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Short Communication

Applying Bloom's taxonomy in clinical surgery: Practical examples

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ABSTRACT

Bloom's cognitive learning taxonomy is widely used in medical education. The revised taxonomy published by David Kathwohl (1956) and his group describes the levels in action forms: *Remember*, *Understand*, *Apply*, *Analyze*, *Evaluate*, and *Innovate*. The taxonomy has been commonly used to design and structure educational goals and objectives. However, most uses occur at the course or program curriculum level, as was originally described. Whereas applying the taxonomy at the level of individual educational activities remained limited for different reasons. Hence, the aim of this article is to promote applying the taxonomy in daily clinical teaching by providing practical clinical examples in a simplified way.

1. Introduction

Bloom's taxonomy has been widely used to describe cognitive learning levels. The initial taxonomy description, developed by Benjamin Bloom and his collaborators in 1956, includes six levels of educational objectives: *Knowledge, Comprehension, Application, Analysis, Synthesis,* and *Evaluation* [1]. This taxonomy was revised in 2001 by one of Bloom's collaborators, David Krathwohl, and his group. The revised description used dynamic verbs instead of the original nouns to describe learner thinking: *Knowledge* was changed to *Remember*, *Comprehension became Understand*, *Apply, Analyze*, *Evaluate*, and *Synthesis was renamed Create* [2]. The *Create* level is at the top of the taxonomy above *Evaluate*. These were placed in a less rigid structure yet maintained the same hierarchy (Fig. 1) [2].

Bloom's cognitive learning levels are commonly used to design and structure educational goals and learning outcomes; however, most applications are limited at the curriculum level and assessment [3]. Course or rotation objectives are usually based on Bloom's cognitive learning. However, applying this taxonomy at the level of daily individual educational activities is limited. One important postulated reason is the limited available descriptions and examples of its use in point of care teaching, more specifically in surgical specialties. There are limited available descriptions on how to apply Bloom's taxonomy in point of care surgical education utilizing practical examples. Often, taxonomy verbs are used (such as recognizing, inferring, and organizing) in an abstract way without a clear understanding of when to apply these verbs and how to best utilize them in our day-to-day surgical teaching activities [3,4]. Even though these abstract verbs are useful for curricula design and assessment, they lack clarity and practicality when applied by clinician educators in daily practice. Thus, the aim of this article is to provide simplified practical clinical examples of applying all levels of Bloom's taxonomy in daily teaching activities specific to surgery as part of our teaching mission as educators to encourage students and residents to learn at a higher cognitive level.

2. Application principles

Educational curricula and assessments often focus on knowledge acquisition aiming at the lower levels of Bloom's taxonomy [5–7]. Educators commonly teach at the lower levels of Bloom's taxonomy, *remember*, and *understand* [8]. Clinical medical educators should harness the higher levels of cognitive learning rather than merely regurgitating, remembering, and recalling knowledge [3,6]. Learning quality in medical education might be compromised without targeting higher cognitive levels of the taxonomy, resulting in a limited ability to analyze and evaluate critical educational material [8]. Developing higher-order thinking skills by applying higher levels of Bloom's taxonomy should be the aim in education [2]. Learning that leads to evaluating and creating new knowledge is the highest known cognitive learning level [10]. Structuring appropriate predefined learner-centered objectives for each teaching session enhances learning outcomes and enables measuring objectives [11–13].

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To enhance the application of Bloom's Taxonomy at the daily point of care level, efforts should be made to familiarize and practice applying the taxonomy at that level. Reviewing clinical scenarios and real-life examples will facilitate applying the taxonomy. In our daily teaching, we usually use higher cognitive levels of the taxonomy with more advanced trainees. For example, when discussing perforated diverticulitis with a fourth-year surgical resident, the discussion goes beyond the indications and urgency of the procedure (applying knowledge), which might be suitable for a second-year resident. Instead, it would include reviewing the evidence and critically appraising the literature (analyzing and evaluating) regarding operative versus conservative treatment or an intervention approach. The same teaching principle extends to all ACGME competencies. In contrast, classical teaching focuses more on discussing information or details, including updates.

3. Practical examples

Examples of three clinical topics from surgery will be reviewed to demonstrate the application of Bloom's taxonomy levels in ascending complexity. A simplified topic will be discussed first for easier explanation and understanding. Topics in ascending complexity will then be discussed to expand the taxonomy application further. Finally, to minimize confusion and simplify understanding, all the taxonomy levels will be applied to each example.

4. First example: subcutaneous abscess

Level one: *Memorize/Remember* the definition, clinical criteria, and description of an abscess.

Level two: *Understand* the etiology, pathophysiology, evolution, and clinical presentation of an abscess.

Level three: *Apply* knowledge to diagnose, confirm, and propose management of an abscess.

Level four: *Analyze* knowledge such as the value of imaging or the evidence supporting treatment approaches. Analysis is the critical appraisal of knowledge. Using this level is potentially confusing and often produces inaccuracies. Some practicing educators may "*Analyze*" the information obtained about the abscess, such as clinical findings or culture results, rather than analyzing or critically appraising knowledge in terms of evidence power, validity, or accuracy.

Level five: *Evaluate* the validity and reliability of the information (knowledge) used to diagnose abscesses in various settings, such as diabetic or immunocompromised patients. Evaluation is another component of the critical appraisal of knowledge. However, the use of *Evaluation* is also frequently used to evaluate the clinical problem rather than knowledge.

Level six: *Create* new knowledge as in finding early diagnostic tests, less invasive treatment approaches, or alternative tools for intervention.

5. Second example: hernia (Fig. 1)

Level one: *Memorize/Remember* the anatomy, stages, types, or treatment approaches of hernias.

Level two: *Understand* the pathophysiology, etiology, predisposing factors, complications, or indications of treatment approaches of hernias.

Level three: *Apply* knowledge to diagnose, repair, or prevent complications of hernias.

Level four: *Analyze* the diagnostic value of imaging, different repair approaches, or recurrence in specific patient groups using the literature. Analyzing knowledge quality is confused with analyzing the clinical problem; analysis is the critical appraisal of knowledge. For example, in a recent interaction with the author, a medical student proposed arranging an MRI to evaluate groin pain in a patient whose physical exam was negative for hernias. The role of an MRI in identifying the cause of groin pain was analyzed based on level four.

Level five: *Evaluate* alternative hernia treatment options in complex situations such as in patients with ascites or approaches for unexpected findings such as malignancies. Evaluation is part of the critical appraisal of knowledge.

Level six: *Create* a new approach to repair hernias, modify mesh application/placement, or handle unusual situations.

6. Third example: shock

Level one: *Memorize/Remember* the definition of shock, clinical criteria and classes of shock, the common medications/interventions used in shock, and the diagnostic tests for shock.

Level two: *Understand* the spectrum of clinical presentation, classifying the types of shock and their relation to the underlying cause, e.g., the changes in vital signs with the severity of blood loss in hemorrhagic shock.

Level three: *Apply* knowledge to diagnose the condition and execute resuscitation measures specific to each type of shock.

Level four: *Analyze* the evidence concerning best treatment approaches in various settings and differentiate different shock states based on clinical and hemodynamic endpoints.

Level five: *Evaluate* the validity of invasive monitoring and its effect on outcomes or the differences between types of resuscitation fluids, i.e., colloids versus crystalloids.

Level six: *Create/Innovate* new knowledge such as validating new diagnostic measures or new prognosticator markers.

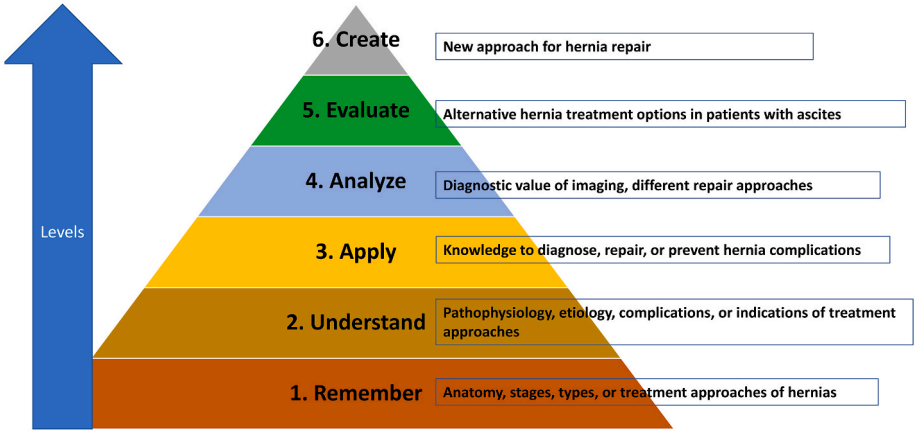

Fig. 1. Revised Bloom's taxonomy with a practical example from surgery (hernia)
Adapted from "Krathwohl D. A Revision of Bloom's Taxonomy: An Overview. Theory Into Practice. 2002; 41 (4):212–218."

In conclusion, clinician educators could better utilize Bloom's taxonomy and apply it in day-to-day point of care teaching encounters. To help with this application, simplified clinical examples from each specialty should be available to educators. In addition, the use of practical clinical scenarios and exercises will familiarize educators with the taxonomy and enable its broader use and implementation, leading to an overall better assessment.

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