Using Bloom's Taxonomy to Develop Effective Assessments in Radiologic Technology Education

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In radiologic technology education, developing effective assessment strategies is essential to ensure that students acquire foundational knowledge and develop clinical skills. Bloom's taxonomy is a widely adopted model for guiding assessment design. It offers a structured hierarchy of cognitive levels, including remembering, understanding, applying, analyzing, evaluating, and creating.[1-4] Initially developed by Benjamin Bloom in 1956 and later revised by Anderson et al, this taxonomy supports educators in aligning learning objectives with increasingly complex levels of cognitive engagement, helping students progress from basic recall to advanced problem-solving.[1-3]

In health care education, where the integration of theoretical knowledge with practical application is paramount, Bloom's taxonomy has been instrumental in shaping curricula that promote critical thinking, decision-making, and clinical competence.[1,2,4] The taxonomy enables instructors to define instructional goals and objectives using action verbs, such as identify, explain, apply, and design, that correspond with different levels of cognitive processing.[1,2] Similarly, the taxonomy also supports the creation of assessment methods that align with intended learning outcomes and communicate expectations to learners.[1,2] In clinical education, where students must translate classroom learning into real-world scenarios that require adaptability and sound judgment, this framework can be a valuable tool.

Bloom's taxonomy offers radiologic technology educators a powerful tool to align assessment strategies with the profession's technical and diagnostic demands. The American Society of Radiologic Technologists emphasizes that education programs must foster critical thinking, technical proficiency, and clinical readiness to ensure graduates are equipped for lifelong learning and evolving health care challenges.[5] When assessments are intentionally designed to reflect Bloom's cognitive levels, they help students move beyond rote memorization to develop applied competencies essential for patient-centered care. This deliberate alignment supports learning outcomes, fosters student engagement, and prepares learners for complex clinical responsibilities.[4]

Bloom's Taxonomy Levels

Bloom's taxonomy is structured into 6 progressive levels that increase in cognitive complexity: remember, understand, apply, analyze, evaluate, and create (see **Figure**).[1-4] Each level builds on the previous one and is associated with specific learning goals and action verbs that help guide instructional design and assessment development.[1-4] Bloom's taxonomy levels can be examined and applied to radiologic technology education to illustrate how assessments can be aligned with cognitive processes and clinical expectations.

Remembering

At this foundational level, students demonstrate their ability to remember by recalling previously learned information.[2,3] Assessments targeting this level

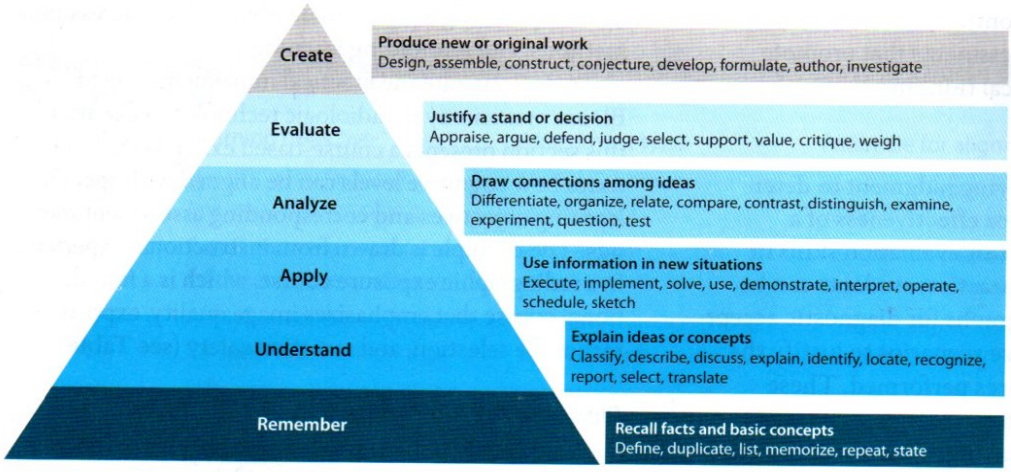


Figure. *Visual representation of Bloom's taxonomy and descriptions of each category as it applies to the classroom. Reprinted with permission from Vanderbilt University Center for Teaching, Wikimedia Commons under the Creative Commons Attribution 2.0 Generic license. commons.wikimedia.org/wiki/File:Bloom%27s_Revised_Taxonomy.jpg. creativecommons.org/licenses/by/2.0/deed.en*

often include multiple-choice questions or straightforward quizzes designed to evaluate knowledge retention.[2] To assess this level in radiologic technology, students can be asked to identify anatomical structures, understand radiation protection measures, or recognize radiographic quality factors. Common action verbs used at this level include list, define, recall, identify, and name, which reflect the goal of retrieving factual knowledge from memory.[2,3] Building a solid base of factual knowledge is essential, as it underpins the development of higher-order cognitive skills.[6]

Understanding

At the cognitive level of understanding, students demonstrate comprehension by explaining concepts or interpreting information in their own words.[2,3] Typical assessment strategies at this stage include short essays, discussion posts, or explanation-based questions.[1,2] In a radiologic technology course, such as radiographic exposure, the understanding level can be demonstrated by describing how kilovoltage affects image contrast or by explaining the rationale for selecting specific imaging techniques. Such activities help bridge foundational knowledge with applied clinical reasoning, reinforcing deeper conceptual understanding. At this taxonomy level, common action verbs include explain, summarize, interpret, and classify, which help clearly define the expected mental processes and guide instruction and evaluation.[2,3]

Applying

The application level in Bloom's taxonomy emphasizes the learner's ability to transfer theoretical knowledge into real-world practice through meaningful tasks and clinical decision-making.[2,4] In classroom and clinical training settings, students can apply their knowledge through hands-on activities, image critique exercises, case-based scenarios, or simulations. For example, students can be required to select appropriate exposure settings or positioning techniques based on a patient's condition or diagnostic needs. Common action verbs associated with this taxonomy level include apply, demonstrate, use, execute, and implement, which support the development of assessments that reflect authentic professional performance.[2-4]

Analyzing

The analytic level of the taxonomy emphasizes the learner's ability to deconstruct information, examine relationships among components, and interpret underlying patterns.[2-4] In diagnostic imaging education, learners might compare digital with conventional fluoroscopy systems or critique the effects of automatic exposure control devices vs manual technique selection on patient exposure and radiation dose. Such tasks encourage deeper engagement with complex concepts and promote analytical reasoning, which are essential for accurate clinical judgments and problem-solving. Verbs frequently associated with the analytic level

include analyze, compare, contrast, differentiate, and examine, which support assessments that promote structured inquiry and critical thinking.[2,3]

Evaluating

Evaluation involves applying judgment to determine the value, credibility, or effectiveness of a procedure or outcome.[3] To test evaluation skills in the classroom and clinical practice, students can be required to examine radiographs for diagnostic acceptability or review clinical case scenarios to justify the appropriateness of procedures performed. These tasks cultivate independent reasoning, encourage evidence-based decision-making, and mirror the evaluative demands of real-world clinical practice.[3,4] Verbs commonly used to assess this cognitive level of the taxonomy include evaluate, justify, defend, critique, and appraise.[2,3]

Creating

Creating represents the highest level of Bloom's taxonomy, emphasizing the learner's ability to synthesize information, generate new ideas, and construct original solutions.[2-4] In instructional and hands-on training, students can be tasked with developing a patient positioning protocol, designing a safety checklist for mobile radiography, or creating an educational tool for patient instruction. Learning activities at this cognitive level promote the integration of prior knowledge with creative thinking, cultivating adaptability and innovation in response to evolving clinical challenges.[4] Verbs typically associated with this taxonomy level include create, design, develop, formulate, and construct, which support assessments that foster originality, problem-solving, and higher-order reasoning.[2-4]

Practical Implementation in Radiologic Technology Education

Successfully applying Bloom's taxonomy in radiologic technology education requires more than simply identifying cognitive levels; it demands thoughtful integration into course design, assessment planning, and instructional delivery. Some of the strategies educators can use to incorporate Bloom's taxonomy in meaningful ways and promote sustained cognitive development include planning for alignment, diversifying assessment methods, and scaffolding learning.

To demonstrate the practical implementation of Bloom's taxonomy in radiologic technology education, this section presents a course-based example that illustrates how cognitive levels can be aligned with specific learning objectives and corresponding assessment methods. The example is drawn from instructional experience in a radiographic exposure course, which is a foundational course that emphasizes image quality, exposure technique selection, and radiation safety (see **Table**).

Planning for Alignment

Effective use of Bloom's taxonomy begins with intentional instructional design. One widely used approach is backward design, which is characterized by the establishment of learning outcomes, followed by identification of assessment criteria, and concluding with targeted instruction planning.[7] In radiologic technology courses, this process involves selecting cognitive verbs that match the intended complexity of learning, such as identifying for foundational recall or evaluating and designing for advanced reasoning. Purposeful verb selection ensures consistency among objectives, instructional activities, and assessments.[2]

In practice, instructors can use the action verbs aligned with Bloom's taxonomy when designing course syllabi and exams to ensure coverage throughout cognitive levels. This strategy promotes balance and avoids the overuse of recall-based assessments, which might not sufficiently reflect the demands of clinical practice. Based on the author's professional experience in teaching radiologic technology, using such verb reference tools helps ensure that assessments reflect the cognitive rigor of the course and the practical expectations of the clinical environment.

Diversifying Assessment Methods

Another key strategy involves selecting diverse assessment types that correspond to specific cognitive levels. Lower-level objectives can be assessed with quizzes or short-answer questions, while higher-level objectives are best measured through simulations, reflective writing, or image critique. In health professions such as radiologic technology and nursing, hands-on assessment methods,

Table

Aligned Learning Objectives and Assessments for a Radiographic Exposure Course Based on Bloom's Taxonomy Levels

Cognitive level	Learning objective	Assessment type	Rationale for alignment
Remembering	Recall the key factors that influence radiographic quality	Multiple-choice or fill-in-the-blank questions	Assesses recall, as students identify quality factors without requiring higher-order thinking
Understanding	Explain how exposure factors influence image quality	Short-answer questions or essay	Gauges comprehension by requiring students to explain exposure concepts
Applying	Apply correct exposure factors for specific anatomical regions	Laboratory simulation with anatomical phantoms	Assesses application of theoretical knowledge in a controlled setting
Analyzing	Differentiate between digital and conventional fluoroscopy systems	Comparative analysis assignment	Requires critical analysis of each system, fostering deeper understanding
Evaluating	Critique the quality of a radiograph based on positioning standards and exposure technique selection	Image critique with feedback	Involves judgment based on image quality standards for radiographs
Creating	Design a patient safety protocol for a radiographic procedure	Project-based assignment or written protocol outline	Encourages synthesis of knowledge and creativity in clinical applications

including laboratory simulations and diagnostic image evaluations, align with Bloom's applying and evaluating levels and mirror authentic clinical practice, reinforcing critical thinking and procedural judgment.[8,9] As emphasized by O'Neill and Padden, diversifying assessment approaches helps educators better capture the complexity of student learning and can enhance engagement, equity, and deeper understanding by allowing learners to demonstrate knowledge in multiple ways.[10]

Formative assessments, such as practice quizzes or group discussions, provide timely feedback on foundational knowledge, fostering student engagement and guiding learning progression.[11] In contrast, summative assessments, including performance-based exams and project-based evaluations, are commonly employed at the end of instructional periods to measure overall student achievement.[12,13] When thoughtfully designed to simulate real-world tasks, summative assessments can effectively gauge a learner's ability to synthesize and apply knowledge in authentic contexts. However, summative assessments' effectiveness depends on thoughtful integration, alignment with learning outcomes, and contextual relevance in the broader assessment strategy.[12,13] Using a combination of these methods ensures validity and diversity in evaluation, allowing students multiple avenues to demonstrate their understanding and skills.[10]

Scaffolding Learning Throughout the Curriculum

Scaffolding is an instructional strategy that involves offering learners temporary and structured guidance to enable them to complete tasks slightly beyond their current abilities, with support gradually withdrawn as they build competence and independence.[14] Grounded in Vygotsky's Zone of Proximal Development, scaffolding aligns naturally with Bloom's taxonomy by helping students transition through cognitive levels with increasing independence.[14] Vygotsky's Zone of Proximal Development describes the range of learning that occurs between a student's current independent capabilities and the enhanced performance made possible through support from a more experienced guide.[14]

During years of teaching in higher education, the author has demonstrated scaffolding's effectiveness in

supporting radiography students in integrating theoretical knowledge into clinical practice. When applied strategically, this approach facilitates measurable improvement in learners' ability to blend didactic concepts with hands-on practice. For example, to scaffold throughout Bloom's taxonomy levels in a radiography course, students first are introduced to fundamental terminology and system components (ie, remembering) such as computed radiography, digital radiography, and fluoroscopic equipment. They then describe the function of image receptors, their electronic components, and associated informatics systems, including medical image management and processing systems, DICOM, and radiology information systems (ie, understanding). As instruction advances, students apply their knowledge by comparing computed radiography and digital radiography workflows in laboratory simulations (ie, applying) or by analyzing the advantages and limitations of flat-panel technology vs image-intensification systems used in digital fluoroscopy (ie, analyzing). Later in the course, learners evaluate system performance based on clinical scenarios or equipment specifications (ie, evaluating) and then propose the most appropriate imaging modality, such as computed tomography, magnetic resonance imaging, interventional radiography, or routine radiography, for specific diagnostic examinations based on case study scenarios (ie, creating). Such intentional scaffolding throughout Bloom's cognitive domains fosters cognitive development and professional readiness in adapting to diverse imaging environments.[1,4]

When embedded thoughtfully into the curriculum, scaffolding helps balance cognitive rigor with clinical relevance throughout learning experiences.[1,14] By promoting structured progression from recall to complex application, scaffolding enables students to connect classroom concepts with real-world diagnostic imaging tasks.[1,14] Such intentional design supports student engagement and contributes to equitable learning by offering multiple entry points to success, particularly for learners with varying levels of prior experience.

Alternative Frameworks for Aligning Objectives With Assessments

Although Bloom's taxonomy remains a foundational tool for designing learning objectives and assessments, several alternative frameworks offer valuable perspectives, particularly for health professions education. One such model is Fink's Taxonomy of Significant Learning, which outlines 6 interrelated domains: foundational knowledge, application, integration, human dimension, caring, and learning how to learn.[15] This model can be effective in radiologic technology education where the cognitive, affective, and psychomotor domains are interconnected. Fink's taxonomy also encourages instructors to design assessments that reflect students' ability to make interdisciplinary connections and develop a professional identity.[15,16]

Another widely used framework is Miller's Pyramid of Clinical Competence, which is especially relevant in clinical education.[17] This model includes 4 hierarchical processes: knows (ie, knowledge), knows how (ie, competence), shows how (ie, performance), and does (ie, action in real-world practice).[17] In radiologic technology programs, this model supports the design of assessments, such as objective structured clinical examinations, image critique exercises, and clinical evaluations, allowing for authentic appraisal of applied competence in professional settings.[18] Objective structured clinical examinations are organized, station-based evaluations in which students perform specific clinical tasks under an examiner's observation.[18]

The Structure of Observed Learning Outcomes taxonomy, developed by Biggs and Collis, offers another valuable alternative.[19] This framework classifies learning outcomes based on levels of increasing complexity, from prestructural and unistructural to multistructural, relational, and extended abstract.[19] In addition, the Structure of Observed Learning Outcomes taxonomy is particularly helpful for designing assessments that evaluate students' depth of understanding such as reflective essays or case-based discussions where learners integrate and apply knowledge throughout modalities and clinical contexts.[19]

Incorporating these frameworks alongside Bloom's taxonomy allows for a more holistic approach to instructional design in radiologic technology education. Rather than relying solely on cognitive hierarchies, educators can adopt models that also account for professional growth, clinical reasoning, and integrative thinking. Selecting the most appropriate framework

depends on instructional goals, student readiness, and the clinical or academic context of learning.

Future Implications

As radiologic technology education continues to evolve in response to technological innovation and shifting health care demands, the strategic use of Bloom's taxonomy will remain essential in guiding curriculum development and assessment practices. Future educators and program leaders must be prepared to adapt Bloom's taxonomy to accommodate advances such as artificial intelligence in imaging, competency-based education models, and interdisciplinary team training. In addition, integrating Bloom's framework into digital and hybrid learning environments offers promising opportunities to personalize instruction and improve student engagement. For example, adaptive learning platforms can tailor content delivery and assessments based on the students' demonstrated cognitive level, fostering progression through the taxonomy at an individualized pace.

Furthermore, as radiologic technology programs expand their focus on diversity, equity, and inclusion, Bloom's taxonomy can support the creation of culturally responsive assessments by ensuring that evaluation strategies are inclusive, meaningful, and accessible to all learners.[20,21,22] By embedding higher-order thinking skills into clinical simulations, project-based learning, and peer collaboration, educators can better prepare students for the dynamic, patient-centered challenges of modern health care. Sustained professional development in instructional design and assessment literacy will be crucial for faculty to implement these changes effectively. Institutions should invest in ongoing faculty development that emphasizes Bloom's taxonomy not just as a theoretical model but as a practical framework for continuous curricular improvement.

Conclusion

Bloom's taxonomy provides a structured framework for creating aligned assessments in radiologic technology education, promoting skill development that prepares students for the complexities of clinical practice. When applied intentionally, Bloom's taxonomy facilitates the progression from foundational knowledge to higher-order reasoning, supporting critical thinking, clinical decision-making, and lifelong learning.

Through the alignment of assessments with each cognitive level, educators can foster deeper engagement, reinforce professional competence, and better measure learning outcomes. As radiologic technology education continues to integrate digital tools and adapt to evolving clinical standards, Bloom's taxonomy provides a timeless yet flexible framework. Its enduring value lies in its adaptability, supporting educators and students in achieving excellence in a rapidly transforming health care landscape.

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