The Impact of Technology on Educational Equivalency: Capabilities Based Educational Equivalency Units

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Supported by the conventional models of classroom education, the Carnegie Unit, as a standard of educational equivalency, has been an inherited mainstay in modern education. Yet, while the Carnegie Unit remains restricted by the limitations of time and space, the surge of educational technologies (e.g., computer-based instruction, Internet-based instruction, instructional design, and system planning) in the past 50 years has transformed education into a system that is not imprisoned by the confines of the classroom.

In hopes of transforming educational equivalency from a unit of measurement that relies on time in the classroom as the standard (i.e., Carnegie Units) to one that is focused on learner achievement and capabilities, the Capabilities Based Educational Equivalency (CBEE) Units model puts forward a framework of academic equivalency which is founded on valid and useful instructional objectives (Watkins & Schlosser, in press). While allowing time and location to vary across courses and academic programs, the CBEE Units model permits the valid comparison of student achievement by holding academic achievement and student capabilities relatively constant.

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Why Equivalency? Why Now?

> Perhaps we are entering a time when new paradigms of the teaching/learning process need to be developed. Or perhaps technology is forcing on us a new paradigm, whether we are consciously aware or not. (Pfnister, 1991, p. 39)

Within the rapid currents of change in education, the question of educational equivalency has become of increasing concern in the development of valid and useful models and applicable theories for education. Changes in the foundations of education (spurred by a good economy, an adult workforce looking for further educational opportunities, and the after-effects of educational reform efforts in recent decades) have brought many new challenges and demands that conventional systems (specifically, systems for educational equivalency) are not capable of managing.

At many colleges and universities, students today are less likely to spend three one-hour sessions in the classroom for 15 weeks than they are to supplement their classroom time with online discussion groups, Internet chats with the instructor, and/or a variety of technology driven instructional tactics. Comparable influences of educational technologies are also being seen in secondary educational institutions; each focused on alternative methods for making learning opportunities accessible to students. However, according to Watkins and Schlosser (in press), "while convenient, widely accepted, and easily transferred across institutions, the time-based standard (i.e., the Carnegie Unit) as an indicator for measuring the equivalency of academic courses and degrees may not be appropriate for educational models and theories built on the cornerstones of useful and accessible learning opportunities."

What is to be done? Unfortunately, models for equivalency that merely build complex relationships between new delivery systems and the conventional standard (e.g., two hours of interactive chat equals one hour in the classroom) will only continue to strengthen the misperception that time-in-the-classroom or time-on-the-Internet is the goal of instruction. For educational institutions that desire to meet the demands of students, as well as parents and employers, the basis of education equivalency must shift from a focus on time (whether in the classroom or on the Internet) to a consistency of capabilities of "passed" or "graduated" students.

Resisting this prevailing reliance on complex formulas for equating time equivalencies, a new standard of Capabilities Based Educational Equivalency Units (CBEE Units) offers educators the advantages of a

results-focused approach to educational equivalency. The application of the CBEE Units model can facilitate: (a) the translation and transfer of credits with a relatively constant level of learner capabilities; (b) the development and validation of institutional accreditation standards with objectives and assessments built in; (c) the design and development of learning opportunities that are responsive to emerging educational technologies, while at the same time being responsible to requirements of students; as well as (d) the communication to potential learners and employers of the attained capabilities of graduates.

Responsiveness to the demands of technology-supported education (where time in the classroom and/or time-on-task commonly varies) requires a model of equivalency and accreditation with achievement as a primary unit of comparison (see Mayhew, 1991; Pfnister, 1991). Heinich and Ebert (1976) noted that "In traditional instruction, time is constant (the number of hours spent in class) and achievement is variable (the grading system). In programmed instruction, time is variable and achievement is relatively constant" (p. 20). Like programmed instruction of the 1960s and 1970s, education that is supported by information technologies can offer learners a delivery system in which time is variable and achievement is relatively constant. Achieving a desirable system with such characteristics, however, requires new approaches to education and educational equivalency.

The proposed CBEE Units model shifts the focus of educational institutions from the number of hours a student spends in the classroom to a measure of the knowledge, skills, attitudes, and/or abilities (i.e., human capabilities) attained through the completion of a course or degree program. The prevailing restlessness in education, primarily brought about by the influences of technology in both the classroom and society, offers today's educators a significant opportunity to make systemic changes (including changes to the systems of educational equivalency) that are capable of meeting the educational requirements of generations to come.

Equivalency Theory and Models

Recent models for defining educational equivalency have come from the field of distance education, where the relationship of conventional courses and degrees with those delivered at a distance rely on two convenient but probably inappropriate variables: time and experiences. In proposing a theory of equivalency, Simonson (2000) and Simonson, Smaldino, Albright, & Zvacek (2000) have suggested that the design and development of different, yet equivalent, learning experiences is necessary for distance education to be regarded as an equitable alternative for learners. While this proposed "equivalency theory" has generated a desirable focus on the relationship of distance and conventional delivery of instruction, the theory suggests several tenets that may be destructive to the long-term success of education (either distance or conventional).

Equivalency theory suggests a standard of equal (but not necessarily useful) experiences for learners. According to Simonson (2000), "the goal of instructional planning for distance education is to develop an approach that makes the sum of the experiences for each learner equivalent" (p. 7). This mandate for equivalent learning experiences, however, does not necessarily equate to the attainment of equivalent and/or useful results. Based on this, relationships of new delivery systems and the conventional standard (i.e., the Carnegie Unit) can be derived (e.g., two hours of interactive chat equals one hour in the classroom). These relationships, however, offer little value, as time, in itself, has little relationship to learner achievement (Nelson, 1990).*

Models for the equivalency and accreditation of educational programs (in possible attempts to be responsive to social issues as well as to keep pace with the changes in technology) have developed without a modern framework for measuring the ability of the courses, programs, and institutions to accomplish their educational objectives (i.e., add value for learners, institutions, and communities). By continuing to use criteria rooted in "seat-based hours" to measure the equivalency of educational courses and degrees, the field of education has, to a large degree, moved to valuing the size, style, color, speed, and "high-tech" appeal of delivery, while failing to fully examine the value added by its content. Should a common "unit of exchange" for educational equivalency be classroom time, time on task, objectives offered, or learning? We suggest that the primary factor of equivalency should focus on the attained and demonstrated capabilities of the learner.

Carnegie Units: What's the Big Deal?

In 1909, the Carnegie Foundation for the Advancement of Teaching established a standardized measure of academic equivalency. Based on this definition, a standard of 750 minutes with a qualified instructor equaled one academic credit hour, or "Carnegie Unit." The Carnegie Unit has since become the essential characteristic of academic accreditation.

*Nelson states that "Research and practice indicate, almost unanimously, that increasing allocated time itself has little influence on increasing student achievement....Too many other factors are involved in the teaching/learning process which limit the influence time has on student achievement" (p. 3). The other mitigating factors include learner ability and development, learner motivation, classroom learning morale, the "curriculum at home," peer groups, time-on-task, as well as instructional quality.

As Heinich and Ebert (1976) noted, "While the Carnegie Unit may not be the only way instruction will be measured by an accrediting association, it is the only way that is accepted without question" (p. 20).

Academic associations have accredited institutions since 1910 (Afshar, 1991). The primary goal of accreditation since then has been the evaluation of "quality" in academic programs and institutions. In terms of academic accreditation, "quality" has commonly been defined as "instructional effectiveness in achieving educational objectives" (Millard, as cited in Afshar, 1991, p. 37), or "quality in education relates directly to the educational appropriateness of objectives and to the effective use of resources in achieving those objectives" (COPA, as cited in Afshar, 1991, p. 37). Though these definitions emphasize the achievement of educational objectives, no standardized system exists for equating the attainment and demonstration of educational objectives to academic credits received. Lezberg (1998) has noted that "The accrediting bodies do not prescribe any particular method for ensuring the integrity of the academic work" (p. 31). Thus, time in the classroom remains the principal factor in conventional educational equivalency, while learner achievement is left to vary or is assumed to be equal.

The CBEE Units Model as an Alternative

As educational institutions integrate more technologies into the design, development, and delivery of courses and degrees, now is the appropriate time to reconceptualize the models used for determining educational equivalency. By utilizing capabilities-based objectives (Gagné, 1977; 1991), the CBEE Units model offers an approach for determining equivalency that is not time dependent but is responsive to emerging instructional technologies, supportive of systematic instructional design, and focused on the useful achievements of learners.

The goal of the CBEE Units model is not, however, to dictate the "quality content" in educational objectives (as important as this is). Rather, it is to offer a system for measuring equality of courses and degrees that can be based on a standardized formula for relating performance capabilities-based objectives to academic credits. A standardized system for relating the achievement of learners to the measurement of academic credits will achieve a system in which time is variable and achievement is held relatively constant (thereby allowing academic equivalency and accreditation to be responsive to the new paradigms of education).

The pragmatic framework for the CBEE Units model is a taxonomy of human capabilities. According to Gagné (1977, 1991), there are five "major kinds of learning, that is, five types of human capabilities that are learned" (p. 18). These five types of human capabilities are the possible results of education and provide a structure for the development and application of objectives within education. Gagné (1977, 1991) suggests that an individual may:

(1) learn to interact with the environment by using symbols (learned intellectual skills);
(2) learn to state or tell some information (learned verbal information);
(3) learn the skills to manage one's own learning, remembering, and thinking (learned cognitive strategies);
(4) learn to execute movements in a number of organized motor acts (learned motor skills); and
(5) acquire mental states which influence one's choices of personal actions (attitudes).

Based on Gagné's framework, the CBEE Units model proposes that a unit value would be given for learner mastery of capability-based objectives within an academic course. The number of units per attained and demonstrated capability is related to a hierarchy of interrelated capabilities proposed by the authors and based on Gagné's framework (see Table 1). Thus, the mastery of a "defined concept" objective, for example, would result in a value of 3 CBEE Units, while the mastery of an "information" objective would result in a value of 1 CBEE Unit. While a generalizable model for the relationship of CBEE Units to the capabilities hierarchy is proposed, additional research is required to determine the appropriate weighting of capability-based objectives in terms of CBEE Units.

The relationship of capability-based objectives and CBEE Units to academic credits, courses, and degrees is central to educational equivalency. A proposed relationship would formulate 30 CBEE Units (built on capabilities-based objectives) to one academic credit (see Table 2). This relationship would provide institutions with a basic framework for converting time-based credits to achievement-based credits with the transition to an objectives-focused curriculum. As with the number of CBEE Units assigned to the hierarchy of capabilities-based objectives, the number of CBEE Units required for one academic credit will be a topic for future research. The required number of attained capabilities per credit hour may differ among academic disciplines, though we propose that within an academic discipline a standard ratio should be set for equivalency. Though the CBEE Unit model is not currently in place at any academic institution, and the purpose of this article is to begin a professional dialogue that can establish standards for application, a hypothetical example of the application of CBEE Units to a course is provided in Table 2. (The authors, however, are applying the CBEE Units model in the development of four graduate courses at Nova Southeastern University.)

Table 1. Human capabilities and CBEE units.

Human Capabilities (Gagné, 1977)	Objective Verb (Gagné, 1977)	CBEE Units per mastered competency
Intellectual skills:		
• Dis-crimination	Discriminates	1 unit
• Concrete concepts	Identifies	2 units
• Defined concepts	Classifies	3 units
• Rules	Demonstrates	4 units
• Problem solving	Generates	5 units
Cognitive Strategy	Originates	6 units
Information	States	1 unit
Motor Skill	Executes	4 units
Attitude	Chooses	4 units

Without defining the content or evaluating the "quality of content," the CBEE Units model can provide accreditation bodies with a basic framework for determining the equivalency of academic courses, degrees, and institutions based on student achievement rather than time. The CBEE Units model does not propose to standardize objectives (curriculum) across programs and institutions, but rather to give a standardized system as a measure of educational equivalency that is not time-based.

Application and Implications

Though the concept of capabilities-based objectives was proposed by Gagné in 1977, its application has not yet been successfully integrated into higher education practice due to many factors. These include a lack of standardized instructional design and development procedures at most educational institutions. And while this time of increasing acceptance of instructional design principles is auspicious, it is also essential for their long-term application that the models for development and application are not overly burdensome or without visible utility.

In application, the integration of CBEE Units into the instructional design and development processes offers advantages to instructors, curriculum coordinators, learners, and instructional designers. For example, by offering multiple uses for performance objectives (for

Table 2. Hypothetical application of CBEE units.

Minimal Capabilities-Based Educational Objectives for the First Part of an Instructional Design Course	CBEE Units
1. Given the appropriate resources and learning opportunities, in a written report the learner will **identify** and **define** a minimum of 10 primary tasks in conducting a valid and useful needs assessment and needs analysis based on two or more needs assessment models.	2+2=4
2. Given the appropriate resources and learning opportunities, in a written report the learner will **generate** a valid and useful explanation as to the possible value of conducting valid and useful needs assessments and needs analyses within his or her organization. The explanation will identify a minimum of 3 possible benefits and 3 possible risks for the organization in implementing the results of the needs assessment.	5
3. Given the appropriate learning opportunities and a list of 10 statements, the learner will correctly **discriminate** between which are appropriate instructional goals and which are performance objectives, for at least 8 statements.	1
4. Given the appropriate resources and learning opportunities, in a written statement the learner will correctly **identify** a goal statement and an objective for an instructional unit that is approved by the instructor as being appropriate in scope.	2
5. Given an instructional goal identified by the learner, the learner will correctly **demonstrate** an ability to conduct a goal analysis in a written report detailing the analysis tasks and results as specified.	4
6. Given a goal analysis conducted by the learner, the learner will correctly **demonstrate** an ability to conduct an instructional analysis in a written report detailing the analysis tasks and results as specified.	4
7a. Given a goal analysis and instructional analysis conducted by the learner, the learner will correctly **identify** a minimum of 10 required entry behaviors that must be mastered by the target population.	2
7b. Given a goal analysis and instructional analysis conducted by the learner, the learner will correctly **identify** a minimum of 15 essential characteristics of target learners (including prior knowledge, attitudes, ability levels, etc.).	2

(Continued)

Table 2. Hypothetical application of CBEE units (cont'd).

Minimal Capabilities-Based Educational Objectives for the First Part of an Instructional Design Course	CBEE Units
8. Given a goal analysis, instructional analysis, and learner analysis conducted by the learner, the learner will correctly **demonstrate** an ability to conduct a context analysis in a written report detailing the analysis tasks and results as specified.	4
9. Given the appropriate learning opportunities and 20 objectives, the learner will correctly **classify** 16 objectives based on skill type (e.g., psychomotor, intellectual, verbal, etc.) as defined.	3
10. Given completed analyses by the learner, the learner will correctly **generate** objectives that contain all three objective components (e.g., skill/behavior, conditions, and criteria) for each subordinate skill identified in the instructional analysis.	5
Total number of CBEE Units for this selection of course objectives:	**36***

*Based on a minimum of 30 CBEE Units per credit hour, mastery of the example capabilities-based objectives would translate to 1 hour of academic credit (with 6 CBEE units contributing the second hour of academic credit); multiple capabilities can be included in one objective (see 1 above); the combination of capabilities (e.g., to generate) receive a greater number of CBEE units. For example, you could write several *identify* and *define* objectives, but would get approximately the same number of units (see 7a, 7b, 8 above).

planning, design, assessment, accreditation, credit transfer models, as well as promoting educational equivalence with other educational institutions), the linkages and alignments that are likely missing from most curricula can be achieved. By informing learners of the capabilities to be attained through participation in an academic course or program, the CBEE Units model offers additional information to learners attempting to make difficult decisions regarding courses, course evaluations, programs of study, and academic majors. However, despite the benefits of developing capabilities-based objectives, resistance to the task of writing valid and useful performance—and accomplishment—related objectives should not be underestimated.

Summary

In an effort to begin a professional dialogue and offer a tentative model for discussion, this article has proposed a basic model for the transformation of equivalency in education from a unit of measurement focused on "seat based hours" to one that is focused on learner achievement. The development of the Capabilities Based Educational Equivalency Units model will require additional dialogue and research in the future, but it may provide education with a starting place for meeting the requirements of an inevitably competitive future education. □

An online forum for continuing this dialogue is available at: http://www.megaplanning.com

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