Measuring Outcomes of Students' Learning

Involving the Learning Modalities, Domains,

Critical Thinking Skills Levels, and

Right- and Left-Brain Thinking

Frances Johnson

Abstract

There is no paucity of literature that relates to the learning domains, the modalities, critical thinking skills, or right- and left-brain thinking. Charts for various aspects of the preceding aspects have taken the forms of pyramids, circles, and the more conventional square or rectangle as well as bubbles and diagrams. None, however, have attempted to chart sample evaluative vocabulary that links the critical thinking skill levels to both the learning domains and the learning modalities. Textual comments indicate links between the preceding and right- and left brain thinking. The extrapolation of the sample evaluative vocabulary provides a quick reference to provide effective and valid evaluation of student learning as follows:

1. Enhance the inclusion of test items related to right- and left-brain thinking;
2. Create a stronger link between test items and learning modalities;
3. Develop a stronger link between test items and the affective domain;
4. Improve the link between test items and the cognitive and psychomotor domains; and,
5. Forge a stronger link between test items in the preceding categories and the Johnson Critical Thinking Skills Levels.

Measuring Outcomes of Students' Learning Involving the Learning Modalities, Domains, Critical Thinking Skills Levels, and Right- and Left-Brain Thinking

Read, review, and regurgitate! For both faculty and students, these words may generate the thought that this is the prevailing paradigm that governs the examination of skills presented in institutions of higher learning. That is not to say that for entry level courses one should avoid the delivery of core course content as well as the measurement of the students' acquisition of basic vocabulary and concepts before embarking on more ambitious academic journeys. However, choosing the appropriate method or methods for assessment or evaluation necessarily involves the consideration of a number of seemingly disparate factors. Such factors as short and long term memory, the effects on learning based on the dominance of either the right brain or the left brain, and the mental processes that have been identified as the cognitive, affective, and psychomotor domains come into play. In addition, the auditory, visual, and kinesthetic or tactile learning modalities have been stirred into the mix. The preceding as well as many variations of the preceding have been the targets of much speculation and research in the ongoing effort to enhance both the delivery of course content and its assessment or evaluation. Because the basic 3R assessment tool fails to address in a meaningful way either the psychomotor or the affective domains of student performance, tests, examinations and other assessment tools are subject to ongoing revisions and updates in order to provide a broader based and more accurate picture of student progress. The preceding paradigm, although modest in its pretensions, serves reasonably well at the basic knowledge level to ensure that core knowledge has been mastered. The simplicity of the approach is that it has application for large entry level lecture classes that mandate that tests be scored by machine or with a template. However, it provides limited utility for assessment of skills at the higher levels of cognitive learning. Such a paradigm provides even less utility for assessing skills in the psychomotor and affective domains. As is so with the cognitive domain, the issue becomes that of identifying relevant concepts and of ranking them according to importance as well as the desired level of performance in order to determine an appropriate method of assessment. These constructs and domains permit discussion as well as some small measure of understanding of the manner in which the human brain functions. They also permit speculation about what is learned and about what is retained. Retention of what is learned is one goal of education. Utilization of what is learned and retained is another. As instruction progresses through Bloom's taxonomy and/or Johnson's (2001) Critical Thinking Skills Levels, assessment of student learning becomes more complex. For most college level courses verifying that basic knowledge has been acquired and retained does not provide a complete measure of a student's progress nor does it fully address a student's application of acquired knowledge.

If, as stated previously, verification (assessment) of knowledge acquisition, retention and utilization are important, then it follows that

the assessment of what is learned provides justification for what is taught. Ideally, assessment of students' learning can and should provide insights into the modification of methods for delivering course content. By providing a variety of techniques the instructor ensures that each student has the opportunity to exercise the domains and/or modalities with which he/she is most comfortable as well as to develop skills in the less favored areas. For a multitude of reasons, student progress must be examined with the same degree of professionalism that is utilized to deliver course content.

Retention of Learning and Learning Modalities

According to data published in several online sites that are maintained by colleges, universities, and the Tehama County (California) Department of Education, short-term memory is not very efficient under certain conditions. According to the learning pyramid attributed to the National Training Laboratories, Bethel, Maine, which depicts the methodology used and average learning retention rates, the learner who is relying on hearing or reading as the single method of processing information, the retention of learning rate is 5% and 10% respectively. When hearing and seeing (visual and auditory components) are used together retention of learning jumps to 20%. Demonstration increases the retention rate by about 10% bringing the rate to 30%. Participating in discussion groups brings the retention rate to 50%, practice by doing to 75%, and teaching others to 90%. Experience, simulated experience, challenging activities, and teaching others provide high rates of improvement in retention

when measured one month later according to data provided under the auspices of the New York Institute of Technology online sources. It is not completely clear who performed the study that provides the basis for the various educational entities that use the data although Ann Boultinghouse of Keystone Instructional Services attributes it to William Glasser. Nor was the date of the original study available. However, it is reminiscent of the SEE, SAY, and DO (visual, auditory, and kinesthetic) paradigm often used by those engaged in elementary education. In a scholarship program operating under the auspices of the New York Institute of Technology, it is indicated that retention one month later showed losses of learning and/or distortion when learning was dependent on just one of following: reading, hearing or seeing. Participating in challenging activities and teaching others provided the greatest amount of retention of learning one month later, 83% and 91% respectively. There is enough evidence to warrant consideration of the implications of retention of learning rates under varying conditions when choosing a method for the assessment of student learning.

Fox Valley Technical College emphasizes a pragmatic approach to curriculum assessment to the extent that it provides a Modality Study Aids web page with specific study techniques suggested for visual learners, for auditory learners, and for kinesthetic or "hands on" learners. Inherent in this is the implication that classroom assessment should include methods of evaluation that engage each of the learning modalities.

Right Brain, Left Brain, and the Affective Domain

Much of the course content that falls within the cognitive domain is oriented toward left brain processing at both the instructional and assessment levels. Both instructional and assessment tools often utilize Bloom's taxonomy. Through the inclusion of essential definitions, facts, sequence, concepts, symbols and other knowledge based criteria, fundamental or core knowledge is delivered to enhance the foundation for higher level critical thinking skills in the cognitive domain. Evaluation of such knowledge is necessary to ascertain whether students are prepared to apply the skills acquired. Hence, many examinations such as multiple-choice, short answer, short essay and essay answers are the assessment instruments of choice for measuring knowledge acquired. Words such as *define, label* or *name, describe, state, identify, choose* and *find* to list a few may appear in short answer and short essay examination questions. The preceding assessment tools fall into the time-honored tradition that provide results that, if well constructed, are viewed as reliable and valid.

As noted in the preceding paragraph such measurement tools test predominately left brain processes that have been labeled as *logical, sequential, rational, objective,* and occupied with *examining the parts.* Right brain thinking is often *random, holistic, intuitive, subjective,* and is focused more on the big picture rather than on details. Bernice McCarthy has extended the concept to include teaching to "the

four styles (concrete experiences, reflective observation, abstract conceptualization, and active experimentation) using both right and left-brain processing techniques. Ideally, assessment of a student's achievement has provisions for evaluating learning in both the right- and left-brain.

It likely is no surprise that right-brain thinkers often engage in activities that align closely with the affective domain. Nor is it likely to be a surprise that Vygotsky's theory of social development, Bandura's theory of self-efficacy and Maslow's theory of self-actualization also relate to the affective domain. The performing arts and creative projects are frequently viewed as primarily engaging right brain processing because of the impact on the emotions of the audience as well as for the affective behaviors inherent in performing such activities. Attitudes, values, beliefs, and emotions generally are activated as subjective or right brain thoughts. Betty Edwards (1989) in *Drawing on the Right Side of the Brain* states that intuition, imagination, and creativity are components of right-brain thinking. Measurement or assessment of the results of learning may include performance as well as attitudinal and/or value scales based upon a previously determined definition of affective behaviors and the circumstances under which they are expected to occur. However, if self-administered attitudinal and/or value scales are used, the results may be skewed by the disparity between what the subject believes to be happening and what others perceive as actually happening. Longitudinal studies and evaluations tend to provide a slightly more accurate

assessment of the development and retention of emotions, attitudes, and values within the affective domain. There are, however, obstacles to be overcome when attempting such assessments. Obstacles that can be anticipated include such things as the mobility of the society in which we live and the frequency of that mobility as well as whether people will respond and whether the response will be handled in a timely manner to such queries. Furthermore, there exist within the population those who with sincerity question not only whether we can but also whether we should attempt to influence the attitudes, beliefs, and values of students.

Yet, the basis of higher education is to promote, encourage, nurture, and teach attitudes, beliefs and values that will provide the foundation for a rewarding career and a rewarding life. Furthermore, your presence in this room is indicative that each of you at some point in time made a conscious decision based on your attitudes, beliefs, and values to expand your educational horizons. Your presence here is also an indicator that since that time you have actively participated in academic life by committing time and energy to research, instruction, assessing student learning and to program development and modification. Much of this has been done while participating in family and community life. In all probability, you have had or still have a direct tie to the aerospace industry.

Who motivated you to embark on an educational journey at a time in your life when you made that decision? Can you still name the individuals most responsible for your decision to attend an institution of higher learning as well by what means the influence occurred? Or was your decision initially influenced more by economic concerns than for other reasons? The attitudes, values and beliefs involved in such decision-making fall within the affective domain although Huitt (1997) would classify the process that may have motivated you to engage in that behavior as *inculcation*. However, consider whether those who influenced you made a conscious decision to have you consider your options. If your answer is in the affirmative, it is a small step to accept the charge to provide opportunities for students to modify and/or develop attitudes, values, and beliefs which will sustain them in their many and varied endeavors.

Is it necessary to establish more course offerings devoted exclusively to the teaching of values and ethics? Or do courses in the humanities, psychology, philosophy, and religions provide opportunities to provide that which is needed? Should more resources be shifted to appreciation of the fine arts associated with the affective domain as well as to the strategies and techniques used by their creators? Or are some, if not all, of the preceding courses providing opportunities to reinforce and develop appropriate attitudes, beliefs, and values necessary for success in the workplace, in the community, and in private life? The preceding questions require the identification of what is being done in regard to the affective domain with the focus on the development of appropriate methods for measuring the outcomes of those efforts.

In addition to the preceding, it is beneficial to examine how the components fit into a paradigm that provides insight and focus with regard to assessing student progress in various areas utilizing a variety of modes of delivery of course content in a variety of settings. Course content is delivered in labs and classrooms, in the field, through distance learning, and through electronic media such as television and the Internet. Ideally, such a paradigm should address recognized domains, critical thinking skills, learning modalities, and right and left brain functions. Desired levels of achievement and retention of learning are governed in part by course outlines and mandated acceptable levels of proficiency deemed necessary to advance to the next academic level. However, carefully planned and well written classroom objectives become a complement to course outlines and course objectives.

Posing fewer problems is the assessment of the psychomotor domain which, in an ideal situation, is performance based as is likely to occur with the performing arts or when presenting speeches in speech courses or demonstrating skills in physical education classes or conducting experiments, completing labs, etc. Although the tactile or kinesthetic modality is the primary modality for the psychomotor domain, the visual and auditory modalities as well as the cognitive (left brain) and affective (right brain) domains are involved in the learning process. It is suggested that the preceding considerations need to be included in the assessment of student learning as well. In fact, the cognitive aspects that are engaged in psychomotor development are tested more frequently than performance itself. However, the most noticeable exception to any attempt at meaningful assessment of student learning in the psychomotor domain is on normed, standardized tests. Performance testing on such a scale is cost prohibitive according to figures released during the spring of 1996 by the General Accounting Office. The estimate for a "national multiple-choice achievement test" is approximately $42 million, "while a slightly longer test with short, performance-based questions would cost $209 million."

Finally, given the time constraints imposed by the length of sessions used by the Embry-Riddle Aeronautical University Extended Campus, the preceding feats need to be doable within a nine-week time frame or an equivalent thereof.

Suggested Sample Evaluative Vocabulary Models

The extrapolations of evaluative vocabulary designated as Model 1 and Model 2 were derived from online publications by Metfessel, N., Michael, W., and Kirsner, in "Instrumentation of Bloom's and Kratwohl's taxonomies for the writing of educational objectives," from a paper *Affective Domain* by N. Perrin, and J. Rueter, and from *Critical Thinking Skills: Building Blocks for Success* by F. Johnson. Such models provide quick access to sample evaluative vocabulary for the learning modalities, domains and critical thinking skills levels. Therefore, they have utility for enhancing the assessment of students' learning in a variety of circumstances.

SAMPLE EXTRAPOLATIONS OF EVALUATIVE VOCABULARY 1

MODEL 1

CRITICAL THINKING SKILLS LEVELS

MODALITIES	STEP 1 CORE	STEP 2 S & R	STEP 3 EXTRAP	STEP 4 UTILITY
VISUAL	identify locate observe read recognize watch	chart map review select Show visualize	apply change confirm differentiate examine identify interpret write	classify diagram graph illustrate modify research
AUDITORY	discuss listen question respond state	quote recall recite restate discuss	argue predict present project refute	categorize defend discuss significance persuade pro/con propose reject
KINESTHETIC	bend dance play sing skip	draw label mime paint Perform sketch	apply build create demonstrate sculpt	activate demonstrate perform conduct operate

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It is neither expected nor desirable that one attempt to utilize all possibilities within the framework of each individual course. Rather it is the goal to bring the affective domain into balance with the cognitive and psychomotor growth and development of the students. This may, at times, involve very basic development of beliefs, attitudes, and values that will enhance, not impede, student progress. Instructors must sometimes counteract negative attitudes toward a specific course because the student or students perceive little or no value to themselves or they may simply not like a particular aspect of the course. Is this an affective student behavior that instructors need to address? It is, if one wishes to assist students to develop attitudes, beliefs, and values that have utility in the workplace, at home, and in their communities. Is it easy to do? Ongoing research indicates that it is not an easy task. Occasionally, the instructor must find ways to turn negative attitudes about course content into positive ones. Sometimes, an explanation of the rationale behind the course is sufficient. Sometimes, peer discussion of the pros and cons of the likely results of maintaining negative beliefs brings new insights into play. These may, in turn, foster the development of more positive attitudes and provide encouragement to reevaluate attitudes, beliefs, and values when situations and circumstances change. None of the preceding scenarios are scientific nor are they especially predictable. Hence, we have the appellation *affective domain* that is presented in Model 2.

SAMPLE EXTRAPOLATIONS OF EVALUATIVE VOCABULARY

MODEL 2

CRITICAL THINKING SKILLS LEVELS

DOMAINS	STEP 1 CORE	STEP 2 S & R	STEP 3 EXTRAP	STEP 4 UTILITY
COGNITIVE	define describe discuss explain recognize identify	analyze classify evaluate infer interpret paraphrase recall review summarize	assumptions connotation figures of speech interpret philosophies predict project satire speculate symbolism	analyze argue create draft evaluate examine options implement modify propose solve synthesize
PSYCHOMOTOR		(See kinesthetic modality on preceding chart)		
AFFECTIVE	acceptance acknowledge awareness follow listen willingness	consider define examine recall restate select specify	abstract balance compare contrast differentiate organize revise	adapt assist augment change defend formulate manage refute resist resolve revise subsidize support theorize

Options for the Evaluation of Students' Learning

The sample vocabulary suggestions in each of the critical thinking skills levels that are related to the cognitive domain involving the visual modality have appeared in some form in the framework for standardized testing that is often used for placement of students. In addition, such standardized tests are often used to compare student achievement with others in similar or like circumstances. Closer scrutiny of the auditory and kinesthetic modalities on standardized tests reveals that such questions are usually limited to listening to instructions and to filling in bubbles with a number 2 pencil. Unless the college/university levels of standardized testing have changed dramatically, only a few questions attempt to elicit responses related to the affective domain. As with commercially prepared tests and/or instructor prepared examinations, the preceding tests utilize Bloom's taxonomy in efforts to accurately measure results. Many vocabulary lists and charts that are rooted in Bloom's taxonomy are available from a variety of sources including those found online.

Commercially prepared examinations that are available from the textbook publishers provide one means of evaluating student progress but may not match each instructor's teaching style or points of emphasis for any given course. Furthermore, such tests or examinations may not address the affective domain and/or the modalities except as noted above or do so in a superficial manner. A commercially prepared testing instrument developed by an expert in the field is or can be a valuable tool. If such is not the case, the validity of what is measured is brought into question. These and other concerns weigh into the decision by the instructor to create his/her own testing instrument.

What, then are the criteria to be observed when an instructor opts to create the assessment/evaluation tool to determine student progress and outcomes? Let us revisit the obvious for a moment. Well-written course objectives help define the nature and level of assessment. Generally, course objectives are or should be established within the framework of the course outline. The syllabus provides the opportunity for the instructor to determine the major focus of the course. This entails making decisions predicated on the needs of the students as identified in the course outline and on the time constraints that impact what to keep and what to leave out as well as the needs of the students themselves. Thus, begins the challenging but not insurmountable task of creating a valid examination. Planning and developing a satisfactory examination prior to meeting students is daunting and is done with little or no knowledge about the learning modalities of individual students. However, a variety of reasons including distance learning and other electronic media delivery of course content dictate that the planning and developing of a few of the examinations be done before classes open. Distance learning and interactive media delivery

of course content usually require that examinations be written prior to the beginning of the class. There are two valid reasons for doing this. One is that the instructor is likely to consider a variety of possibilities and prepare test items that access not only a variety of modalities but of domains as well in order to measure the outcome of student learning for each individual in a given course. The other reason is that students involved in distance learning or interactive media delivery of course content do not work at the same pace. Consequently, there often exists no fixed examination date such as is found in a traditional classroom. Furthermore, according to the previously cited New York Institute of Technology students retain more for longer periods of time that which has been learned if they participate in activities that engage them in "see, say, and do" paradigm. In a study "Effects of Anticipation of Tests on Delayed Retention in Learning" conducted by Haynie (1997), he found that anticipation alone without taking a test did not improve retention of learning. However, when the anticipation was followed by actually taking the test, retention did improve. As Haynie stated, "The conclusion here is that, in general, students do likely *study more earnestly* when they expect a test than if they do not, but maximum benefit in retention is gained only by having students anticipate and then actually take a test." The preceding rationale suggests that the writing of examinations prior to the opening day of a course may provide a greater sense of direction to both the students and the instructor. An added benefit for the instructor is that prior preparation reduces the time needed to add or delete items from the test on an *as needed* basis.

Is it feasible to include the modalities and the domains of learning inclusive of the higher level critical thinking skills in the assessment of student learning as proposed by the models presented in this paper for most, if not all, courses offered at an institution of higher learning? Admittedly, it is not always practical or desirable in large introductory lecture classes with students sitting in a lecture hall that resembles an amphitheater. However, as a student moves into the higher levels of academia or participates in distance learning and/or interactive media, the number of students in any given course decreases to a size that makes such inclusion possible. This is especially true in an institution of higher learning such as Embry-Riddle Aeronautical University with its focus from its inception on meeting the educational needs of those engaged in the aircraft industry.

Flexibility of choice is an integral part of the models. The instructor determines which of the modalities and domains as well as which of the critical thinking skills levels (Johnson 2001) will be targeted for examination. It remains both the instructor's choice and responsibility to determine whether a specific assessment instrument will utilize multiple choice, short answer, short essay, long essay, research paper, an exhibit or demonstration, a performance, a project (group or individual), speech or some combination of the preceding. The schedule for the administration of the testing or assessment instruments is left to the discretion of the instructor within the time constraints of the course schedule. The decision

to choose to use textbook publisher prepared examinations or those of his/her own creation also rest with the instructor. The evaluation of students' growth and development may examine general knowledge and application or may be criterion-referenced (mastery tests) or some combination or the adaptation of the preceding possibilities. It remains in the instructor's domain to adapt both delivery of the material and method(s) of testing, assessment, or evaluation to the time frame within which such delivery occurs.

It is likely that the cognitive and psychomotor domains are examined more thoroughly at the basic or core knowledge and application levels throughout the educational process. Scrutiny of the psychomotor domain occurs more readily in such courses as physical education, the performing and industrial arts, etc. The higher levels of the cognitive domain are scrutinized in more detail as one enters into areas of specialization.

The most perplexing challenge that is inherent in the evaluation of student progress lies within the area of the affective domain. Evaluating the subjective area of attitudes, beliefs, and values is fraught with pitfalls. One such is that concepts may mean one thing to one person and the opposite or something very different to another. Nor are such concepts easily subjected to the scientific method of study that begins with a premise that may be proved or disproved. Another difficulty for the evaluator of the affective domain is that people may say or even believe one thing but do another. Various other difficulties are encountered when

attempting to assess the affective domain of student learning and behavior including much discussion and disagreement about what should be included in the domain itself. It is generally agreed that beliefs, attitudes, and values belong in this category with the focus on positive behaviors. Others argue that the terms are so broad as to be meaningless. However, the overriding question to be answered is to whom and by what standards do we bequeath the option of defining which beliefs, attitudes, and behaviors are positive? Are the beliefs, attitudes, and behaviors targeted for the course flexible enough to encourage creative and tolerant thinking as well as "by the book" should the situation warrant such a decision. Such questions could go on for some time. However, it is likely that the answers to the preceding questions are going to be influenced by the attitudes, values, and beliefs that relate to a multitude of issues.

As is evidenced by the strength of subjective concepts, it is necessary to determine the appropriate role of an institution of higher learning in defining these concepts. It is a given that the creation of such institutions was and is based in the underlying belief that those who are well educated fare better in life and in the world than those who are not. It is both implied and often stated that education changes the way one perceives and responds to situations in which one finds oneself. It is increasingly a given that if one wishes to avoid a dead-end job lacking challenges and opportunities for growth, one must be well educated. Even our television commercials espouse, and rightly so, that it is a

terrible thing to waste a mind. This is but one of many attempts to encourage youngsters to pursue an education beyond high school. Yet, definitive parameters are elusive and difficult to formulate in so diverse a society. One must be ever mindful of the ramifications of subjective attitudes, beliefs, and values that can be far reaching in unexpected and sometimes undesirable ways. Hippocrates, as translated by Francis Adams, states in his oath that reads in part, "I will follow that system of regimen which, according to my ability and judgment, I consider for the benefits of my patients, and abstain from whatever is deleterious and mischievous." Although his statement refers to the practice of medicine, one can by substituting the word *students* for *patients* establish baseline parameters for the testing, assessing, measuring, and/or evaluating the affective domain.

Model 2 (page 11) provides sample vocabulary lists that can be used to structure questions designed to elicit responses that reflect attitudes, beliefs, and behaviors. In addition, questions may be structured to engage the student in the examination of other and/or opposite attitudes, beliefs, and values. There does exist the possibility that students will attempt to answer according to what they perceive as "what the instructor wants to hear" rather than what they feel, believe, or do. Other methods of evaluating affective behaviors include self-evaluation scales predicated on the assumption that one can and does perceive in oneself that which others observe. A Likert-like scale with rankings from most preferred to least, from strongly agree to strongly disagree etc., may

be developed for this purpose. The problems with scales of this sort are twofold. The response may be an attempt to provide the answer that the student perceives to be the one the instructor is seeking. Or the response may be an honest attempt to report accurately but the student does not perceive the behavior in the same manner that others do. Psychological scales are used to identify maladaptive aspects of behaviors if the situation warrants and criteria for administering them are met. Such behaviors tend to fall within the affective domain. Generally, such measures are inappropriate for use in most college level settings unless one is entering a professional field demanding knowledge of administering and interpreting the results of such scales. Other highly specialized scales are used to determine types of leadership behavior as well as types of student or employee behaviors. However, the instruments that do tap into the affective domain tend to be administered so infrequently that they do not meet the criteria necessary to measure outcomes of student learning with respect to the affective domain.

Observations by the instructor of students' participation and interaction within group activities such as discussions, demonstrations, and research projects, etc. may reveal underlying attitudes, beliefs, and values. Such observations tend to be more subjective than other instruments used for measuring what students have learned. Putting aside momentarily the ethical arguments that were previously discussed, it is difficult but not impossible to assess such observations with a numerical point value. Let us return now to the ethical dilemma. It is real. It should be of

concern to us. It calls into question the tenets upon which our country is based as well as those upon which our institutions of higher learning rest. Yet, we recognize the need to discourage and penalize those who cheat on exams and those who plagiarize the work of others. Too much intrusion into the affective domain of an individual or society stifles the rights of those upon whom it is imposed. Too little development of the affective domain has the potential to become the *fast track* to decisions by individuals and societies that are detrimental to humanity. The challenge is to find some middle ground that is neither too restrictive nor so lacking in substance that it is rendered meaningless. It is also advisable to provide specific affective domain objectives to students in addition to those that address cognitive and performance objectives.

What is needed are methods to deliver instruction of course content in ways that also involve making judgments based on attitudes, beliefs, and values as well as the ramifications of those judgments upon the individual, friends, family, and the larger community. This is no small or insignificant task. In fact, it is a daunting one. Yet, the body of research indicates that many consider the task to be of the utmost importance, not only from the standpoint of the delivery and measurement of instruction but to the success of future endeavors by the students that we are charged to educate. Many leaders in business and industry are actively seeking to develop more positive beliefs, attitudes, and values in the workplace as evidenced by websites with postings related to the preceding.

How does one proceed? It has been suggested that the development of rubrics for use if observation is a part of the assessment of student learning of course content can be designed to control for subjectivity. Such a rubric might be used to observe interaction with peers, with group projects, etc. The development and use of rubrics to monitor such responses can identify the subjective elements and provide a basis for assigning point values to the task. Judith Slisz (2001) in "Examples of Interactions and Assessment Model for Online Courses Offered by Teikyo Post University" proposes the use of rubrics for the required online conferencing as well as for the individualized components of online courses. The rubrics differ in that the online conferencing component engages the affective domain through making supported value judgments about the work of others as well as about one's own. The rubric for course content has fewer affective and more cognitive domain aspects. Craig Mertler (2001) suggests that rubrics fall into categories, holistic and analytical. Furthermore, he has developed templates, charts, and a design plan to assist with the implementation of the use of rubrics to evaluate the outcomes of student learning.

For many courses such as the humanities, social sciences, communications psychology, and others, it is possible to construct questions and activities that elicit value judgments supported by evidence from both assigned readings and research. The logical and insightful development of an answer can provide further insights into aspects of the affective domain. Open-ended questions can be developed for many kinds of

course content thereby creating opportunities for students to examine the rationale underlying their beliefs, attitudes and behaviors as well as those of the authors or developers of texts, theories, proposals, etc. Role playing, speech making, cooperative learning projects, panel discussions in a quasi-debate format and cognitive questions that elicit opposite or differing opinions, beliefs and opinions may be used to integrate the learning modalities with the learning domains. The sequencing of affective objectives accord to Krathwohl's hierarchy of receiving, responding, valuing, organizing, and characterizing was suggested by Barbara Martin in 1989.

Time constraints inherent in any academic offering often leave time for little more than a cursory attempt to involve the affective domain in most cognitive domain oriented courses. This is especially true when working with nine-week sessions or variations thereof. However, a longitudinal study by Richard M. Felder (1995) and Felder, Felder, and Dietz (1998) in an ongoing five course program for engineering students suggests that scores improved and that retention of learning was better for those in the experimental cooperative learning group than for those in the control group. Attitudes toward cooperative learning became more positive as students became more accustomed to working as members of groups as indicated by the following:

In the semester following the experimental course sequence, the students were asked to evaluate the sequence retrospectively. Of the 67 seniors responding, 92% rated the experimental courses more instructive than their other chemical engineering courses, 8% rated them equally instructive, and, none rated them less instructive. Ninety-eight percent rated group homework helpful and 2% rated it not helpful, and 78% rated in-class group work helpful and 22% rated it not helpful. (Felder 1995)

Felder noted that the Hawthorne effect could have affected the results of his study. However, his findings do suggest that attitudes, beliefs, and values affect students' interactions, performance, and retention of learning in the classroom setting. His findings further reinforce the rationale for seeking ways to broaden the scope of the measurement of the outcomes of student learning to include the affective domain. It should be noted that cooperative efforts in the workplace have been linked by some to greater productivity and improved safety in that environment.

Summary

Admittedly, measuring or assessing the affective domain to determine what has been learned and what has been retained such that it may be used is oftentimes an elusive task. It is subjective, not easily measured, and is sometimes treated as if it there is something inherently wrong with planned development of values, beliefs, and attitudes. Yet, the body of literature published during the recent and not so recent past indicates that education especially at the college/university level is predicated upon changing one's beliefs, attitudes, and values to ensure realizing one's potential for intellectual growth and development. The literature related

to testing indicates that the cognitive domain with its left brain thinking and predominately visual modality is the most thoroughly tested aspect student learning. Assessment of the psychomotor domain relies heavily on performance (kinesthetic modality and right brain activity) in certain performing and mechanical arts and physical education arenas. However, it is possible to include activities, projects, etc. that will involve some facet of the domains, modalities, and critical thinking skills in each of the courses that rely heavily on the more traditional cognitive level. The proposed models with sample vocabulary provide a brief checklist to enhance the inclusion of a variety of levels of questions, activities, projects, etc. covering the learning modalities and the recognized domains involved in learning. It is not all-inclusive nor should it be. It is the prerogative of each instructor to make the final decision regarding the format as well as the domains and modalities to be tested.

There is no scarcity of literature about any of the preceding topics. However, it is my belief that the Johnson's Sample Extrapolations of Evaluative Vocabulary Models 1 and 2 represent a more comprehensive approach to directly linking the domains of students' learning as well as the learning modalities to critical thinking skills levels in a user friendly manner. The models are designed as thought provoking and time saving guides to enhance the formulation of questions in appropriate domains, modalities, and critical thinking skills levels at the instructor's discretion in a specific field. It has application in most, if not all, courses including online and interactive delivery of course content.

In addition to the preceding concepts, the key to successful measurement of students' learning rests within the framework of well-written course outlines and well-written objectives. It is upon such a foundation that the ability to design and implement effective measurements of student learning in both academic and technical and/or job related learning situations resides. But that research will have to wait for another forum.

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