



BLOOM'S TAXONOMY AND PUBMED: HOW ACTIVE IS YOUR LEARNING?

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Background

- The Central Library of the San Matteo Hospital in Pavia, Italy, during the past years organized several courses to teach doctors, researchers, nurses and students in the use of PubMed and other medical-scientific databases. At the end of each course an evaluation test was administered to participants.
- We realized that the test, although useful in giving an idea of the learning level, must be more structured in order to draft a report regarding exact indexes.

Aims

- The aim of this work is the creation of an evaluation test based on the identification of skills in the cognitive domain, revolving not only on knowledge but also on comprehension and critical thinking.
- This evaluation test has been conceived to be administered to people attending a course like NLM Training PubMed.

Research on Evaluation tests currently in use to assess learning levels

PubMed

1st step: *'PubMed'[Mesh] AND ('Teaching'[Mesh] OR 'Education'[Mesh] OR 'education' [Subheading] OR 'Teaching Materials'[Mesh])*---> 506 records (indexed in PubMed but not specific for PubMed learning)

2nd step: 'Test*'--->17 records

3rd step: manual selection---> **4 records.**

Google

using 'PubMed course' or 'PubMed learning' as keywords

No useful records

Results after such research strategies

confirmed our initial idea that there was and is, a lack of scientific basis in the drafting of a report of exact indexes

SO

we started our work from a proven teaching tool,
the classical version of Bloom's taxonomy.

taxonomy... *from the greek (taxis) = organization, ordering, disposition and (nomos) = norm, rule of learning objectives, an organized list where objectives could be more precisely classified*

Who was Benjamin Samuel Bloom?

- In 1948, in Boston, during the congress of the American Psychological Association, a group of college examiners underlined the need having theoretical instrumentation in order to improve the quality of examination tests.
- A committee composed by B. S. Bloom, M. D. Engelhart, E.J. Furst, W. H. Hille D. R. Krathwohl was commissioned to draw a taxonomy of learning objectives, an organized list where objectives would be more precisely classified.
- This list should become the Bloom's Taxonomy.

Bloom developed three areas

the AFFECTIVE AREA: attitudes, emotions, etc.

the PSYCHOMOTOR AREA: manual and physical skills

the COGNITIVE AREA: mental skills

Bloom's taxonomy

- includes the recalling or recognition of terminology and facts, classifications, categories, procedural patterns
- there are six categories: from the simplest behaviour to the most complex, the first to be mastered before the next can take place

in our work we considered the cognitive area

with its six categories:

- Knowledge
- Comprehension
- Application
- Analysis
- Synthesis
- Evaluation

Knowledge

<u>Definition</u>	<u>Evaluated skills</u>	<u>Examples</u>	<u>Questions</u>
the student reminds information & contents in the same form in which they have been explained & showed by teachers	to recognize, to tell, to uncover, to list, to locate, to recall, to show, to repeat, to find, to explain, to investigate, to name, to point to, to reproduce	to explain graph parts, to translate a problem in numbers, to summarize a story, to draw conclusions from reading	How? What difference? Which reasons?

Comprehension

<u>Definition</u>	<u>Evaluated skills</u>	<u>Examples</u>	<u>Questions</u>
the student understands information & contexts & is able to reuse them	to summarize, to relate, to experiment, to compare, to demonstrate, to explain, to reword, to discuss, to translate, to interpret, to extract, to make paraphrases, to give examples	to translate texts	How? Can you explain? Can you repeat with your own words?

Application

<u>Definition</u>	<u>Evaluated skills</u>	<u>Examples</u>	<u>Questions</u>
the student selects and translates known facts, data and rules to solve a new problem or to perform a new job	to reuse, to calculate, to demonstrate, to solve, to apply, to build, to operate, to spend, to try, to put into action, to report, to relate, to draw, to adapt, to predict	to make a chart, to solve particular problems on the basis of general rules, to apply laws of statistics to evaluate the reliability of a written test	What would happen if...?

Analysis

<u>Definition</u>	<u>Evaluated skills</u>	<u>Examples</u>	<u>Questions</u>
the student can find sequences in a story, is able to show connections between different parts, to separate materials or concepts into component parts so that its organizational structure may be understood, is able to distinguish between facts & inferences	to analyze, to break down, to compare, to contrast, to diagram, to deconstruct, to differentiate, to discriminate, to distinguish, to identify, to illustrate, to infer, to outline, to relate, to select, to separate, to find connections	to recognize logical fallacies in reasoning, to identify motives or causes, to find evidence in order to support generalizations	Which author can be compared to another? What is the difference between a the first part of a research and the second one?

Synthesis

<u>Definition</u>	<u>Evaluated skills</u>	<u>Examples</u>	<u>Questions</u>
<p>the student is capable of integrate & of combine known ideas to create new ideas or products.</p> <p>Students can build a structure or pattern from different elements, put parts together to form a whole, with emphasis on creating a new meaning or structure</p>	<p>to categorize, to combine, to negotiate, to compose, to create, to devise, to design, to explain, to generate, to modify, to plan, to rearrange, to reconstruct, to rewrite, to hypothesize, to predict, to create, to invent, to extend, to develop, to couch</p>	<p>to integrate training from several sources to solve a problem, to revise & process to improve the outcome, to produce a unique communication, to produce a sequence of operations, to follow on abstract relationships, to verify hypotheses</p>	<p>If sentences about A & B are true, which of the following sentences is false?</p> <p>Write an argumentation on your thesis.</p>

Evaluation

<u>Definition</u>	<u>Evaluated skills</u>	<u>Examples</u>	<u>Questions</u>
the student is able to make judgments on the basis of both internal and external criteria	to judge, to esteem, to criticize, to justify, to choose, to predict, to argue, to remove, to appraise, to support, to discriminate, to defend	to make an evaluation of a poem, a sentence, a theory, giving reasons for your judgment, to select the most effective solution for a problem, to hire the most qualified candidate during a selection, to explain & justify a new budget	Which option would you choose? Explain your choice.

a New Evaluation Test

aimed to evaluate the cognitive skills of students
who attended a PubMed course, like the one
performed by National Library of Medicine and
hosted on:

http://www.nlm.nih.gov/pubs/manuals/pm_workbook.pdf.

for each category of Bloom's taxonomy
we developed the following number of questions,
each category with a different score:

category	n° questions	n° points for each right answer
knowledge	6	1
comprehension	3	2
application	3	2
analysis	2	3
synthesis	2	3
evaluation	2	3

Scoring

- Right answers totally provide 36 points.
- The contents of PubMed course can be considered assimilated if the student gets at least 21 points.

Questions for Knowledge category

- 1) What ages are included by the term, 'Child'?
- 2) Which methods do you know to bypass 'Automatic term mapping'?
- 3) There is an article titled about salted food published in the journal with the name containing 'Hypothesis' or 'hypotheses'. Can you find it?
- 4) What does 'MeSH' mean?
- 5) In which order the records are shown by default, when you display the results of a research?
- 6) What can you do to find records containing a word and its synonyms?

Questions for Comprehension category

- 1) Which is the difference between Single Citation Matcher and Batch Citation Matcher?
- 2) Which kind of records will you lose, choosing to perform your search uniquely using MeSH terms?
- 3) Which kind of records do you lose, choosing to perform your search uniquely using free language terms in the search box?

Questions for Application category

- 1) Use the search box to find the two articles published in 2009 by Roysommuti on taurine depletion.
- 2) Using the Search Builder on the Advanced Search page, search the journal 'Pediatrics' for citations with vaccines or vaccination as a Major Topic. Limit to articles published in the last year.
- 3) Create a NCBI account.

Questions for Analysis category

1) Using the Limits screen, find English-language articles on clinical trials using non pharmacological therapy to treat seasonal affective disorders. Show all results in Abstract format on one page. Select three or four citations from the previous exercise and save them in a Collection Send the same results in a clipboard. Which are the differences between the two lists?

2) Compare the searches 'Kidney allograft' and kidney allograft, with and without quotes, using the 'Details' link. What do you reckon about the differences?

Questions for Synthesis category

- 1) In one search, find references about the relationships between circadian rhythms and either cortisol or melatonin in humans
- 2) Convert a research performed in common language on breast cancer into a research performed using Mesh terms

Questions for Evaluation category

1) How can you re-perform the same search again in the future? Which is the better way in your opinion? Give reasons of your choice.

2) Reconsidering question 2 of the section 'Synthesis', which search strategy gives more benefits? Explain your answer using judgments in terms of internal evidence and of external criteria.

Open vs Multiple Choice Questions

- Questions, especially those belonging to the categories of Application, Analysis, Synthesis, Evaluation, are conceived to be administered as 'open' questions, since they require structured argumentation.
- They cannot be turned into multiple choice questions, without losing efficacy and incisiveness.

Following is a multiple choice version
of the previous test

Questionnaire with Multiple Choice Question 1

What ages are included by the term, 'Child?'

- a. The term 'Child' in MeSH covers children ages 6 to 12 years. 'Child, Preschool', which includes children aged 2 to 5 years, is indented under Child.
- b. The term Child in MeSH covers ages from 1 to 12 years
- c. The term Child in MeSH covers ages from 1 to 18 years
- d. The term Child is not present in MeSH. You can use it just in a free language search.

Questionnaire with Multiple Choice Question 2

Which methods do you know by means of which you can bypass 'Automatic term mapping'?

- a. Using quotes
- b. Using tag fields
- c. 'Automatic term mapping' cannot be bypassed
- d. Using quotes, or tag fields, or an asterisk

Questionnaire with Multiple Choice Question 3

There is an article titled [something about] 'salted food' published in the journal [something] hypothesis or hypotheses. How can you find it?

1. Writing in the search box 'salted food' AND 'hypothesis OR hypotheses'
2. Writing in Single Citation Matcher 'hypotheses' in the journal name field and 'salted food' in the title field
3. Looking for 'salted food' in MeSH and limiting the results with 'Hypothetical journal'
4. Writing in the search box 'salted food' [TI] AND hypoth*

Questionnaire with Multiple Choice Question 4

What does 'MeSH' mean?

- a. Medical Searching Headings
- b. Medical Subject Hitting
- c. Medical Synonyms Hunting
- d. Medical Subject Headings

Questionnaire with Multiple Choice Question 5

When you display the results of a research, in which order the records are shown by default,?

- a. Relevance
- b. Alphabetical by Author
- c. Recently added
- d. Alphabetical by journal name

Questionnaire with Multiple Choice Question 6

What can you do to find records containing a word and its synonyms?

- a. I can use OR operator
- b. I can use the asterisk
- c. I can use MeSH
- d. It is not possible to find synonyms

Questionnaire with Multiple Choice Question 7

Which is the function of Single Citation Matcher?

- a. With Single Citation Matcher it is possible to select the best articles among the results of a research, with Batch Citation Matcher you can combine two different researches
- b. In Single Citation Matcher it is possible to find all the articles written by an author, in Batch Citation Matcher you can combine the articles of two or more authors
- c. In Single Citation Matcher you must write a citation string using an input form, in Batch Citation Matcher you can fill in the information you have about a citation
- d. In Single Citation Matcher you can fill in the information you have about a citation, in Batch Citation Matcher you must write a citation string using an input form

Questionnaire with Multiple Choice Question 8

Which kind of records do you lose, choosing to perform your research uniquely using MeSH terms?

- a. The records not yet indexed
- b. The records recently added
- c. The records with the label 'as supplied by publisher'
- d. All the categories before mentioned

Questionnaire with Multiple Choice Question 9

Which kind of records do you lose, choosing to perform your research uniquely using free language terms in the search box?

- a. All the categories of the previous question
- b. The records with MeSH subjects.
- c. I don't lose any particular category of records, but the results are less accurate
- d. I don't lose any particular category of records, but the results are less recent

Questionnaire with Multiple Choice Question 10

Use the search box to find the two articles published in 2009 by Roysommuti on taurine depletion

- a. Fill in the fields in Single Citation Matcher
- b. Digit '2009 roysommuti taurine depletion' in the search box
- c. Look for 'Taurine depletion' in MeSH and fill the fields in Limits
- d. All the searches above mentioned are successful

Questionnaire with Multiple Choice Question 11

Search the journal *Pediatrics* for citations with vaccines or vaccination as a Major Topic. Limit to articles published in the last year.

- a. In Advanced Search fill in the correct field for the journal and in Limits select the correct range of time. Select 'Vaccines' in MeSH database and check the box for major topic
- b. Digit 'Vaccines OR vaccination' in the search box, in Limits fill in the correct field for the journal
- c. Select 'Vaccines' in MeSH database and check the box for major topic, in Limits select 'Child' in the Ages list
- d. Digit 'Vaccines OR vaccination' in the search box, in Advanced Search fill in the correct field for the journal and the correct range of time and check the box for major topic

Questionnaire

Question 12

Create a NCBI account

Questionnaire with Multiple Choice Question 13

Using the Limits screen, find English-language articles on clinical trials using non pharmacological therapy to treat seasonal affective disorders. Show all results in Abstract format on one page. Select three or four citations from the previous exercise and save them in a Collection send the same results in a clipboard. Which are the differences between the two lists?

- a. The Collection shows abstracts, the Clipboard only summaries
- b. In the Clipboard you can ask for updating results, in the Collection you cannot
- c. There is not any remarkable difference between the two kind of lists
- d. The collection is a part of your NCBI account, the clipboard is a temporary space which cannot be personalized

Questionnaire with Multiple Choice Question 14

Compare the searches 'kidney allograft' and kidney allograft, with and without quotes. Using the 'details' link. What about the differences?

- a. The search with quotes gives less records but is more precise than the other one
- b. The search with quotes gives more records but is less precise than the other one
- c. There is not any remarkable difference between the two kind of searches
- d. The search without quotes gives more records which are not indexed with MeSH terms

Questionnaire with Multiple Choice Question 15

In one search, find references about the relationships between circadian rhythms and either cortisol or melatonin in humans

- a. (Circadian rhythm* AND melatonin OR cortisol) AND "humans"[MeSH Terms]
- b. melatonin OR cortisol AND "humans"[MeSH Terms] AND Circadian rhythms
- c. Circadian rhythm* AND (melatonin OR cortisol) AND "humans"[MeSH Terms]
- d. Humans AND Circadian AND rhythms AND (melatonin OR cortisol)

Questionnaire with Multiple Choice Question 16

Convert a research performed in common language on breast cancer into a research performed using Mesh terms.

- a. Breast cancer → "Breast metastasis"[Mesh]
- b."Breast cancer" → "Breast Neoplasms"
- c. Breast cancer → "Breast Neoplasms"[Mesh]
- d. Breast AND cancer → Breast AND 'Neoplasms'[Mesh]

Questionnaire with Multiple Choice Question 17

How can you reperform the same search again in the future? Which of these ways is better in your opinion? Give reasons of your choice.

- a. Creating a bookmark in the Details'
- b. Using NCBI
- c. Saving results in the Clipboard
- d. Saving MeSH terms in a file

Questionnaire

Question 18

Regarding the research mentioned in question 16, which search strategy gives more benefits? Explain your answer using judgments in terms of internal evidence and of external criteria.

thus

- We have created exact indexes which are pliable with which we can assess both open questions and multiple choice questions in order to ascertain and evaluate learning.

Next steps

- The questionnaire we realized will be tested on our researchers during our next PubMed course.
- It shall be compared with the answers obtainable through a ‘traditional’ questionnaire.