OBJECTIVES, EVALUATION, AND THE IMPROVEMENT OF EDUCATION

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Abstract

For five years, from 1995 until 2000, a group of eight educators and researchers met twice annually in Syracuse, NY, for the purpose of revising Bloom's Taxonomy. Based in part on the structure of educational objectives, in part on advances in cognitive psychology, and in part on numerous other attempts to classify educational objectives that were made since the publication of Bloom's Taxonomy, this group produced a two-dimensional table, known simply as the Taxonomy Table. The horizontal dimension was a modification of Bloom's Taxonomy, with verb forms replacing the noun forms of the original category labels: Remember, Understand, Apply, Analyze, Evaluate, and Create. The vertical dimension consisted of four types of knowledge: Factual Knowledge, Conceptual Knowledge, Procedural Knowledge, and Metacognitive Knowledge. The purposes of this article are to (1) describe the major differences between the original Taxonomy and the Taxonomy Table, (2) discuss ways in which the Taxonomy Table can be used to examine and ultimately improve the quality of assessment and instruction, and (3) explore how the Taxonomy Table can be used to provide more accurate estimates of curriculum alignment and opportunity to learn.
Objectives provide specifications for much of the information to be collected. Any educational enterprise seeking to bring about changes in learners is duty-bound to collect information about the extent to which such changes have occurred. (Wolf, 1979, p. 51)

On the surface, it seems so reasonable and so simple. You specify the changes in learners that should result from schooling. You evaluate the extent to which the changes have taken place. You use the results of the evaluation to improve the schooling process. Although it is reasonable, it is not simple. Problems arise at each step along the way.

Dick Wolf was aware of all the problems. "One frequently voiced dissatisfaction with statements of educational objectives, both general and specific, is that they fail to say anything about the basic structure, intentions, or framework of an educational enterprise" (Wolf, 1979, p. 44) (emphasis mine). Furthermore, although a "great deal of activity goes on under the heading of evaluation, relatively few people are trained to do such work. There is also, alas, a widespread lack of agreement about what evaluation is and how evaluation studies should be conducted" (p. iii) (emphasis mine). Finally, "educational evaluation is clearly decision-oriented. It is intended to lead to better policies and practices. If this intention is in any way lacking, evaluation probably should be dispensed with" (p. 6) (emphasis mine).

One of the early attempts to develop a framework that was intended to promote agreement among educators and had the potential to lead to better practices was the Taxonomy of Educational Objectives, which was designed by Benjamin Bloom and his colleagues.2 Almost a half century after its publication, the Handbook in which the Taxonomy first appeared remains one of the most familiar educational books of all times (Bloom (Ed.), Engelhard, Furst, Hill, & Krathwohl, 1956). Educators throughout the world can recite its six major categories: Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation. Krathwohl (1994) has estimated that the Handbook has been translated into twenty-one languages.

The decision to embark on a revision of such a classic text was not made easily. Preliminary discussions of the possibility of a revision began shortly after the publication of the volume, Bloom’s Taxonomy: A Forty-Year Retrospective, in 1994 (Anderson & Sosniak, 1994). These informal discussions – between David Krathwohl and Lorin Anderson – led to a decision to invite a group of educators from across the United States to attend a two-day meeting at which the feasibility and desirability of revising the Taxonomy was discussed. By the meeting’s end, those attending were in agreement that a revision was both needed and worth attempting.

Between 1995 and 2000 a group of educators worked on a revision of the Taxonomy. The group included those with expertise in cognitive psychology (Richard Mayer, Paul Pintrich, and Merle Wittrock), curriculum and instruction (Lorin Anderson, Kate Cruikshank, and James Raths), and testing, measurement, and assessment (Peter Airasian, David Krathwohl). Meetings were held twice a year for five years, with most of the writing done between meetings.

As in the case of the original work, the revision was a group effort. The results of this effort were published as A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom’s Taxonomy (Anderson (Ed.), Krathwohl (Ed.), Airasian, Cruikshank,
The purposes of this article are to (1) examine the primary differences between the original Taxonomy and the revision, (2) describe how the revised Taxonomy can be used to examine and improve assessment and instruction, and (3) discuss how the revised Taxonomy can be used to increase our understanding of curriculum alignment, particularly opportunity to learn.

The Original and Revised Taxonomies

As mentioned earlier, the original Taxonomy contained six major categories situated on a single dimension. Along the dimension the categories were arranged from simple to complex and from concrete to abstract. That is, knowledge and comprehension were believed to be more simple and concrete than synthesis and evaluation, which were more complex and abstract. In addition, it was assumed that the dimension represented a cumulative hierarchy. That is, mastery of each "lower" category was a prerequisite for achieving mastery of the next "higher" category. Finally, with the exception of Application, each category was broken into subcategories. Comprehension, for example, was subdivided into Translation, Interpretation, and Extrapolation.

Those engaged in revising the original Taxonomy had two major resources at their disposal. The first was a set of 19 alternative taxonomic frameworks that had been developed during the time period from the publication of the original Taxonomy to the time at which the revision was published. Based on his analysis of these frameworks, David Krathwohl divided them into two general types: unidimensional, representing a single dimension or set of categories like the original Taxonomy (11 alternative frameworks) and multidimensional, representing two or more dimensions or sets of categories (8 alternative frameworks).

The second resource was the curriculum standards that had been adopted by numerous states and which were intended to be used by teachers in those states to plan and deliver instruction and to assess learning. As the various standards were examined, two things became evident. First, standards are simply mandated objectives. That is, they are objectives that teachers are expected to teach regardless of how important the teachers themselves believe them to be. Second, and more importantly, all statements of objectives (standards included) have a common grammatical format, namely, subject-verb-object. The subject is the student or the learner. The object indicates the content that the student or learner is expected to learn. The verb indicates what the student or learner is expected to do with or to that content.

Consider the following objective: The student will use the law of supply and demand to estimate the costs of goods and services. The subject is "the student," the verb is "will use," and the objective is "the law of supply and demand." The final portion of the objective -- "to estimate the costs of goods and services" -- simply indicates the purpose for which the law of supply and demand (the object) is to be used (verb) by the student (the subject). When the original Taxonomic categories were examined within this context, it became apparent that, with one exception, the categories, although stated as nouns, were intended to function as verbs. This interpretation was supported by comments made by Bloom and his colleagues (1956) throughout the Handbook. On page 18, for example, they wrote: "We are of the opinion that although the objectives and test materials and
techniques may be specified in an almost unlimited number of ways, the student behaviors involved in these objectives can be represented by a relatively small number of classes. Therefore, this taxonomy is designed to be a classification of the student behaviors which represent the intended outcomes of the educational process." (p. 18). Behaviors are verbs.

The lone exception was Knowledge which had a dual function. At first blush, Knowledge is simply the lowest level of the cognitive Taxonomy. At the same time, however, statements made by the authors of the original Taxonomy suggest that Knowledge is different from the other categories in the Taxonomy. Consider the following excerpt:

A teacher, in classifying the goals of a teaching unit, may find that they all fall within the taxonomy category of recalling or remembering knowledge. Looking at the taxonomy categories may suggest [that the teacher] could include some goals dealing with the application of this knowledge and with the analysis of the situations in which the knowledge is used (Bloom et al., 1956, p. 2).

A careful reading of this excerpt suggests two important points. First, "recalling or remembering knowledge," not knowledge per se, is the lowest level of Bloom's Taxonomy. The consecutively higher levels are comprehending knowledge, applying knowledge, and so on. This is consistent with the contention that the original Taxonomic categories were intended to function as verbs. Second, knowledge, as used in this way, is a second dimension, one which crosses all levels of the cognitive dimension. This need for a second dimension is also consistent with the multidimensional frameworks that David Krathwohl reviewed.

Table 1: The Taxonomy Table

<table>
<thead>
<tr>
<th>The Cognitive Process Dimension</th>
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<tbody>
<tr>
<td>The knowledge dimension</td>
</tr>
<tr>
<td>1. Remember</td>
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<tr>
<td>2. Understand</td>
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<tr>
<td>3. Apply</td>
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<tr>
<td>4. Analyze</td>
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<td>5. Evaluate</td>
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<td>6. Create</td>
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<table>
<thead>
<tr>
<th>The knowledge dimension</th>
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<tbody>
<tr>
<td>a. Factual knowledge</td>
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<tr>
<td>b. Conceptual knowledge</td>
</tr>
<tr>
<td>c. Procedural knowledge</td>
</tr>
<tr>
<td>d. Meta-cognitive knowledge</td>
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</tbody>
</table>

As a consequence, the revised Taxonomy contains two dimensions, which can be best represented as a table (see Table 1). The horizontal dimension, known as the Cognitive Process Dimension, is a modification of Bloom's Taxonomy. Application, Analysis, and Evaluation have been replaced by their verb forms. Knowledge has become Remember; Comprehension, Understand, and Synthesis, Create. The shift from Comprehend to Understand was based on the desire of the authors to use terminology that was consistent with the way in which teachers talked about their work. The shift from Synthesize to Create was based on general agreement that synthesis was a part of the process of creating, with creating being superordinate. After a goodly amount of discussion, the relative position of Evaluate and Create was changed, with Create assuming the highest (i.e., most complex, most abstract) position on the Cognitive Process Dimension.

Two final points regarding the Cognitive Process Dimension must be made before moving on. First, although the dimension is believed to be hierarchical in that the "higher" categories are believed to be more complex and more abstract than the "lower" ones, the constraint of a "cumulative hierarchy" was removed. That is, for example, Understand is no longer a necessary prerequisite for Apply. In fact, a student may Apply in part in order to Understand. Second, when multiple cognitive processes are included in an objective (e.g., Understand, Analyze), the objective is classified according to the most complex cognitive process (e.g., Analyze).

The vertical dimension, known as the Knowledge Dimension, consists of four general types of knowledge: Factual, Conceptual, Procedural, and Metacognitive. Moving from "content" to "types of knowledge" permitted the development of a taxonomy that was appropriate for all subject matters and all grade or school levels. Since content is subject-specific, staying with "content" would have required a somewhat different Taxonomy Table be prepared for each subject matter. Bloom, Hastings, and Madaus (1971) attempted to address the problem of the content-cognitive process interface in their Handbook of Formative and Summative Evaluation of Student Learning. The entire second half of the handbook is devoted to eleven experts describing the modifications of the original Taxonomy that they believed necessary in order to conform more closely to the content and structure of their subject matters.

Factual Knowledge consists of the terminology, details, and elements that students must know to be acquainted with a particular subject matter. Knowing what to call something is an example of Factual Knowledge. Conceptual Knowledge is knowledge of classifications and categories, principles and generalizations, and theories, models, and structures. It is knowing the interrelationships among the basic elements within a larger structure that enable them (the elements) to function together. Procedural Knowledge is knowing how to make or do something. It includes methods, techniques, algorithms, and skills. It also includes the criteria one uses to determine when to use appropriate Procedural Knowledge. Finally, Metacognitive Knowledge is knowledge of cognition in general as well as awareness and knowledge of one's own cognition. It includes strategic knowledge, task knowledge, and self-knowledge.

In combination, the verb and the object provide clues as to the proper placement of an objective in the Taxonomy Table. Consider the objective mentioned earlier, "The student will use the law of supply and demand to estimate the costs of goods and services."
As mentioned earlier, the verb is "use." "Use" suggests Apply. The object is "the law of supply and demand." "Laws" are "generalizations" which suggests Conceptual Knowledge. This objective, then, is a special case of the general objective: Apply Conceptual Knowledge.

Why is important to be able to classify and categorize objectives in terms of the Taxonomy Table? The best answer to this question may have been given by Bloom himself almost 60 years ago. A taxonomy of educational objectives could do much to bring order out of chaos in the field of education. It could furnish the conceptual framework around which our descriptions of educational programs and experiences could be oriented. It could furnish a framework for the development of educational theories and research. It could furnish the scheme needed for training our teachers and for orienting them to the varied possibilities of education (1949, p. 4).

The Taxonomy Table, Assessment, and Instruction

When Bloom came up with the idea of a taxonomy of educational objectives, he was serving as the Associate Director of the Board of Examinations of the University of Chicago. It is not surprising, then, that he saw the development of a taxonomy as a way of reducing the labor of preparing annual comprehensive examination. In fact, the second half of the original Handbook contained test items for the six taxonomic categories. Like its predecessor, the Taxonomy Table has implications for the preparation of test items and other assessment tasks (e.g., performance measures). In addition, however, as suggested by Bloom in 1949, the Taxonomy Table has implications for planning instruction.

The Taxonomy Table and Assessment

As shown in Figure 1, all assessment tasks are derived from the same blueprint. The three major components are the introductory material, the stem, and the response. As shown in Figure 1, the introductory material can take many forms: written, pictorial, or real objects (e.g., rocks to be classified). The stem can take the form of a question, an incomplete statement, or a directive (e.g., "Do this." "Prove that."). Finally, the expected response can be short or long (i.e., extended). Within the short-answer format, students may have to supply the answer or choose one from a set of response options. Within the extended response format, students may have to write something or perform some action (or series of actions).

Not all assessment tasks include all three components. In fact, the components that are included provide clues as to the nature of the objective being assessed. Assessing Remember Factual Knowledge objectives rarely includes introductory material. Such material is not needed. In contrast, tasks for the purpose of assessing Apply Procedural Knowledge quite often contain introductory material. This material provides the context within which the procedural knowledge is to be applied and provides information needed to apply the procedural knowledge.
INTRODUCTORY MATERIAL

(1) Written
(2) Pictorial
(3) Real Objects

STEM

(1) Question
(2) Incomplete Statement
(3) Directive

RESPONSE

(1) Short-Answer
(2) Extended Response

* Supply (Fill in the blank)
* Select (Multiple-choice, Matching, True-False)
* Written
* Performance

Note: To score short-answer tasks, you need a scoring key. To score extended response tasks, you need criteria and an accompanying checklist, rating scale, or rubric. For short-answer tasks, the standards are embedded in the task itself (introduction material, stem, response). For extended response tasks, the standards are largely or completely embedded in the criteria used to evaluate the response.

Figure 1: The Structure of Assessment Tasks

Similarly, when short-answer responses are included in an assessment task, clues as to the objective being assessed (e.g., Understand Conceptual Knowledge) can be found in the task itself (particularly the introduction material, if it exists, and the stem). In contrast, when an extended response is called for (as in the case of objectives including Create as the verb, for example), the clues are not in the task per se. Rather, the clues are found in the criteria used to evaluate the extended response given by the student. These criteria are usually included on a checklist, as a set of rating scales, or, increasingly, as a set of rubrics.

The fact that different objectives require different approaches to assessment has been known for some time. Dick Wolf put it this way:

[Assessment] of learner performance – in relation to a set of objectives – is not limited to the measurement of factual information acquired during a period of
instruction. Neither is it limited to paper-and-pencil tests. ... Evaluation is a continuous and comprehensive process, utilizing a variety of evidence-gathering procedures. It is inextricably linked to the objectives and learning experiences of an educational venture (1979, p. 51).

The Taxonomy Table encourages educators to act on this long-standing knowledge by working together to develop and use prototypical assessment tasks for the various cells of the table. For objectives that focus on Remembering Factual Knowledge, for example, the prototype may take the form of a three-step procedure. First, write the factual knowledge to be remembered as a statement. Second, transform the statement into a question about the factual knowledge. Third, either have students supply the answer or develop a set of response options which are relatively homogeneous and consistent with the types of factual errors made by the students.

For objectives that focus on Understanding Conceptual Knowledge, the stem of a prototype for multiple-choice items may take the following form: "Which of the following is an example of X?" (where X can be replaced by "spider," "sonnet," "rational number," "impressionistic painting," or any other important concept). Each question would be followed by four plausible and homogeneous response options (that is, they belong to the same general category of responses and are likely to be selected by at least some of the students).

Finally, for objectives that focus on Applying Procedural Knowledge, a simple two-step procedure may serve as a useful prototype. First, prepare introductory material that describes some problem or situation. Second, write a stem that instructs students to demonstrate the use of specific procedural knowledge to answer the question or solve the problem embedded in the introductory material.

The three examples of prototypes given above were selected because of the frequency with which objectives fall into these three cells of the Taxonomy Table. It must be emphasized, however, that prototypical assessment tasks can be developed for all 24 cells. All it takes to do so is to convene groups of educators who are willing to use the framework and spend the time necessary to develop the prototypes. One major advantage of such prototypes is to increase the validity of the assessments tasks. A second advantage, one consistent with Bloom's original purpose, is to increase the efficiency of the preparation of assessment tasks.

The Taxonomy Table and Instruction

Just as different assessment tasks are required by objectives that are placed within different cells of the Taxonomy Table, different objectives also require different instructional approaches and techniques. Because Factual Knowledge is so plentiful (since, for example, almost any sentence in a textbook can be designated as important by some teacher), focusing students' attention on the most important terms and details is a crucial element of effective instruction when Remembering Factual Knowledge is the objective. The use of repetition, mnemonic devices, acronyms, and songs are also effective ways of helping students Remember Factual Knowledge.
In contrast to Remember Factual Knowledge, objectives that focus on Understand Conceptual Knowledge require the building of cognitive categories and their interrelationships. Consequently, when possible, the defining features of the categories (i.e., "What makes X. X?") should be emphasized. Giving students examples, non-examples, and "near" examples can be used to help students hone in on particular concepts and differentiated them from related, yet different, concepts (e.g., tourists, migrants, immigrants). Finally, helping students make connections between and among concepts (to build conceptual frameworks) and using metaphors and similes to help students make connections with what they already know and understand are important instructional strategies when Understanding Conceptual Knowledge is the objective.

Teaching students to Apply Procedural Knowledge requires yet another set of instructional techniques and methods. The Procedural Knowledge should be presented visually so students can see the entire skill, method, or algorithm. Modeling the procedure for students enables them to follow the application of each step. Giving students "worked out examples" is another useful instructional technique. Finally, discussing the limits of the applicability of the Procedural Knowledge helps students see the bounds of application and reduces the likelihood of overuse (or misapplication).

In contrast to the instruction pertaining to objectives that focus on Remember, Understand, and Apply, instruction related to objectives including Analyze, Evaluate, and Create is substantially different. Specifically, instruction related to these objectives requires teachers to assume a less direct role in facilitating student learning. Suppose, for example, the objective emphasizes evaluating. In teaching such an objective, the teacher needs to make students aware of the criteria they should use in conducting the evaluation or make, in fact, encourage them to come up with their own criteria. The teacher also may need to emphasize the importance of two kinds of evaluation activities: monitoring work in progress and critiquing the finished product. Other than that, the teacher spends most of his or her time supervising student work and monitoring student learning, providing constructive feedback as necessary and appropriate. If a teacher assumes too direct a role when teaching these types of objective, he or she is likely to change the very nature of the objectives. Suppose, for example, a teacher decides to show students how to evaluate something (e.g., "First you do this, Then you do this," and so on). When this approach to teaching is used, Evaluate has been transformed from a cognitive process to a type of knowledge, specifically Procedural Knowledge. The teacher's decision may result in a more efficient way of teaching, but what is learned is not the same as what was intended.

One of the benefits of the Taxonomy Table vis à vis instruction may well be its use as an organizing framework for the numerous findings derived from research on teaching. Rather than search for correlates of general student achievement, the search for correlates of specific types of student achievement may be more beneficial. Each cell of the Taxonomy Table represents a different type of intended student learning. Organizing the current research in terms of the cells of the Taxonomy Table (or, alternatively, the row or columns if the cells prove to be too specific) may provide a level of understanding of the research which has not been possible to this point in time.
The Taxonomy Table and Curricular Alignment

A curriculum is said to be aligned when there is a strong connection among objectives, assessment, and instruction (Anderson, 2002). Curriculum alignment is a multi-faceted concept with opportunity to learn being a key component. While opportunity to learn focuses primarily on the relationship between assessment and instruction, curriculum alignment also addresses the relationship between assessment and objectives, and between instruction and objectives.

Why should educators be concerned about curriculum alignment? At least three answers can be given to this question. First, examining alignment enables educators to understand the differences in the effects of schooling on student achievement, particularly for certain groups of students (Winfield, 1993). Tracking or streaming often results in curriculums that differ in terms of their academic demands, both in terms of rigor and pacing. Students in the more demanding, rapidly paced curriculums tend to learn more independent of the quality of instruction provided. This finding led Gamoran, Potter, Smithson, and White (1997) to conclude that "low-achieving high school students are capable of learning much more than is typically demanded of them. The key is to provide a serious, meaningful curriculum" (p. 336).

Second, poor alignment results in an underestimate of the effect of instruction on student learning. Teachers may be providing high quality instruction, but if what they are teaching is not aligned with state or national standards, either as stated or as assessed, the quality of their teaching will not be recognized; indeed, their teaching efforts may be viewed as failures. Third, proper alignment is central to the success of educational accountability programs. As Baratz-Snowden (1993) has asserted: "If students are to be held accountable for their learning, then schools must be held accountable as well by demonstrating that they provide students with opportunities to learn to meet the standards that have been set" (p. 317).

What value does the Taxonomy Table have in examining and, ultimately, improving curriculum alignment? To answer this question, it is necessary to describe the procedure used to examine alignment within the context of the Taxonomy Table. The first step is to place all the objectives in a given curriculum unit (or set of units) in the appropriate cells of the Taxonomy Table. The next step is to analyze the unit assessments in terms of the Taxonomy Table. Typically, the number and/or percent of items (for short-answer tasks) or the number and/or weighting of the evaluation criteria (for extended response tasks) are written into the appropriate cells. The third step is to analyze the major instructional activities and related materials in terms of the Taxonomy Table. Similar to the analysis of the assessments, the number of and/or emphasis given to various activities are noted in the appropriate cells.

At this point in the process, there are some cells that contain one or more objectives, related instructional activities and materials, and appropriate assessments. This is indicative of a high degree of alignment. There also are cells that have one or more objectives and related instructional activities and materials, but no assessment. Similarly, there may be cells that have instructional activities and materials and assessments, but no objectives. These are instances of partial alignment. Finally, there may be cells with
neither objectives, nor instructional activities and materials, nor assessments. These cells indicate potential "missed opportunities" in designing and/or delivering the unit(s).

Using the Taxonomy Table to examine alignment provides at least three benefits over more conventional approaches. First, because the Taxonomy Table requires examining objectives in terms of both knowledge and cognitive processes, it provides a more accurate estimate of alignment (Gamoran et al., 1997). Second, because objectives, instruction activities and materials, and assessments are each examined in terms of the Taxonomy Table rather than with each other, the Taxonomy Table emphasizes alignment in terms of student learning and provides a more in-depth examination of alignment. Third, because the Taxonomy Table is appropriate for use across subject matters and school or grade levels, it enables educators to examine differences in alignment from one subject matter to another or, perhaps more importantly, from one grade level to the next.

Concluding Comments

The Taxonomy Table provides educators with a conceptual framework that promotes shared understanding and meaningful communication. It provides a means by which educators can develop a more complete understanding of specific objectives and use this understanding to improve assessment, instruction, and the essential link between them.

In the introduction to his book on evaluation in education, Dick Wolf (1979) indicated his desire to present a conceptualization of evaluation that was "comprehensive, coherent, sensible, and practical" (p. 2). Since 2001, the author has talked and worked with literally thousands of teachers and administrators about the revised Taxonomy. In an increasing number of instances, these efforts have been translated into action, with teachers and administrators using the revised Taxonomy to plan and deliver curriculum units in their schools. Based on this rather extensive experience, the revised Taxonomy seems to meet all four of the criteria that guided Dick as he wrote his book. I think he would have liked that.

Note

1. The author expresses his appreciation to David R. Krathwohl for his insightful comments and constructive suggestions on an earlier version of this manuscript.
2. Although it came to be known as Bloom's Taxonomy, the design of the taxonomy was a group project. Furthermore, the volume in which the Taxonomy appeared was written by five authors: Bloom, George Engelhard, Edward Furst, Walker Hill, and David Krathwohl. Bloom was the lead author and the editor of the volume.
3. The question must be a verbatim transformation of the statement if Remember Factual Knowledge is being assessed. A paraphrase of the statement would result in an assessment task that assesses Understand Factual Knowledge.

References


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