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Validation and Application of an Objectives Analysis Tool for Course Evaluation

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ABSTRACT

This paper focuses on the design and implementation of a multivariate matrix to evaluate courses verifying compatibility with Tyler's principles within Bloom's criteria. By combining these two constructs, a matrix can be constructed which will provide both a means of evaluating the completeness of a course curriculum unit and a basis for comparing distance-learning curriculum units with their traditional counterparts. We will focus on the development of the model, its implementation, and discuss our plans for validating the model using empirical data.

Keywords

Distance learning, objectives analysis, Bloom, Tyler, multivariate matrix.

INTRODUCTION

Distance-learning, unlike the traditional classroom, occurs when the student and the instructor are logistically separated. Considered from this perspective, distance-learning is not a new concept to academia. Educational institutions have been providing distance-learning courses in various formats for many years. As technologies developed, various types of distance-learning have evolved along with the technologies. Universities have been providing directed and independent study distance-learning courses utilizing videotapes and interactive television since these technologies became available. The advent of Internet technologies and their application to distance-learning has resulted in an explosive growth of distance-learning courses at the collegiate level. According to U.S. Department of Education reports, distance-learning enrollments at the university level increased 70 percent during the period between 1995 and 1998 (Boehie, 2000). This growth has continued as more online courses became available through a variety of educational venues. At all levels, these courses create significant problems for faculty and others concerned with evaluating the quality of instruction and content of these courses. The key question is whether students receive a quality education through online distance-learning formats.

Although numerous studies suggest the effectiveness of distance-learning courses to be comparable to that of traditional coursework, evaluations of e-learning course effectiveness have been based on comparison of final grades for students who took the online courses compared with grades of students who participated in classroom-based courses (Sonner, 1999). This limited basis of evaluation does not resolve the concern for the quality of education provided using internet-based delivery. "While technology has provided meaningful tools for tracking, sorting, and disseminating information, it has created unprecedented complexity, as well as a concern for the value and integrity of that information" (Karr, 2002). Additionally, decisions regarding distance-learning are made in a context unfamiliar to many faculty and administrators. Resolving curriculum issues, a difficult challenge within itself, is compounded by the application of rapidly evolving technologies. Even accreditation organizations have difficulty resolving issues raised by distance-learning. The Council for Higher Education Accreditation suggested the following issues needed to be addressed regarding distance-learning effectiveness (Eaton, 2000):

- What is an effective framework for distance-learning?
- How can quality be evaluated and insured?

A significant body of research exists that addresses these issues for traditional curriculum development. As early as the 1940's, Ralph Tyler, in his seminal work, stated that teachers should formulate the course objectives, define the objectives in terms of student behavior, collect situations in which students are to indicate the presence or absence of each objective, and provide the method of evaluating the student's reactions in the light of each objective (Tyler, 1949).

These concepts, further developed in his 1949 book Basic Principles of Curriculum and Instruction, provide the basis for curriculum and course development through the establishment of objectives and the evaluation of effectiveness through measurement of student mastery of these objectives. Subsequent research developed the concept of course objectives. Taxonomies developed by Bloom, Krathwohl, Gagne, Anderson and others classify learning objectives by type and hierarchical order, providing a basis for framework development (Bonner, 1999). The most widely applied of these is Bloom's Taxonomy. According to Bloom, it is intended to provide for classification of the goals of our educational system. It is expected to be of general help to all teachers, administrators, professional specialists, and research workers who deal with curricular and evaluation problems. It is especially intended to help them discuss these problems with greater precision (Bloom, 1956).

The educational outcomes described in the taxonomy are discussed from a behavioral perspective and address the changes in individuals resulting from educational experiences. Thus, the taxonomy provides a means of classifying the behaviors which represent the desired outcomes of educational processes (Psychology of Learning, 2002). Specifics of the taxonomy are discussed later in this paper.

While widely applied to traditional classroom curriculum, the work of Bloom and Tyler has not been integrated into the venue of distance-learning. One reason for this may be the significant differences between delivery methods employed in traditional classroom courses and those mandated by the technologies used in distance-learning. Traditional delivery methods used to achieve Bloom's learning objectives are predominantly unavailable to the online course instructor. Furthermore, traditional evaluation procedures prescribed by Tyler fail to address the unique circumstances imposed by e-learning. Lack of immediate feedback, time and space separation of students from faculty and each other, elimination of nonverbal (body language) communication and reduction of control of testing environments may weaken the evaluation process unless provisions are made to adapt feedback and testing to online distance-learning.

Previous studies (e.g. dlnc.org, 2002) partially address the delivery methods available to online course instructors in conjunction with Bloom's taxonomy and Tyler's principles. The works discuss some of the delivery methods available to online educators. While informational, we contend that the works did not address the following issues:

- Provide a more comprehensive list of online delivery methods
- Propose specific online delivery methods to Bloom's cognitive learning hierarchy
- Incorporate feedback and evaluation methods appropriate to e-learning to verify course effectiveness
- Integrate the above into a comprehensive framework for development and evaluation of online distance-learning courses

Thus, the purpose of this paper is derived from the necessity to address these issues. Due to space constraints, we will not review Bloom's or Tyler's theories here, but rather address the integration issues.

METHODOLOGY

A Framework for Design and Evaluation

Utilizing a combination of Bloom's classifications and Tyler's principles, it is possible to construct the following framework for design and evaluation of curriculum:

Bloom Criterion
Tyler Objectives
Sequenced
Appropriate
Attainable
Challenging
Measurable
Specific
Tyler Experiences
Practice
Reward
Performance

Variety
Outcomes
Tyler Organization
Continuity
Sequence
Integration
Tyler Evaluations
Behaviorally targeted evaluation
Baseline evaluation
Successive evaluations
Appropriate evaluation type

Integrating Evaluation Questions into the Framework

To use the framework as a functional tool for design or analysis of curriculum components, specific questions were developed to address each of the above evaluation points. The following expansion of the above framework adds questions to address each evaluation point. Questions are based on the descriptions of each of the evaluation criteria by their respective authors.

Bloom Criterion – Which of the Bloom criterion is being addressed by this learning activity? To determine criterion category, compare objective statements with verb list in appendix. To stipulate category in course design, use verbs appropriate to criterion from verb list in appendix.

Tyler Objectives – Is the objective statement written utilizing verbiage appropriate to the Bloom criterion? (Reference the Verb list in the appendix)

Specific - Are objectives stated in a clear, well defined, and concise manner

Are objective statements absent of ambiguity?

Measurable – Is the objective stated such that a specific measurement is provided to indicate goal achievement?

Attainable – Are the objectives attainable by the students with effort in the time allowed? **Appropriate** – Are the objectives focused on the desired behavior?

Are the objectives appropriate to the Bloom criterion?

Sequenced – Are milestone measurements with time deadlines indicated?

Challenging – Are the objectives difficult but attainable?

Communicated – Are objectives well communicated to students?

Tyler Experiences – Which distance-learning tools are used to deliver the course? Evaluate specific tools using Tyler's five general principles for establishing educational experiences based on the following questions:

Practice – Do online activities require students to practice the skills necessary to achieve the desired behavior?

Is a feedback mechanism provided to correct student mistakes during practice activities?

Reward – Are rewards provided to students that motivate them to perform the tasks necessary to achieve the desired behavior?

Are the rewards delivered to the students in a timely manner after the desired behavior has been achieved?

Are the rewards withheld from students who do not achieve the desired behavior?

Performance – This is the same as attainable objectives discussed previously.

Variety – Are a variety of experiences (based on a variety of distance-learning tools) used to enhance student learning?

Do the distance-learning methods implemented provide experiences appropriate to the Bloom Criterion category being designed or evaluated?

Outcomes – Are distance-learning tools selected and implemented to restrict the possible outcomes to those that achieve the desired behavior?

If student activities result in undesired outcomes, is a feedback mechanism provided to correct students?

Tyler Organization – Which level of structural element is being developed or analyzed?

Continuity – Are multiple opportunities provided for students to practice the skills necessary to achieve the desired behavior to be practiced?

Are practice opportunities provided continuously throughout the course?

Sequence – Do successive experiences (activities) build upon the preceding one but to go more broadly and deeply into the matters involved?

Do successive experiences evolve to achieve the desired level of complexity within Bloom’s hierarchy?

Integration – Do the activities used to develop the skills necessary exemplify the relationship of the desired behavior to other subjects/fields?

Tyler Evaluations -

Behaviorally targeted evaluation – Do the evaluations used specifically evaluate the intended behavior?

Baseline evaluation – Is a baseline evaluation used to assess students initial knowledge of the desired behavior?

Successive evaluations – Are a series of evaluations used to assess student progress?

Appropriate evaluation type – Are the skills and knowledge necessary to successfully complete the evaluations representative of the skills and knowledge necessary to achieve the intended behavior?

Appropriate Bloom Criterion Level – Are the evaluations appropriately structured to reflect mastery of the behavior at the desired Bloom criterion level?

Implementing a Framework Evaluation Scale

A scale was established to measure and assess the evaluation points with respect to Bloom’s taxonomy within Tyler’s principles. Under the premise that each of Tyler’s principles is equally important in the design and analysis of curriculum, each of Bloom’s categories was subjectively assigned an equal weight (Baker, 2003). Upon further research, we determined that the weights needed to be correlated to each of the Bloom criteria addressed by the course objectives (Baker & Papp, 2003). This is accomplished through the taxonomy questionnaire (Figure 1).

		Never	Rarely	Sometimes	Usually	Always	Return to Summary
		1	2	3	4	5	Page
1	5	The objectives require the student to memorize or remember information?					K
2	4	The objectives require the student to restate or rewrite information?					C
3	3	The objectives require the student to apply the information to a problem or scenario?					AP
4	2	The objectives require the student to analyze information provided?					AN
5	1	The objectives require the student to combine information to construct something new?					S
6	3	The objectives require the student to make value decisions about issues or information?					E
7	2	The objectives require the student to list or label information?					K
8	3	The objectives require the student to describe information in their own words?					C
9	4	The objectives require the student to explain why information is significant?					AP
10	5	The objectives require the student to compare/contrast information?					AN
11	2	The objectives require the student to arrange or organize information?					S
12	4	The objectives require the student to make judgements based on information provided?					E
13	3	The objectives require the student to duplicate, reproduce, or recall information?					K
14	2	The objectives require the student to translate or convert information into another form or medium?					C
15	1	The objectives require the student to employ or practice using the information?					AP
16	1	The objectives require the student to differentiate or distinguish among choices?					AN
17	2	The objectives require the student to formulate concepts based on information?					S
18	3	The objectives require the student to compare and choose among alternatives?					E
19	4	The objectives require the student to define, describe, or record information?					K
20	1	The objectives require the student to give examples of information?					C
21	5	The objectives require the student to solve problems using the information?					AP
22	4	The objectives require the student to categorize or distinguish among information?					AN
23	3	The objectives require the student to compose or develop new information?					S
24	2	The objectives require the student to rate compare, rate, or score alternatives?					E

Figure 1. Weight

Calculations Based on Bloom’s Criteria

The 24 questions contained therein represent the six levels of Bloom criteria. The scores for each of the categories are averaged to determine the relative weight of each of the Bloom criteria. Currently, this is a subjective measurement, but further research is underway to determine if an empirical value can be derived using a multiple regression model. Once the weights for each category have been obtained, each of Tyler’s principles is evaluated using a 10-question analysis of the objectives (see Figure 2).

Tyler Objectives					Return to Summary Page
The responses to the evaluation questions that follow are based on the following Likert Scale. Click into the answer cell and select a value between one and five from the drop-down list.					
	Never	Rarely	Sometimes	Usually	Always
	1	2	3	4	5
1	Are the objectives attainable by the students with effort in the time allowed?				1
2	Are milestone measurements with time deadlines indicated?				1
3	Do the objectives require the learner to perform an activity to learn the subject material?				1
4	Are the objectives focused on the desired behavior?				1
5	Are the objectives stated in specific terms?				1
6	Are the objectives clearly and obviously delineated as objectives of the learning component?				1
7	Are the objectives sequenced to develop learner skills?				1
8	Are the skills the students are required to learn relevant to them?				1
9	Do the objectives specify the content area to be mastered?				1
10	Are the objectives appropriate to the grade level of the course				1
Average Knowledge-Objectives Score>					1.00

Figure 2. Sample Framework Component

The resulting framework as illustrated in Figure 3 provides a weighted total for each Tyler principle within each of Bloom’s criterion. Each of Bloom’s criteria are displayed horizontally across the top. Vertically down the left side are each of Tyler’s principles. The cells composing the intersection of the rows and columns are the scores for each of the analyses of Bloom’s criteria with respect to Tyler’s principles. Once each of the 24 domains have been assessed, the summary screen will calculate a weighted total for each of Bloom’s criteria and each of Tyler’s principles. A final score, based on these weighted totals, will be used to determine the overall effectiveness (score) of the course. Figure 3 illustrates the revised Multi-Dimensional framework integrating Bloom and Tyler.

Distance Learning Framework Evaluation Summary							
Tyler Weighted Average Score	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Weighted Total
Objectives Score >	0.70	0.50	0.65	0.60	0.40	0.60	= 3.45
Experiences Score >	1.82	1.30	1.69	1.56	1.04	1.56	= 8.97
Observations Score >	2.28	1.63	2.11	1.95	1.30	1.95	= 11.21
Evaluations Score >	3.50	2.50	3.25	3.00	2.00	3.00	= 17.25
Weighted Total >	8.30	5.93	7.70	7.11	4.74	7.11	= 40.88

Figure 3. Multi-Dimensional Framework

Objective Assessment Tool

To assess course objectives with respect to Bloom’s criteria, we have developed a model that will allow users to assess their course objectives according to the established Bloom Taxonomy list. The user analyzes his/her course objective by objective. The model will parse each objective and determine the corresponding level at which the objective is written. The

user will receive detailed feedback as to the level of each objective and may then either re-write the objective to meet the desired level or request assistance from the tool in selecting an action verb that corresponds to the desired Bloom level (see Figure 4). This tool is currently being tested on sample syllabi and will be used extensively in the assessment and creation of the Course Evaluation Matrix.

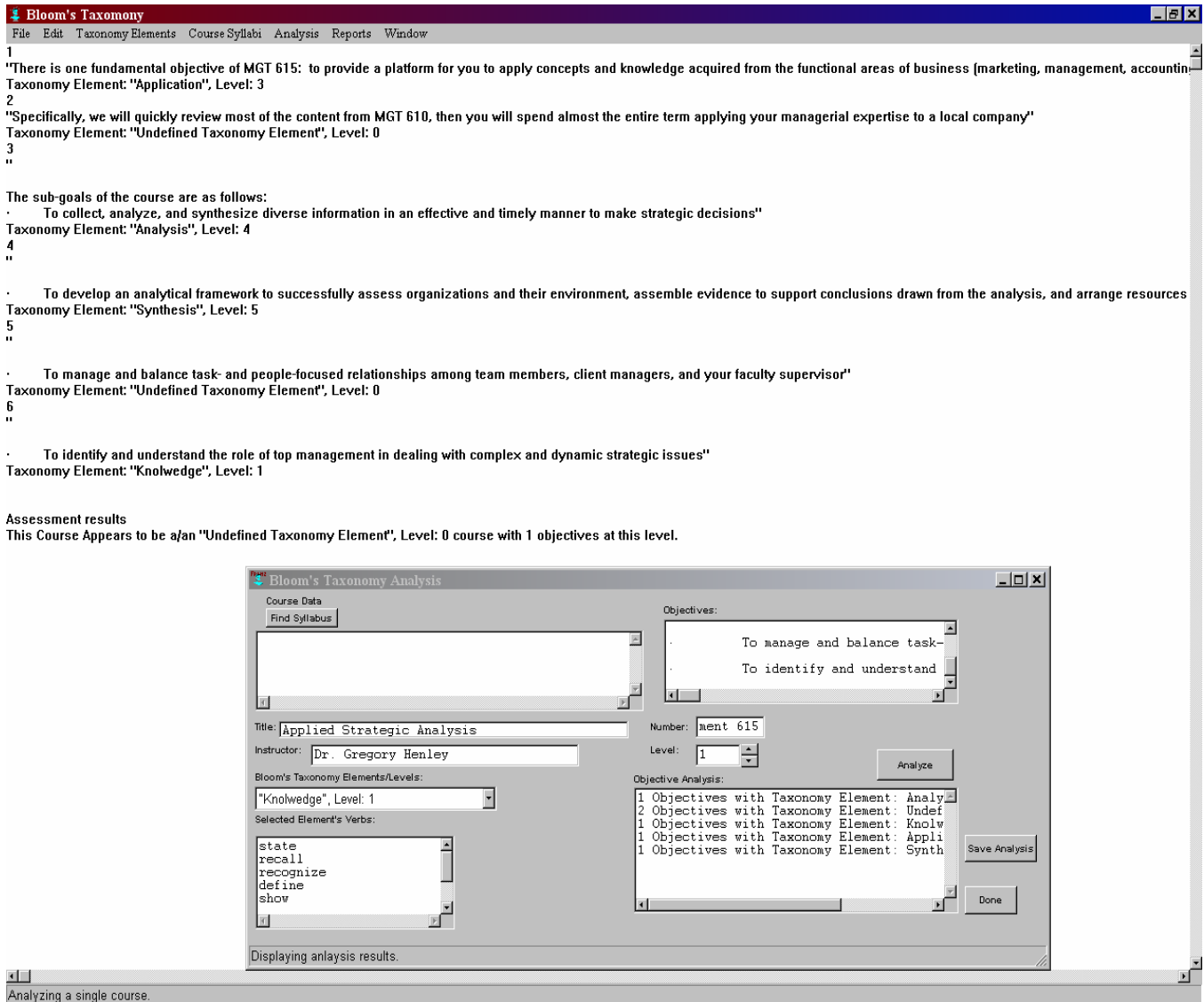


Figure 4. Course Objective Assessment

Research in Progress

Given the framework outlined above, during the summer and fall of 2004 the authors plan to empirically test and validate the framework by evaluating several distance-learning courses. Once a sample data set is obtained, a more comprehensive statistical analysis will be conducted to determine the extent of construct validity and reliability of the instrument. A confirmatory factor analysis will be employed to determine whether the discrete elements in the framework are unique with respect to measurement. A regression model will developed to determine the correct weights for each of the Tyler principles to account for variances in criteria importance.

CONCLUSIONS

Several preliminary conclusions can be drawn about the framework based on this analysis. First, the framework provides an in-depth means of evaluating distance-learning curriculum components, verifying compatibility with Tyler's principles and determining Bloom's criterion level. While the purpose of this discussion is neither to verify nor vilify Tyler's principles, applying these long established principles to the developing distance-learning curriculum provides both a means of evaluating the completeness of a distance-learning curriculum unit and a basis for comparing distance-learning curriculum units with their traditional counterparts. Obviously a significant number of additional evaluations using the framework are needed to substantiate its validity and reliability as an instrument for distance-learning evaluation, but the evaluation discussed herein supports its functionality with a minor modification to the evaluation scale.

Second, utilizing a purely binary evaluation measurement (Yes/No point assignment) as described in Baker (2003) is inappropriate for many questions. For example, the framework question "Are rewards provided to students that motivate them to perform the tasks necessary to achieve the desired behavior?" can be answered in the affirmative if the only reward provided is the grade or if other reward mechanisms are incorporated. The question "Are a variety of experiences used to enhance student learning?" is not specific as to what constitutes a variety. Are two experiences a variety, does it require five, or is it situational? The Continuity question asking "Are multiple opportunities provided for students to practice the skills necessary to achieve the desired behavior to be practiced?" poses the same enigma. Do two practice opportunities constitute multiple opportunities or does it require more? Rewording the questions and using a Likert scale metric, while being more subjective for the evaluator, can better differentiate between levels of conformance with the framework questions thus providing a more accurate assessment of the curriculum element being evaluated. Hence, we stipulate that a Likert scale is essential.

Third, complexity of evaluations using the framework will increase at higher levels of Bloom's classifications of learning objectives. The framework is designed to be applied to each classification level contained within the curriculum unit being evaluated. Since higher level classifications, those requiring synthesis or evaluation, usually contain some lower level classifications as part of a developmental foundation, each subordinate level contained within the curriculum unit will need to be analyzed using the framework. Absent this hierarchical evaluation, there is no way of insuring the proper foundation is developed to achieve the high-level objectives. While this is not viewed by the author as a problem, it is a schedule and time-management issue that potential evaluators using the framework will need to address.

Directions for Further Research

While the functionality of the framework is established by the study herein, the effectiveness of the framework as a tool for evaluation of distance-learning courses has not been validated. To validate the framework, additional evaluations using the proposed model are recommended. Numerous universities offer distance-learning courses. Because of the significantly greater number of courses available at the university level, university courses will be used for future studies. Proposed framework validation will be based on six courses or lessons, one each from each of Bloom's criterion levels, using the revised metric.

Another appropriate area of study would be an analysis of the effectiveness of the various distance-learning tools and delivery methods in achieving learning objectives at the different Bloom criterion levels.

Further research is also planned that would explore Bloom's affective domain (Krathwohl, Bloom & Masia, 1964) and extend the matrix to incorporate these taxonomies.

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