowing; exhibit a thoughtful, detached demeanor; desire privacy; and prefer to think things out as opposed to talk things out.
      (d) In type theory, extraversion does not mean sociable and introversion does not mean shy.
   (2) Judging or Perceiving (J or P)
      (a) Along with the E-I dichotomy, the J-P dimension determines which of the two (S/N or T/F) functions is dominant and which is auxiliary. When confronted with a new situation, one uses the perceiving functions (S/N) to gather information and then relies on the judging functions (T/F) to make appropriate decisions.

(b) The J/P dichotomy also describes a person's orientation to the outer or external (also called extraverted) world.
(c) In judging one's desire to make a decision and engage in planning and organizing activities. Closure is made as soon as enough information is gathered to make a decision.
[1] Thinking judging (TJ) types make decisions based on rational analysis.
[2] Feeling judging (FJ) types arrive at decisions and engage in planning based on a relative balance between values.
[3] The judging orientation involves only the thinking or feeling functions and refers only to decision-making.
(d) Respecting perception, one attends to incoming information.
[1] For the sensing perceiver (SP), the information is likely to be immediate and observable.
[2] For the intuitive perceiver (NP), the data are most likely new possibilities and/or ideas.
[3] Perceivers are likely to suspend judgment for as long as possible, as they are curious, open, and able to adapt easily.
[4] Perceiving incorporates the sensing and intuition functions.

d. Expressing Type
(1) There are 16 personality types in type theory, each expressed in a four letter sequence: E/I, S/N, T/F, J/P. A person with the ISTJ type
(a) Is an introvert who draws energy from his or her surrounding environment and applies that energy to the internal world of ideas, personal experiences, and concepts;
(b) Uses his or her senses to gather information about the immediate environment (sensing is the dominant function);
(c) Employs the thinking function to provide balance to the "irrational" sensing function (thinking is the auxiliary function); &
(d) Makes decisions based on rational analysis and ceases the gathering of information (or perceiving) as soon as enough is available to make a decision.

e. MBTI type and relationship to learning style (i.e., 16 learning styles) has been extensively, conveniently summarized by Dr. Gordon Lawrence (1993, 1997). Behaviors associated with specific types can be learned by other types.

f. The Four Functions and Learning Style
(1) Sensing (S) types are sequential, seek thorough understanding with detailed specification, easily memorize facts, and are practical. Those with the "ST" combination prefer systematic orderly active learning tasks, which engage the senses, e.g., demonstrations, simulations, visual presentations, incorporating sound. "SF" types also want to be engaged in learning where the senses are associated along with a personal connection to the learning and learning activity.

(2) Intuitive (N) types seek relationships between and among the facts and concepts to be learned, preference is for general concepts arrived at independently.
(3) The thinking (T) types prefer the professor's organizational perspective, exploring factual content deeply. "NT" types prefer well organized instructor lectures within highly structured courses. They also prefer independent study and research.
(4) Feeling (F) types learn best when they have rapport with the instructor as well as a personal relationship with the material to be learned. "NF" types value personal relationships, low conflict levels, faculty feedback, and dislike didactic instruction.

g. The Four Attitudes or Orientations and Learning Style
(1) Types exhibiting extraversion tend to prefer group efforts, projects, discussions, kinesthetic activities and active learning. Extraverted, sensing types, work to accomplish goals by managing a schedule; they also make reports on their self-selected topics. "EN" types prefer self-directed learning and group projects, particularly those that enable creativity and originality.
(2) Introverted types focus on solitary learning modalities, e.g., reading, personal reflection time, qualitative reasoning. "IS" types prefer active learning and visual assists, e.g., demonstrations, labs, simulations, computer assisted instruction, films, audio tapes, etc. "IN" orientations prefer self-directed learning, tutorials, and formal sequential instruction.
(3) Those with the judging attitude prefer formal, structured learning experiences, employing orderly processes. Those with the perceiving orientation seek to learn in flexible, adaptive environment learning through discovery and their impulses.

C. Information Processing Models

1. The second level of Curry's onion is occupied by information processing models, i.e., how people process information. Considered briefly are several, but only Kolb's (1984) experiential learning model is described in detail.

2. <u>Holistic and Serial Learners</u>
a. Pask (1975, 1976) has posited that there are two general learning strategies: holists and serialists. "Holists" build a comprehensive framework into which detailed content is inserted, essentially a "top down approach. Pask refers to holistic learners as comprehension learners.
b. "Serialists" concentrate of discrete bits of information and then, using logical analysis, builds a hierarchical framework; essentially using a "bottom-up" approach. Serial learners are called operation learners.
c. Pask also asserts that there are two aspects to learning description building and procedure building. In description building, a conceptual map is constructed which describes how content is related, thus, providing a

global outline. In procedure building, the scaffolding (i.e., proof and linkages) supporting the global view rich description is concentrated on.
(1) The design of a car is an example of description building, whereas the plans for the electrical and braking systems are procedure building in Pask's conception.
(2) Holistic learners are better at description building and serialists prefer procedure building.

d. Versatile learners are highly skilled in both description and procedure building.

3. Educational Set Theory
   a. Siegel and Siegel (1965) theorized a continuum where a "preference to learn factual material" anchored the left end and a "preference for conceptual material" anchored the right end.
   b. Factual learners prefer factual content in its own right and make little or no effort to connect the facts into a more comprehensive whole. Concept learners seek facts, but then relate them into principles, concepts, theories, etc. They argue for the "subsumption" approach, i.e., anchoring (e.g., board, inclusive) concepts first, then detailed facts, examples, etc. are next introduced when teaching concept learners. There is limited evidence to support the assertion that concept learners learn best with the "subsumptive" and that factual learners perform better when first given facts and then tasks which require them to integrate the facts into a comprehensive framework.
   c. The Siegel's argue that content sequencing is strongly related to learning styles. Sequencing material to be learned by learning preference does improve student performance.

4. Deep-elaborative/Shallow-reiterative Learning
   a. Schmeck (1983, p. 233) defines learning style as, "a predisposition on the part of some students to adopt a particular learning strategy regardless of the specific demands of the learning task. Thus, a style is simply a strategy that is used with some cross-situational consistency."
   b. Schmeck (1981) posits that there are two types of learners deep-elaborative or Shallow-reiterative. A learner prefers one style over the other.
      (1) Deep-elaborative processing requires significant reflection upon the meaning of the concept and analyzing its meaning within the context of personal experience, paraphrasing, and other information from differing sources.
      (2) Shallow-reiterative processing requires the simple repeating and memorization of facts associated with the word, concept, idea, etc.
   c. Deep-elaborative learners learn more and learn, faster than shallow-reiterative learners. They perform better on tests and other classroom learning tasks.

d. Schmeck argues that tests and learning tasks should be structured so that deep-elaborative learning is required. Focusing assignments and testing strategies on higher order intellectual skills will help learners develop a deep-elaborative style. However, there are learning situations where shallow-reiterative processing is appropriate, e.g., learning an alphabet or vocabulary.
e. Another contribution by Schemck is the notion that while one learning style is preferred, another can be developed. Hence, learning style can be adaptive.

5. The Style Delineator
   a. Gregorc (1979) posits that a learning style preference is natural and that humans learn via concrete experience and abstraction, either randomly or sequentially. He classifies learning style preference into a four category taxonomy: concrete sequential (CS), concrete random (CR), abstract sequential (AS), and abstract random (AR). While each person has a clear preference, each person possesses all four learning styles.
   b. Concrete Sequential (CS) Learners
      (1) CS learners prefer to learn through their senses by direct, logically structured, active experiences. They prefer a kinesthetic experience, with detailed, sequential directions.
      (2) As for learning experiences, CS learners respond well to teaching demonstrations, workbooks, and programmed instruction. Learning activities, e.g., tours, field trips, etc., are effective learning tools.
   c. Concrete Random (CR)
      (1) CR learners like to, independently or in small work groups, find their own way to learn, usually by experimentation. Such learners tend to intuitively make leaps in connecting experiences and/or "learnings."
      (2) CR learners prefer simulations or games, self-directed study, and problem solving tasks.
   d. Abstract Sequential (AS)
      (1) AS learners prefer written and verbal symbols, i.e., written and aural learning. Thinking abstractly, they easily grasp theory and concepts.
      (2) As for instructional preferences, AS learners prefer reading, listening, and organized presentations by a recognized authority.
   e. Abstract Random (AR)
      (1) AR learners focus on the learning environment, e.g., mood, atmosphere, medium, and messenger, using as many of the five senses as possible. Content is linked to and evaluated in light of the above.
      (2) AR learners prefer movies, discussion, and question/answer sessions.
   f. Gregorc (1979) was one of the first learning theorists to link learning style preference to instructional preference.

D. Social-Interaction Models

1. There are three common models cited frequently in the literature: Grasha (1972), Reichmann & Grasha (1974), or Fuhrmann & Grasha (1983).

a. The central theme of social interaction models is that learners will learn best when the learning environment meets or matches their social needs or preferences.
b. Mann's work involved traditional aged college freshman and is based on a small sample and is beyond our consideration.

2. Grasha and Reichmann posited that student social learning styles fell into six typologies.
   a. Independents: These confident, self-directed students prefer to learn on their own according to what they see as needed. They will consider others' opinions.
   b. Dependents: These authority dependent students will learn only what is necessary to get by rely and on the instructor to structure and manage the learning environment.
   c. Collaborative learners: These learners value the classroom social environment where group efforts and discussion produce learning.
   d. Competitors: These students see learning as a win/lose proposition. The classroom is the field of competition. They win by out-performing other learners, given the prevalent evaluation criteria.
   e. Participants: Such students attend class and participate as required. They take responsibility for learning and generally like to learn.
   f. Avoiders: These "learners" don't want to learn and don't participate.

   g.

Learner	**Learning Activity Preference**
Independents	Self-directed, independent thinking, student centered
Dependents	Instructor centered assignments and teaching methods
Collaboratives	Lectures with small group discussion, outside class talks
Competitors	Enjoy leadership roles, teaching method variety
Participants	Lecture/discussion, class discussions
Avoiders	Self-evaluation

3. Fuhrmann and Grasha (1983) have posited that learners exhibit one of three learning styles depending on the learning situation. They argue that no one situation is preferred over the other as appropriateness is context dependent.
   a. Dependent: The learner has little or no information about course content, expectations, etc. upon entry. This is common in math, science, language, and introductory courses. Dependent learners need structure, guidance, continuous reinforcement, and encouragement from the instructor who is perceived as expert. The traditional instructor's role of lecturing, demonstrating, monitoring, evaluating, encouraging, grading, and leading is expected by dependent learners.
   b. Collaborative: Collaborative learners want to participate in learning and usually have some knowledge or thoughts they want to communicate. Typically such learners seek an opportunity to problem-solve, practice, interact, watch, and experiment with peers in a "safe" environment. The instructor's role becomes that of a learning partner and environment manager. In teaching collaborative students, the instructor performs the traditional roles of managing, evaluating, encouraging, observing, and

grading. However, she or he also questions, models, and materially interacts with learners.

c. Independent: Typically, independent learners enter a learning exercise with significant relevant knowledge levels and prefer to learn on his or her own and at his or her own pace. Such learners need time for experimentation and support. As a facilitator, the instructor allows the independent learner to precede, acts as a consultant and evaluator. The instructor may elect to negotiate and provides feedback.

4. A key contribution by social-interaction theorists to learning style research is the clear indication that learner social and emotional needs interact with the learning environment and instructor behavior. This interaction directly affects learning.

E. Instructional Preference Models

1. Given the complexity and depth of Hill and Nunnery's (1973) cognitive style mapping theory and Canfield's (1980) learning style inventory, the reader is referred to those reference citations.
   a. The available research supports the belief that when teaching methods are matched to student instructional preferences, learning is improved.
   b. Since higher education traditions do not encourage the prescription of teaching methods by institutions for faculty, every effort should be made to assist learners to discover their learning style preferences so that less preferred styles are developed. This strategy provides the learner with a repertoire of skills to draw upon when an instructor with a differing teaching style preference is encountered.
   c. Learners have information intake preferences which may guide instructors when preparing presentations, learning exercises, or tests. These intake preferences may be considered proxies for learner instructional preferences. While not as detailed as the Hill and Nunnery or Canfield's theories, the Fleming (1987) VARK scale easily identifies learner information intake preferences.

2. Fleming (1987) published the "How Do I Learn Best" or VARK scale which focuses on information presentation preferences. The instrument was based upon earlier work by Fleming and Mills (1992). There are four intake preferences.
   a. Visual (V): This preference includes graphics (e.g., charts, graphs, films, visual aids, etc.).
   b. Aural (A): This preference includes tutorials, lectures, audiotapes, discussions, etc.
   c. Read/write (R): Information is presented in words.
   d. Kinesthetic (K): This preference is exhibited by those who learn best through experience and practice (real or simulated).

e. The VARK instrument maybe retrieved at http://www.vark-learn.com. Study guides for each information intake preference are found at the same site.
f. It is recommended that students use study habits that support their information intake preferences. Instructors are encouraged to employ teaching methods, learning exercises, and assessment strategies that appeal to as many of the preferences as practical. Such a strategy will also encourage learners to develop other less preferred intake preferences.
g. Guidance of interpretation of the VARK maybe retrieved at http://www.ntlf.com/html/lib/suppmat/74vark2.htm.

F. Active Teaching and Instructional Design Principles

1. Individual student attributes, moving from the core towards the outermost layer of Curry's (1983) onion, influence each other across the layers. Preferences closer to the outside are the least stable and most susceptible to change. Design learning experiences for as many levels of Curry's onion as possible.

2. The volatility of students' social interactions and instructional preferences make constructing valid and reliable measures and matching teaching and learning styles difficult. Use flexible teaching strategies.

3. Schmeck (1981) argues that tests and learning tasks should be structured so that deep-elaborative learning is required. Focusing assignments and testing strategies on higher order intellectual skills will help learners develop a deep-elaborative style. However, there are learning situations where a shallow-reiterative processing is appropriate, e.g., learning an alphabet or vocabulary. Select learning experiences based on intended learning targets (also called outcomes).

4. Another contribution by Schemck (1981) is the notion that while one learning style is preferred, another can be developed. Hence, learning style can be adaptive. Matthews (1996) agrees that learning style is changeable, particularly due to maturation and external environment stimuli. Hayes and Allinson (1996a) add experience as a learning style change agent. Sternburg (1997) acknowledges that societal expectations influence learning style. The key here is that as learners grow, mature, and are prodded to engage experiences which require different learning preferences; their learning style adaptability will grow and develop.

5. Gregorc (1979) was one of the first learning theorists to link learning style preference to instructional preference. Gremli (1996) reported that when choral students were permitted to learn in their preferred style, achievement improved. Hayes and Allinson (1996b) analyzed seven studies where learning and teaching methods were matched. In four of the seven studies, learning was improved. Billings and Halstead (1998) reported improved achievement when

methods and nursing student learning style preferences were matched. In designing and delivering instruction, don't be a slave to tradition; experiment and innovate based on research and best practices.

6. A key contribution by social-interaction theorists to learning style research is the clear indication that learner social and emotional needs interact with the learning environment and instructor behavior. This interaction directly affects learning. Students and trainees who are taught by a caring, enthusiastic, and reasonably demanding teacher, who is properly supported by his or her administration or manger, learn!

7. Multiple teaching methods which appeal to a variety of learning styles presented within a class will positively impact learning and under-developed individual learning styles (Billings & Halstead, 1998; Felder, 1996; Heffler, 2001).

IV. Active Learning: Definition, Theory, and Models

A. Active Learning Defined

1. Bonnwell and Eison (1991, p. 2) define active learning as "anything that involves students in doing things and thinking about things they are doing." They go on to describe active learning as
   a. Learners do more than listen.
   b. Student intellectual skill development is emphasized with less stress on merely transmitting knowledge.
   c. Higher order intellectual skills (i.e., analysis, synthesis, and evaluation) are the focus.
   d. Learners are engaged in learning activities (e.g., problem solving, planning, discussion, etc.).
   e. Learners explore their values and attitudes.

   Bonwell and Eison (1991, p. iii) go on to write that active learning "engenders greater understanding because it requires interpretations through analysis, synthesis, and evaluation, in sum, a higher –order learning."

2. Faust and Paulson (1998, p. 4) offer a similar definition, "active learning is, in short, any learning activity engaged in by students in a classroom other than listening to an instructor's lecture." They also define active learning techniques as, "those activities that an instructor incorporates into the classroom to foster active learning."

B. The Basis: Constructivist Learning Theory

1. Active learning is based on constructivist learning theory (Appendix 1.1) which holds that students or learners actively engaged in learning, process information by reconstructing it in a new and personally relevant manner. New cognitive structures are created in the brain to connect his or her "old" information to the "new" information. The application of the "new"

information leads to deeper understanding and significantly improved retention.

2. Critical tenets of constructivism include
   a. Knowledge is a result of a learner's interaction with his or her environment (e.g., a learning exercise).
   b. Cognitive dissidence (i.e., the gap between current knowledge and desired knowledge) is the stimulus for learning.
   c. The processes employed in the learner's interaction with his or her environment (e.g., learning activity) influence learning. The learning content, context, and activity interact with the learner's goals to construct (i.e., produce) knowledge or understanding.

3. Constructivist Instructional Activity Design Principles
   a. Learning activities must be associated or anchored within a larger relevant context (e.g., a unit assignment within the context of a larger course or the repair of a car axle to driving the car).
   b. The learner must own or at least have some significant ownership of the problem or task which is at the core of the learning activity. This can be aided by allowing the learner to propose a problem or task which becomes the nucleus of the learning activity or the instructor can give a problem, but it should be one that the learner can relate to and "own."
   c. An "authentic" learning task must be designed considering the learner's cognitive and social development. For example, a third grader should be given a problem or task suitable for a third grader so that third grade level learning is constructed.
   d. The learning activity itself should enable the learner to function at the expected performance level when the learning activity is completed.
   e. The learner should "own" the processes used to solve the problem or complete the task. While an instructor knows that specific skills and processes are required, he or she should allow the learner to come to that realization him- or herself and to construct those processes, using already available resources, including the instructor.
   f. The learning activity must encourage and challenge the learner's thinking. The instructor is a learning coach or consultant. He or she guides the learner, often by questioning, but doesn't "take over" the learning for the student.
   g. Ensure learners to test what they think they know against alternative views and contexts. This negotiation process "corrects" and validates what is known and understood. Cooperative learning groups produce a suitable learning community for this testing and refinement to occur.
   h. Ensure that both the learner and instructor reflect on the learning, learning activity, and learning process.

C. Selected Active Learning Models

1. Three selected active learning models or strategies which embody (a) constructivist learning theory, (b) active teaching instructional design principles, and (c) active learning benefits are presented below.

2. The Interactive Lecture
   a. The lecture is the most commonly used information sharing strategy utilized in educational institutions and training organizations. It has been deployed for centuries. The interactive lecture is described in Chapter 4.
      (1) Used inappropriately, lecture will not only limit learning but destroy student motivation to learn. An example of inappropriate lecture use is to talk at students for 30 or more minutes.
      (2) Used appropriately, lecture is highly effective in promoting student learning, especially with respect to the lower two intellectual skills i.e., knowledge and comprehension. When active learning (AL) activities are integrated into lectures, higher order intellectual skill (i.e., analysis, synthesis and evaluation) acquisition is achieved.
   b. Johnston and Cooper (1999) have advanced the interactive lecture concept, which they define as "a lecture in which active- and group-learning exercises are embedded at frequent intervals in order to foster deeper processing of content." Please see Chapter 3.

3. Cooperative Learning Groups
   a. Description
      (1) According to Faust and Paulson (1998), within the cooperative learning strategy, learners are organized into formal work teams of three or more with learning efforts focused on a common objective. The experience is characterized by interdependence, individual accountability, and heterogeneous composition.
      (2) Panitz (n.d.a) offers a similar definition. He goes on to add
         (a) The instructor maintains control of the learning environment, designs learning activities, structures work teams, and, in his view, does not empower students.
         (b) Cooperative learning is more directive than collaborative learning.
         (c) The product of learning tends to be quantitatively analyzed.
   b. Kagan (1989) contributes that in cooperative learning the instructor designs the social interaction structures (e.g., work teams) and the learning activities, which are always content dependent.
   c. Cooperative learning groups are described in Chapter 4.

4. Problem Based Learning
   a. PBL was developed by Dr. Howard Barrows, a physician and medical educator at McMaster University in Hamilton, Ontario, Canada.
      (1) Dr. Barrow's learning involved three separate but related phases

> "[a] an essential body of knowledge, [b] the ability to use…knowledge effectively in the evaluation and care of …patients' health problems, and [c] the ability to extend or improve that knowledge and to provide appropriate care for future problems which they must face" (Barrows, 1985, p. 3)

(2) Dr. Barrows intended that learners become independent and self-directed learners, capable of being critically thinking problem solvers.

b. PBL integrates basic or core knowledge with problem solving or critical thinking skills, by linking learning to a contextual application, e.g., learning the component elements of a balance sheet while actually constructing one for an organization's annual financial report.
c. Problem based learning as expressed in the case study approach is described in Chapter 5.

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Appendix 1.1 Theories of Learning	
Functionalistic Theories (Thorndike, Skinner, & Hull)	Hergenhan and Olson, 1997
Association Theories (Pavlov, Guthrie, & Estes)	Hergenhan and Olson, 1997
Cognitive Theories (Gestalt Theory, Piaget, Tolman, Bandura, & Norman)	Hergenhan and Olson ,1997
Neurophysiological Theories (Hebb)	Hergenhan and Olson, 1997
Constructivism—General	Fosnot, 1996; Prawat & Floden,1994
Constructivism—Psychological or Individual	Phillips, 1995; 1997
Constructivism-- Social	Vygotsky, 1978; 1986; Prawat,1996
Brain-based Theories:	Bransford, Brown, & Cocking, 2000; Jensen, 1995
Cognitive Theory	Ausubel, 2000; Amsel, 1989; Wadsworth, 1989