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Bloom's Taxonomy and its Use in Classroom Assessment

Alison Cullinane

Introduction

One of the most important aims in post primary education is the attainment of critical or higher-order thinking skills. Identifying how to encourage, teach and then assess these skills is an important role of the teacher. One tool which has been well regarded and has had many successes in the past is Bloom's Taxonomy of educational objectives (Bloom *et al.*, 1956).

This research and resource guide will deal specifically with the original Bloom's Taxonomy. The author is aware of the revised taxonomy published in 2001 (Anderson *et al*), but Bloom's version continues to be the most referred to taxonomy.

What is Bloom's Taxonomy?

Benjamin Bloom found, in a study which involved the analysis of third level examination scripts, that 95% of questions examined were from lower levels of cognitive thinking (Lord and Baviskar 2007). It was from this research, that in 1948, Bloom and his team of educational psychologists created three different divisions of educational objectives; *Bloom's Taxonomy*. This research body found that most educational objectives could be placed in one of the three domains; *Cognitive, Affective* and *Psychomotor*. Only the *Cognitive* and *Affective* domains were published by Bloom and his team. The *Psychomotor* domain was later developed by other educational researchers such as Simpson (1972).

Applications of Bloom's Taxonomy

There are many applications of Bloom's Taxonomy. It was initially designed to be applied when setting examinations papers at third level but it now has been used as a basic reference for educators globally. Research has found that the Taxonomy is used most frequently at policy making levels and sparingly by schools and teachers in the classroom (Anderson and Sosniak, 1994). Teachers have been using the Taxonomy for decades to help aid four common areas.

(1) Specifying lesson objectives,
(2) Preparing tests,
(3) Asking questions at different taxonomic levels.
(4) Increasing the cognitive levels of activity

Useful applications of the taxonomy include formulating questions to challenge your students in class tests, during class time and for homework assignments. The taxonomy is also useful in the designing of lesson plans and can be used to adapt a previously designed lesson.

When designing class tests, you can use the following section as a guide and resource to aid the promotion of critical thinking among your students. It is necessary to apply and use a combination of all of the levels in the various assignments for it to have a beneficial effect on your students. The section illustrates how, from each level, the verbs used to ask questions can be incorporated into questions; this will help students strive to achieve higher levels of critical thinking.

The Cognitive Domain

In literature most references to Bloom's Taxonomy refer to the *Cognitive* domain. The objectives dealt with in the *Cognitive* domain place an emphasis on remembering or recalling information. Cognitive objectives vary from simple recall of material that was learned to highly original and creative ways of combining and synthesising new ideas and materials.

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The taxonomy is divided into six levels: *Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation.* Bloom's Taxonomy is hierarchical; meaning that learning at the higher levels is dependent on having attained prerequisite knowledge and skills at the lower levels. (See *Fig 1*)

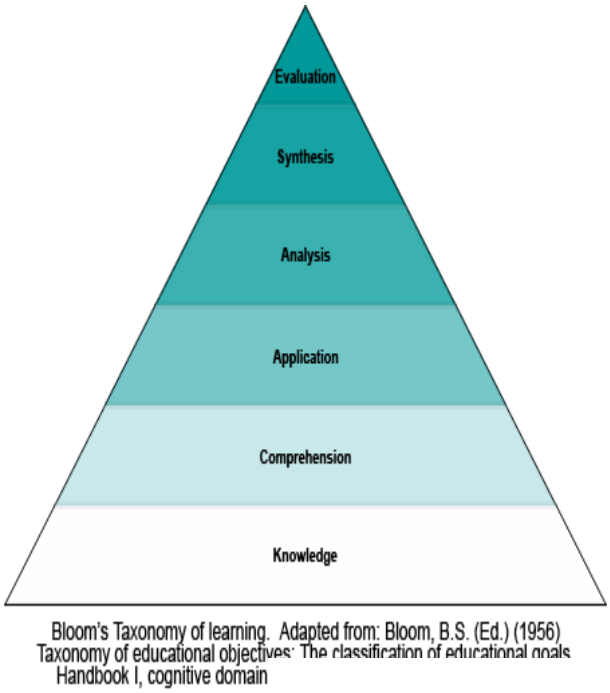

Fig. 1: Illustrates the Cognitive domain of Bloom's taxonomy.

1. Knowledge: The recall of information.

This is the lowest level of the Taxonomy. Questions are asked solely to test whether a student has gained specific information from the lesson. Definitions, naming dates, naming people etc are all examples of *Knowledge* type questions. It can also include knowledge of the main ideas being taught.

Table 1: Verbs used in question stems to assess at a *Knowledge* level.

define	name	order
describe	recite	recognise
label	recall	record
list	relate	reproduce
match	repeat	state
arrange	underline	

Example Question:

Q Name a polysaccharide.

2. Comprehension: The translation, interpretation or extrapolation of knowledge.

Comprehension is possibly the most emphasised intellectual ability in schools. At comprehension levels students go past simply the recall of facts. Instead they will have an understanding of the information. With this level, they will be able to interpret the facts and be able to put them into their own words. For example; students will not only be able to name the components of the cell but also be able to understand the function of each part.

Table 2: Verbs used in question stems to assess at a *Comprehension* level.

arrange	explain	interpret
classify	express	locate
describe	identify	report
discuss	indicate	restate
sort	translate	extrapolate

Example Question:

Q Explain the term *niche*, in relation to ecology.

3. Application: The application of knowledge to a new situation

Students will have to apply and use the knowledge they have learned. They might be asked to solve a problem with the information they have gained in class, to create a viable solution, or illustrate an idea or concept with the use of a diagram

Table 3: Verbs used in question stems to assess at an *Application* level.

apply	practice	solve
choose	prepare	use
illustrate	schedule	demonstrate
operate	sketch	measure

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Example Question:

Q Illustrate the cell as it goes through the various stages of cell division.

4. Analysis: Break down knowledge into parts and show relationships among the parts.

In this level, students will be required to go beyond knowledge and application and actually see patterns that they can use to analyse a problem. This involves dissecting ideas and material into its component parts; therefore examining and discriminating between the relationships of the parts. For example, asking "what are the dietary needs of a lactose intolerant person" requires the students to analyse the dietary needs of that individual and arrive at a conclusion based on this analysis.

Table 4: Verbs used in question stems to assess at an *Analysis* level.

analyse	diagram	question
calculate	discriminate	test
categorise	distinguish	differentiate
contrast	examine	compare
criticise	experiment	inventory

Example Question:

Q. Compare and contrast the various types of lichens you have found from the individual locations you have studied. Why do you think there may be a difference in the occurrence of the lichens in these locations?

5. Synthesis: Bring together parts (elements, components) of knowledge to form a whole and build relationships for new situations.

Students are required to use the given facts to create new theories or make predictions at this level. Knowledge from multiple subjects can be combined and utilised before coming to a conclusion. For example, if a student is asked to invent a new product or game they are being asked to synthesise new ideas.

Table 5: Verbs used in question stems to assess at a *Synthesis* level.

arrange	design	prepare
assemble	formulate	propose
collect	manage	set up
compose	organise	synthesise
create	Plan	write
construct	modify	conduct

Example Question:

Q. Plan and design an ecological fieldtrip booklet for your class which you will undertake at various locations, including the lake, woodland and seaside.

6. Evaluation: Judgements about the value of material and methods for given purposes.

Evaluation is deemed the highest level of cognitive thinking. It is a complex process and is regarded to encompass combinations of all the other objectives. Students are expected to assess information and come to a conclusion such as its value or debating the pros and cons of the information in front of them. You are writing evaluation questions when you use words like select, judge, debate, recommend, etc.

Table 6: Verbs used in question stems to assess at an *Evaluation* level.

appraise	estimate	select
argue	evaluate	support
assess	judge	value
attack	predict	score
compare	rate	defend

Example Question:

Q. Prepare a case you would present to defend your views on stem cell research in the world today.

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The Affective Domain

The *Affective* domain focuses on encouraging the development of factors such as student feelings, motivation, attitudes, perceptions and values towards the material they are learning. This domain transcends activities ranging from listening to others, participating in discussions to showing self-reliance when working independently (Bloom *et al.,* 1964). Students require a well rounded education so they are not simply gathering information but are responding to what they learn, valuing it, being able to organise the material and even characterise themselves as scientists. The *Affective* domain is useful for areas of moral concern, where students have an opportunity to respond to controversial or sensitive issues in science such as animal testing, stem cell research (embryonic), donor transplantations, cancer research and radiation (nuclear disasters i.e. the Chernobyl disaster). The *Affective* domain in the curriculum is acknowledged to be an important aspect to learning. Research concerned with attitudes to science and their effect on the learning on science show that without a positive attitude towards science, students will not want to learn the subject (Littledyke, 2008). Behaviours in this domain are classes into five separate categories; 1. Receiving, 2. Responding, 3. Valuing 4. Organisation and 5. Characterisation by a value or value complex (Bloom *et al.,* 1964).

The Psychomotor Domain

Bloom did not focus on, or devise categories for skills in the *Psychomotor* domain, but other educators have created their own psychomotor taxonomies (Simpson, 1972). The *Psychomotor* domain deals with physical movement and skills that may be required in-order to complete a course or subject matter. Psychomotor objective are as important to concentrate on as the *Cognitive* and *Affective* objectives with-in science education. Psychomotor skills are essential in science; and may include; adjusting a microscope, preparing slides, manipulating apparatus and field work study.

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