Evaluating the Knowledge and Cognitive Domain of Individual Test Questions Against Anderson et. al Revision to Bloom's Taxonomy

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Educators strive to challenge students through rigorous assignments, critical thinking exercises, and creative problem solving. Often, the content delivered to students is identified by accreditation bodies and defined by industry boards. With the Student Learning Outcomes (SLO) stated and the Course Objectives determined, the mechanisms for content dissemination is at the educator's discretion. In order to aid educators through these often vague requirements of content dissemination, categorical frameworks or taxonomies have been designed to "increase precision and promote understanding" (Anderson et al. 2001). Bloom's Taxonomy of Educational Objectives utilizes classifying statements of what we expect/intend students to learn as a result of instruction (Krathwohl 2010). Better known as Bloom's Taxonomy, the original Taxonomy presented a cumulative hierarchy of six major categories in the cognitive domain - Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation (Bloom et al. 1956). A revised edition of Bloom's Taxonomy by Anderson et al. (2001), adjusted the single Knowledge category into two separate dimensions, the Knowledge Domain and the Cognitive Process Domain. The amendment to the original Taxonomy eliminated the unidimensionality of having both the noun and the verb aspects embodied within the Knowledge category. This change adjusted the Knowledge category to be more aligned with the other major categories in that the noun and verb are separate dimensions, while also revising the Cognitive Domain terminology to avoid confusion with the original Taxonomy. With the advent of the revised taxonomy, a framework for producing material using both dimensions allow for the type of subject matter (knowledge) and the verb action (cognitive process) to be integrated at a deeper level. Typically, the revised taxonomy is used to develop assignments with intended outcomes. The goal of this research utilized the taxonomy to review individual questions from a test that evaluates student-learning outcomes for a senior level project controls class. By evaluating each question against the taxonomy, a measure of the test rigor is quantified based on the domains for each question. In order to execute this goal, the research used two objectives, (1) Utilize the Revised Taxonomy to evaluate each question of a test recently given to students in a senior level course focused on project cost controls and scheduling, (2) Quantify the coded questions and evaluate the knowledge and cognition depth of the test based on the cumulative hierarchy. Each question was coded based on its specific Knowledge and Cognitive domain. The results were placed into a "Taxonomy Table," which maps the six new categories in the Cognitive Domain (Remember, Understand, Apply, Analyze, Evaluate, Create) in correlation with the four Knowledge Domain categories (Factual, Conceptual, Procedural, Metacognitive). The coding revealed that the 32-question test had a majority of questions (11 of 32) falling under the "Procedural Knowledge–Apply Process" category, with every question requiring at a minimum "Factual Knowledge". Procedural Knowledge requires knowledge of how to do something, including methods of inquiry and criteria for using skills, algorithms, techniques, and methods. The "Apply" cognitive process requires the student to execute or implement a procedure (Krathwohl 2010). In terms of rigor, this requires the students to utilize subject specific mastery to calculate or perform a task. "Conceptual Knowledge–Understand Process" (7 of 32) and "Procedural Knowledge–Understand Process" (6 of 32) round out the top three domain pairings. Evaluating each question in an exam against the Revised Bloom's Taxonomy is a unique approach to measuring the rigor of a typical assessment tool. Measuring the rigor of an assessment using a standard metric can reveal the actual depth of the assessment tool against the intended depth (or rigor) of the assessment. Future research could evaluate additional course materials in aggregate to gauge the rigor of the assessment material as whole against the intended rigor for the SLOs. If measured properly, this could be utilized as a metric for accreditation.

Keywords: Knowledge Domain, Cognitive Domain, Bloom's Taxonomy, Assessment

References

Anderson, L. W., Krathwohl, D. R., Airasian, P. W., Cruikshank, K. A., Mayer, R. E., Pintrich, P. R., Raths, J., & Wittrock, M. C. (2001). *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*. New York: Longman.

Bloom, B. S., Engelhart, M. D., Furst, E. J., Hill, W. H., and Krathwol, D. R. (1956). *Taxonomy of Educational Objectives Handbook I: The Cognitive Domain*. New York: David McKay Co Inc.

Krathwohl, D. R. (2010). A Revision of Bloom's Taxonomy: An Overview. *Theory Into Practice*, 41(4), 212-218