Developments In Business Simulation & Experiential Exercises, Volume 17, 1990

An Exposition of Guilford's SI Model as a Means of Diagnosing and Generating Pedagogical Strategies in Collegiate Business Education

Jeanne H. Burns, Southeastern Louisiana University
Alvin C. Burns, Louisiana State University

ABSTRACT

Of those few occasions where ABSEL thinking has been guided by a learning/teaching model, Bloom's taxonomy of cognitive learning objectives has been exclusively adopted. While Bloom's model is highly regarded, it has problems. Also, numerous other such models exist in the education literature. Guilford's Structure of Intellect model is chosen as appropriate to college-level business education. The model is described in detail. It is used to diagnose various approaches and generate alternative teaching strategies.

INTRODUCTION

Collegiate business pedagogical development has been criticized for its lack of sound conceptual frameworks (Butler, Markulis and Strang, 1985). Nonetheless, some ABSEL thinking has been influenced by the learning objectives taxonomy espoused by Benjamin Bloom (1956). About a decade ago, Gentry, McCain and Burns (1979) advocated the adoption of Bloom's taxonomy not only as a framework for research on pedagogical effectiveness, but also as a vehicle useful in theory construction and simulation/game development. Some ABSEL authors have sought to incorporate the taxonomy in their work (Butler, Markulis, and Strang, 1985; Gentry and Burns, 1981; Anderson and Lawton, 1988; Lewis, Yates and Gomolka, 1988); however, the adoption is far from universal.

Bloom's taxomony of the cognitive domain of learning objectives is briefly summarized in Figure 1. As can be seen, it proposes six different and increasingly more complex levels of learning: (1) basic knowledge, (2) comprehension, (3) application, (4) analysis, (5) synthesis and (6) evaluation. One can find ample evidence of the adoption of the taxonomy by educators at various levels. Three important advantages of Bloom's paradigm have been noted by Maker (1982). They include widespread acceptance of the taxonomy by educators in general, relative simplicity and consequent easy applicability, and the useful guides, which the taxonomy provides for teachers. On the other hand, Marker (1982) also points out some significant problems with Bloom's taxonomy. First, little research support exists for it. Second, it has limited scope, and third, its basic assumption of sequential, hierarchical learning may not be valid.

There are, in fact, a great many models to be found in the education literature. Joyce and Weil (1979) have conducted an extensive review and identified over eighty different learning models. They categorized these into four classes: social interaction models, personal models such as those dealing with development of the self concept, behavior modification models, and information-processing models.

Bloom's model falls into the last category as does a number of others. Many of these are competing, while others are complementary. For example, there is Krathwohl's (1964) Affective Domain Taxonomy, which was developed as a companion to Bloom's Cognitive Domain Taxonomy. Bruner's (1960) theory on the basic structure of a discipline, on the other hand, is a fully developed philosophy about education, which sometimes clashes with others. Parnes (1967) has developed an elaborate process model intended to enhance the creative problem solving abilities of adults; while Williams (1970) has advanced a three-dimensional framework associated with teaching strategies for thinking and feeling. Also, Treffinger (1979) has promoted his model, which facilitates self-directed learning.

FIGURE 1
BLOOM'S TAXONOMY*

Learning Level	Description
1. Basic Knowledge	Student recalls or recognizes information.
2. Comprehension	Students changes information into a different symbolic form.
3. Application	Student discovers relationships, generalizations and skills.
4. Analysis	Student solves problems in light of conscious knowledge of the relationship between components and the principle that organizes them.
5. Objective Synthesis	Student goes beyond what is known, providing new insights.
6. Objective Evaluation	Student develops the ability to create standards of judgment, to weigh and to analyze.

* Adapted from Bloom (1956)

The models cited above are simply exemplary of the rich body of literature and theory available with regard to frameworks for information-processing learning. This paper reviews one such model and illustrates how it can be applied to collegiate business courses at various levels as a means of diagnosing the learning process (es) involved and of suggesting alternative pedagogies. It should be obvious that the models differ with respect to underlying assumptions about the learning environment, learning processes, teacher intervention, and student intellectual maturity. Consequently, in reviewing the numerous alternative models and selecting the one presented, the authors applied five criteria. First, the model must be applicable to collegiate classroom environments. Second, the model had to be course-oriented rather than discipline or curriculum-based. Third, the model must be complex rather than simplistic, i.e., multidimensional. Fourth, the model should be capable of diagnosing a pedagogical strategy In current use; and fifth, the

model should provide for alternative teaching strategies to effect similar or better results.

GUILFORD'S STRUCTURE OF INTELLECT MODEL

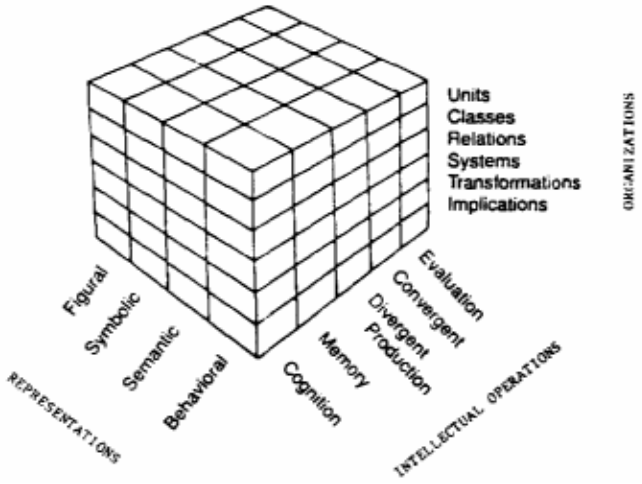
The learning model, which best satisfied the five criteria just reviewed is Guilford's Structure of Intellect model, popularly referred to as the "SI" model. The model is also known as the Sol" model based on Mary Meeker's (1985) popularization of Guilford's theories. The SI model was developed by Guilford based on his extensive testing and performance appraisal work with air force pilots (Maker, 1982). It is partially empirically based as it draws heavily on factor analyses results compiled by Guilford across a multitude of intelligence, achievement, and aptitude tests over multiple subject pools.

Three fundamental assumptions (Guilford, 1966) underlying the SI model can be contrasted to Bloom's taxonomy. First, Guilford assumes that there are many different types of intelligence within the adult mind; whereas, Bloom's taxonomy implicitly assumes intelligence is a unidimensional concept. Next, Guilford believes that these intellectual capacities can be developed through alternative, specific strategies; while Bloom provides only general strategies. Finally, Guilford's model is morphological (Gowan, Khatena, & Torrance, 1979); whereas, Bloom's is hierarchical. That is, Bloom assumes that learning progresses uniformly upward from level to level in sequential fashion, while Guilford holds that each intellectual capacity is independent of others, and a person can display strengths in one intellectual area without necessarily displaying strengths in other related areas.

Guilford's model identifies where one can teach rather than what one should teach. His system is best represented by a three dimensional cube The authors have adapted Guilford's original model and labeled the three dimensions as: Intellectual Operations; Representations; and Organization. The dimensions examine (1) five intellectual thinking processes that can be used; (2) as individuals respond to four different representations of information; (3) which can be organized in six different ways. Guilford maintains that all individuals are capable of performing tasks, which relate to the three dimensions; however, the degree and extent to which they demonstrate proficiency is highly dependent upon the development of separate categories within each dimension. Each cell in Guilford's cube (i.e., 120 cells) represents the interaction of different categories across dimensions. To fully understand how this model can help educators diagnose learning processes involved in classroom based tasks, an understanding of the meaning of each dimension and its individual categories must be attained.

Intellectual Operations. The first dimension represents five categories of intellectual thinking that individuals utilize when responding to various types of tasks (Guilford, 1977; Meeker, 1985). Cognition is the most basic of the categories and represents a person's simple recognition, comprehension, and understanding of information. As an example, cognition would be displayed if an individual accurately identified the makes of Ford, Chevrolet, and Pontiac in a picture containing three cars. Memory involves the storage and retrieval of previously comprehended information. If asked one day later to name the three cars previously shown in the picture, an individual would retrieve from memory the terms: "Ford, Chevrolet, and Pontiac." Evaluation, in turn, requires individuals to make comparisons, judgements, and decisions about information already comprehended. A task, which requires an individual to look at a picture of a Ford, Chevrolet, and Pontiac and select the car, which is most economical, would involve evaluative thinking. Divergent Production and Convergent Production rely upon Memory (i.e., retrieval of information) and Cognition (i.e., understanding of information). Both require individuals to generate new information from existing information, yet differ in how individuals respond to a situation. With convergent production, one uses analytical and logical thinking to arrive at one accepted response, while Divergent Production requires the use of flexible and original thinking as a variety of logical responses are generated for a given situation. A task involving convergent thinking might require an individual to specify how Pontiac could alter its existing models to make the automobiles as economical as Fords. In contrast, a task involving divergent thinking would require the same individual to specify how manufacturers could make future cars more economical.

FIGURE 2
GUILFORD'S STRUCTURE OF INTELLECT MODEL



Representations of Information. The second dimension pertains to different ways in which information can be presented to individuals and involves four categories (Guilford, 1977; Meeker, 1985). Figural representations are the most basic of the four and appear as graphic images or concrete objects. A picture of a Ford, Chevrolet, and Pontiac car would be a figural representation. Symbolic representations are represented by symbols (i.e., letters, numbers, signs, equations, notations, etc.) which have no significance by themselves yet they represent something else. The Pontiac symbol could represent car sales on a graph. Semantic representations are expressions of meaning and appear in the form of words, sentences, and paragraphs. For Pontiac, the semantic representation might be the copy in an advertisement. Behavior representations are nonverbal signs (i.e., body language, Facial Expressions) that individuals project when communicating information. Two salesmen might verbally present the same information about the cost effectiveness of a Pontiac to a group of potential buyers; however, one

individual might convey a totally different message than the other individual due to behavioral manifestations.

Organizations. The third dimension pertains to how Figural, Symbolic, Semantic, or Behavioral Information has been organized in a task and contains six categories (Guilford, 1977; Meeker, 1985). Units are the most basic of the six classes and involves an individual's ability to react to single, unrelated items of information. Counting the number of Pontiacs sold in 1989 would be an example of thinking involving "units." Each Pontiac represents one unit.
Classes involve an individual's ability to deal with information that has been grouped into meaningful sets because of similarities. Asking an individual to compile a list of cars that were economical would be an example of thinking involving "classes. Relations require an individual to respond to information, where connections, associations, or correlation's exist between units of information. Prioritizing models of cars from least to most economical would involve relational" thinking. Systems are more complex than classes or relations and involve information that is interrelated. The development of a plan that would increase the gas efficiency of Ford would involve the use of "systems". Transformations involve the modification, redefinition, or revision of Existing information in order to create something that is new or different. Requiring an individual to examine strategies of existing economy automobile companies and then recommend strategies to increase the economical aspects of Ford automobiles would be an example of thinking involving transformation. Finally, implication involves the use of existing information in order to determine consequences or make predictions about future events, Projecting future changes in the car industry based upon changes in the past would involve implication.

APPLICATION OF GUILFORD'S MODEL

Each cell in Guilford's model corresponds to different types of learning situations in collegiate classrooms and the business world. The diversity of the learning situations can be seen in Figure 3 as the five different types of intellectual operations can interact with the four different types of information representations which can interact with the six different ways in which information can be organized for a given task. Guilford's model clearly shows that there are many different ways in which one can examine an individual's understanding of material in collegiate courses. Educators using traditional approaches to assess knowledge fail to tap many other aspects of learning that are equally important. Guilford's model helps educators reassess areas of learning that are routinely being examined and recognize important areas that are being unintentionally ignored. Figure 4 illustrates typical examples.

With basic business courses, the majority of the class assignments require students to recognize relevant information that they are studying (Cognition), recall the information when needed (Memory), and/or apply the information in order to answer a question correctly (Convergent Production). The students interact primarily with written/verbal words/sentences (Semantic) or numbers/symbols (Symbolic). They typically respond to details (Units), categories (Classes), or associations (Relations) when processing the information. The combination of these categories result in the kind of activities commonly found on examinations. It is not until students start to enter higher level business courses and become deeply involved in case studies, simulation, critiques and business plans that they are exposed to tasks which involve the use of some creative problem solving (Divergent Production) and evaluation thinking (Evaluation). It is also at this point that students become exposed to activities that allow them to see how information fits together into a whole (Systems).

FIGURE 3
TYPES OF LEARNING SITUATIONS

INTELLECTUAL OPERATIONS	REPRESENTATIONS	ORGANIZATIONS
COGNITION	FIGURAL	UNITS
MEMORY	SYMBOLIC	CLASSES
EVALUATION	SEMANTIC	RELATIONS
CONVERGENT PRODUCTION	BEHAVIORAL	SYSTEMS
DIVERGENT PRODUCTION		TRANSFORMATIONS
		IMPLICATIONS

FIGURE 4
EXAMPLES OF "TRADITIONAL" LEARNING ACTIVITIES

INTERACTION OF DIMENSIONS	ACTIVITY
Cognition-Figural-Units	Examine the picture and identify the names of the 3 cars.

The activity involved basic recognition (Cognition) of separate objects (Units) found in a visual picture (Figural).

***

Convergent-Semantic-Systems	Develop a plan that will increase the gas efficiency of Fords.

The activity involved interrelating information (systems) while using words, sentences, etc. (semantic) in order to arrive at one correct solution to a problem (convergent production).

***

Divergent-Semantic-Implications	Use existing information and make projections regarding changes that will take place in the future in the car industry.

The activity involved the use of verbal and written information (Semantic) in order to create a variety of original ideas (Divergent Production) which anticipate a future happening (Implication).

By matching experiential activities commonly found in individual professors' classrooms (e.g., simulations, case studies, plans) to corresponding cells in Guilford's model, one can clearly identify the various types of learning actually taking place in different courses. As can be seen In Figure 5, many such activities may involve the use of convergent thinking rather than divergent or evaluative thinking. Yet research has found that individuals who possess well developed divergent thinking abilities have a greater tendency to suggest Innovative ideas while Involved in their jobs (Guilford, 1977). College students may be rarely exposed to activities that require them to transform existing information or make implications, yet they are expected to demonstrate that ability when making projections or providing strategies in the business world. Collegiate courses also rarely provide students with feedback regarding their behavioral presentation of information when speaking in front of a group, yet this is an important factor that often determines whether a client accepts a new idea.

FIGURE 5
EXAMPLES OF EXPERIENTIAL ACTIVITIES

ACTIVITY	CATEGORIES
Develop a Business Plan	Convergent-Semantic-Systems Convergent-Symbolic-Systems Students examine written and verbal words and symbols which are interrelated and develop one best plan.
Article Reviews	Convergent-Semantic-Units Convergent-Semantic-Classes Students read written words and identify the key concepts in the articles.
Computer Simulation	Convergent-Semantic-Implications Convergent-Symbolic-Implications Students read written words, examine income statements, formulate plans and make decisions.

The preceding exposition reveals the diagnostic power afforded by the SI model: by analyzing what he or she does, an educator may discover over- or under-emphasis on certain, critical intellectual process(es) development. It can also be used to suggest alternative representations of information or their organization to broaden the array of educational vehicles conceivable. While not a panacea, Guilford's SI model clearly provides for a much more comprehensive framework than does Bloom's Taxonomy and we recommend that collegiate business educators consider its adoption.

REFERENCES

Anderson, Philip and Leigh Lawton, (19S8), 'Assessing Student Performance on a Business Simulation Exercise," Developments in Business Simulation and Experiential Exercises, Vol. 15, Patricia Sanders and Tom Pray (eds.), 241-245.

Bloom, Benjamin S., (1956), Taxonomy of Educational Objectives: The Classification of Educational Goals, Handbook I: The Cognitive Domain, New York, NY, Longman, Greens and Company.

Bruner, J, (1960), The Process of Education, Cambridge, MA, Harvard University Press.

Butler, Richard, Peter Markulis and Daniel Strang, (1985), "Learning Theory and Research Design: How has ABSEL Fared?", Developments in Business Simulation and Experiential Exercises, Vol. 12, James Gentry and Alvin Burns (eds.), 86-90.

Gentry, James and Alvin Burns, (1981), "Operationalizing a Test of a Model of the use of Simulation Games and Experiential Exercises," Developments in Business Simulation and Experiential Exercises, Vol. 8, William Biggs and David Fritzsche (eds.), 48-52.

Gentry, James, Kenneth McCain and Alvin Burns, (1979), Relating Teaching Methods with Educational Objectives In the Business Curriculum," Insights into Experiential Pedagogy, Samuel Certo and Daniel Brenenstuhl (eds.), 196-198.

Gowan, J. C., Khatena, J., & Torrance, E. Paul, (1979), Educating the Ablest, F. E. Peacock Publishers, Inc.

Guilford, J. P, (1967), The Nature of intelligence, New York, NY: McGraw Hill Book Company.

Guilford, J. p, (1977), Way beyond the IQ, Buffalo, NY, Creative Education Foundation, Inc.

Joyce, B. and B. Weil, (1972), Models of Teaching, Englewood Cloffs, N.J., Prentice-Hall, Inc.

Krathwohl, D.R., B. Bloom, and B. Masia, (1964), Taxonomy of Educational Objectives The Classification of Educational Goals. Handbook II: Affective Domain, New York, NY, David McKay Co.

Lewis, William, Rebecca Yates and Eugene Gomolka, (1988), Developments in Business Simulation and Experiential Exercises, Vol. 15, Patricia Sanders and Tom Pray (eds.), 170-174.

Maker, C. J, (1982), Teaching Models in Education of the Gifted, Rockville, MD: Aspen Systems Corporation.

Meeker, R, (1985), SOl Training Manual, El Segundo, CA, SOl Institute.

Parnes, 5., (1967), Programming Creative Behavior, Buffalo, NY, State University of New York at Buffalo.

Treffinger, D. and R. Barton, (1979), Fostering independent Learning," G/C/T, 7, 3-6; 54.

Williams, F., (1970), Classroom Ideas for Encouraging Thinking and Feeling, Second Edition, Buffalo, NY, D.O.K. Publishers.