

Providing Vocational Career

The pupil:

- Adopts science related vocations such as engineering, medicine, agriculture, animations, horticulture etc.
- Makes science as his career and profession

Bloom's Taxonomy of Educational Objectives

Bloom and his associates developed a system of classification of objectives called the taxonomy of educational objectives in 1956, on the assumption that the teaching-learning process may be conceived as an attempt to change the behavior of pupils with respect to subject matter or learning experience. Dr. Benjamin S. Bloom of University of Chicago was the editor of book "Taxonomy of Educational Objectives". Taxonomy means a system of classification and Bloom's Taxonomy of Educational Objectives has classified educational goals into three main areas or domains. Each of these domains is further categorized according to the level of behavior, progressing from the most simple to the highly complex.

These three domains are:

1. Cognitive Domain (Related to Head)
2. Affective Domain (Related to Heart)
3. Conative or Psychomotor Domain (Related to Hand)

Knowing (Mind)
Feeling (Body)
Doing (Spirit)

COGNITIVE DOMAIN

COGNITIVE DOMAIN

- Bloom's Taxonomy is an order of learning with six levels.

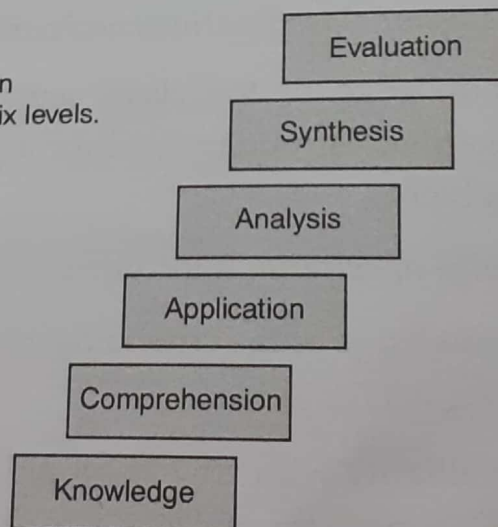


Fig: Cognitive Domain of Bloom's Taxonomy

The cognitive domain includes those objectives which deal with the recall or recognition of knowledge and the development of intellectual abilities and skills. It is the domain in which most of the work in curriculum development has taken place.

It is organized under six major classes:

1. **KNOWLEDGE:** Knowledge includes those behaviors and test situations which emphasize the remembering, either by recognition or phenomena. It includes three levels:

(i) **Knowledge of specifics:** It means the recall of specific and isolable bits of information. The emphasis is on symbols with concrete referents. It is further divided into:

(a) **Knowledge of Terminology:** It is the knowledge of the verbal and non-verbal symbol.

(b) **Knowledge of Specific Facts:** It includes knowledge of dates, events, persons, places etc.

(ii) **Knowledge of ways and means of dealing with specifics:** It includes knowledge of the ways of organizing, studying, criticizing and judging facts and phenomena. It has five categories:-

(a) **Knowledge of conventions:** It involves knowledge of the ways of treating and presenting ideas and phenomena. It is also used to make pupils conscious of correct form and usage in speech and writing.

(b) **Knowledge of trends and sequences:** It includes:-

- Knowledge of processes, directions and movements of phenomena with respect to time
- Knowledge of basic trends underlying the development of public assistance programs

(c) **Knowledge of classifications and categories:** It includes:-

- Knowledge of the class, sets, divisions and arrangements which are regarded as fundamental for a given subject field, purpose, argument or problem

(d) **Knowledge of criteria:** It includes:-

- Knowledge of the criteria by which facts, principles, opinions and conduct are tested or judged.
- Familiarity with criteria for judgment appropriate to the type of work and the purpose for which it is read.
- Knowledge of criteria for the evaluation of recreational activities

(e) **Knowledge of Methodology:** It includes knowledge of method of inquiry, techniques and procedures employed in a particular subject field.

(iii) **Knowledge of the Universals and Abstractions in a field:** It includes knowledge of the major schemes and patterns by which phenomena and ideas are organized. It is of two types:-

(a) **Knowledge of principles and generalizations:** It includes:-

- Knowledge of particular abstractions which summarize observations of phenomena.
- Knowledge of the important principles by which our experience with biological phenomena is summarized.
- The recall of major generalizations about particular cultures.

(b) **Knowledge of Theories and Structures:** It includes knowledge of the body of principles and generalizations together with their inter-relations which present a clear, rounded and systematic view of a complex phenomenon, problem or field.

2. **COMPREHENSION:** This represents the lowest level of understanding. It refers to a type of understanding or apprehension such that the individual knows what is being communicated without necessarily relating it to other material or seeing its fullest implications. It is divided into three areas:

(a) **Translation:** It is just on the basis of faithfulness and accuracy. The translation abilities include:

- Translation from one level of abstraction to another.
- Translation from symbolic form to another form, or vice-versa.
- Translation from one verbal form to another.

(a) **Interpretation:** It includes the explanation or summarization of a communication. It involves:

- The ability to grasp the thought of the work as a whole at any desired level of generality.
- The ability to interpret various types of social data.

(b) **Extrapolation:** It includes:

- The extension of trends or tendencies beyond the given data to determine implications, consequences, corollaries, effects etc.
- The ability to deal with the conclusions of work in terms of the immediate inferences made from explicit statements.

- The ability to differentiate the value judgments from predictions of consequences.

3. **APPLICATION:** It follows the principle that to apply something requires comprehension of the method, theory or abstraction applied. It includes:

- The use of abstractions in particular and concrete situations
- Applications to the phenomenon discussed in one paper of the scientific terms or concepts used in other papers.
- The ability to predict the probable effect of a change in a factor on a biological situation previously at equilibrium.

4. **ANALYSIS:** It emphasizes the breakdown into parts and of the way their devices used to convey the meaning or to establish the conclusion of a communication.

It includes:

(a) *Analysis of elements:* It includes:

- Identification of the elements included in the communication.
- The ability to recognize unstated assumptions.
- Skill in distinguishing facts from hypothesis.

(b) *Analysis of relationships:* It includes:

- The connections and interactions between elements and parts of a communication
- The ability to check the consistency of hypothesis with given information and assumptions.
- Skill in comprehending the inter-relationships among the ideas in a passage

(c) *Analysis of organizational principles:* It includes:

- The organization, systematic arrangement and structure which hold the communication together. This includes the "explicit" as well as "implicit" structure. It includes the basis, necessary arrangements and the machines which make the communication a unit.
- The ability to recognize form and pattern in literary or artistic works as a means of understanding their meaning.

5. **SYNTHESIS:** It means:

Putting together of elements and parts so as to form a whole. It involves the process of

working with pieces, parts and elements etc. and arranging and combining them in such a way so as to constitute a pattern or structure. It has three aspects:

(a) *Production of Unique Communication*: It includes:

- The development of a communication in which the writer or speaker attempts to convey ideas, feelings and experiences to others.
- Skill in writing, using and excellent organization of ideas and statements.
- Ability to tell a personal experience effectively.

(b) *Production of a Plan or Proposed set of Operations*: It includes:

- The development of a plan of work or the proposal of a plan of operations.
- Ability to propose ways of testing hypothesis.
- Ability to plan a unit of instructions for a particular teaching situation.

(c) *Derivation of a set of Abstract Relations*: It includes:

- Development of set of abstract relation which is either to specify or explain particular data or phenomenon.
- Ability to formulate appropriate hypothesis based upon an analysis of factors involved and to modify such hypothesis in light of new factors.
- Ability to make discoveries and generalization.

6. **EVALUATION**: It is defined as making of judgment about the values, purpose, of ideas, works, solutions etc. It involves the use of criteria for appraising the extent to which the particulars are accurate affective economical or satisfying. The judgments may be either quantitative or qualitative. It has two levels:

(a) *Judgments in terms of Internal Evidence*: It includes:

- Evaluation of the accuracy of a communication from such evidence as logical accuracy, consistency and other internal criteria.
- The ability to indicate logical fallacies in arguments.

(b) *Judgment in terms of External Criteria*: It includes:

- Evaluation of material with preference to selected or remembered criteria.
- The comparison of major theories, generalizations and facts about particular cultures.
- Judging by external standards, the ability to compare a work with the highest known standards in the field especially with other works of recognized excellence.

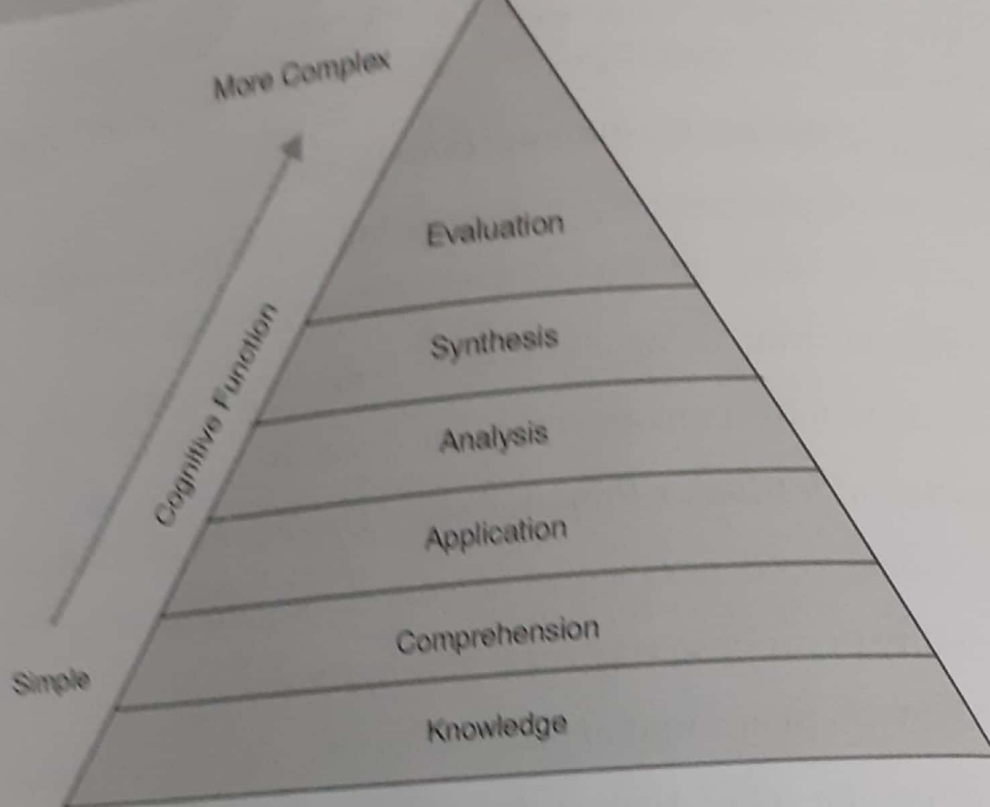


Fig. : Cognitive Domain of Bloom's Taxonomy

Advantages of Cognitive Domain

1. Cognitive domain highlights learner's thought processes, which is most important to understand how our brain works.
2. Cognitive domain helps to improve our behaviour & bring out favourable actions.
3. Cognitive functions such as memory, retention, comprehension, problem solving etc. determine academic achievement of students in schools.
4. Cognitive domain builds a deeper understanding of the concepts, thus improving students' confidence & enthusiasm.

Limitations

1. Cognitive domain does not specify our emotions, feelings & attitudes that govern our thought process.
2. It is difficult to measure some of the cognitive functions, especially those which are internal such as attention & perception.

AFFECTIVE DOMAIN

It includes objectives which describes changes in interest, attitude, values and development of appreciation and adequate adjustment.

According to Bloom the objectives in this domain have five categories:

1. RECEIVING: First and the lowest level of the affective domain includes an

individual's awareness of various sources of information on science. It includes an

individual's awareness of various sources of information on science. It includes:

- Awareness of the phenomenon
 - Willingness to receive phenomenon
 - Controlled or selected attention
2. **RESPONDING:** In comparison to simple awareness or attention to make some response to a stimulus or phenomenon. This level is higher. It includes:
- Obedience corresponding.
 - Willingness to respond.
 - Satisfaction and response.
3. **VALUING:** This level of affective domain indicates and internalization of and commitment to certain ideals or values. Development of scientific attitude is the main objective of this level. It includes:
- Acceptance of value
 - Preference of value
 - Commitment to a value
4. **ORGANIZATION:** Building a system of values is the main concern of this level. It includes:
- Conceptualization of a value
 - Organization of a value system
5. **CHARACTERIZATION BY A VALUE:** This is the highest level of this domain and includes characterization of a person's behavior by certain controlling values, ideas and believes.
- It has two aspects:
- Generalized set
 - Characterization

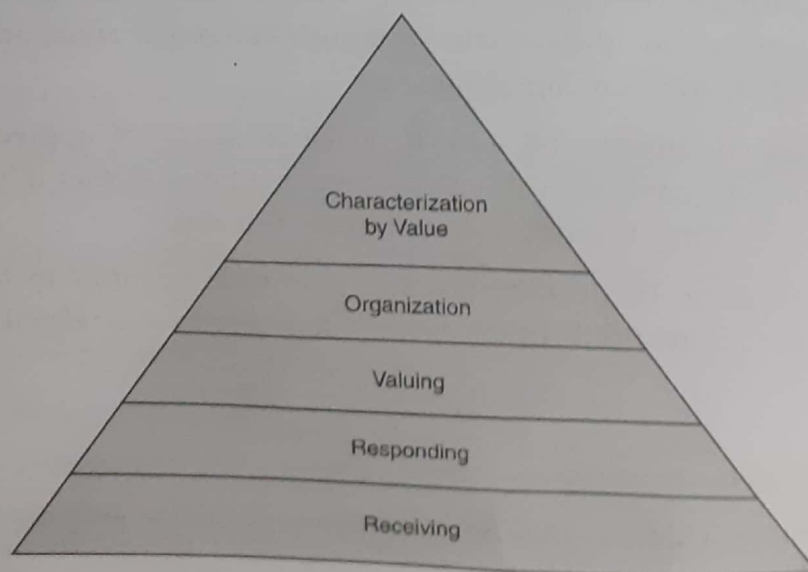


Fig. : Objectives in Affective Domain

The levels are described with examples as follows:

Affective Domain Hierarchy		
Level	Definition	Example
Receiving	Being aware of or attending to something in the environment.	Individual reads a book passage.
Responding	Showing some new behaviors as a result of experience.	Individual answers questions about the book, reads another book by the same author, another book.
Valuing	Showing some definite involvement or commitment.	The individual demonstrates this by voluntarily attending a lecture.
Organization	Integrating a new value into one's general set of values, giving it some ranking among one's general priorities.	The individual organizes an experiment.
Characterization by Value	Acting consistently with the new value.	The individual is firmly committed to the value, perhaps becoming a scientist or person with scientific temper.

Advantages:

This domain is useful in developing:

1. **Scientific attitude:** Through the study of science the learner has to follow a systematic scientific approach in all the related activities like observation, analysis, classification, experimentation and drawing of inference.
2. **Appreciation:** A student of science develops sense of appreciation for scientific inventions and discoveries. This can be developed in a learner if he is exposed to such situations and trained to judge its importance critically.
3. **Interest in Science:** The learner develops interest in scientific matters through science education. He automatically involves himself in discussions related to science.

Drawbacks:

1. Objectives not clearly stated
2. Most difficult to achieve as it is difficult to bring change in attitudes
3. Least emphasized in schools

Conative or Psychomotor Domain

A third domain is the manipulative or motor skill area or psychomotor domain. This was not there in original Bloom's taxonomy but was later added by his co-workers. Science education has ample scope for developing certain mechanical or manipulative skills drawing and designing skills. Development of such skill is due to proper co-ordination between the psychological function of perception through the sense organs and motor function of manipulation through motor organs like hand, legs etc. Through the study of science there is better chance for developing such skills.

This domain is characterized by progressive levels of behaviors from observation to mastery of a physical skill. Several different taxonomies exist in psychomotor domain:

Classification by Dave : He specified following 5 levels in conative domain:

1. **Imitation-** Observing and copying someone else
2. **Manipulation-** Guided via instructions to perform a skill
3. **Precision-** Accuracy, proportion and exactness exists in the skill performance without the presence of the original source.
4. **Articulation-** When two or more skills are combined, sequenced, and performed consistently.
5. **Naturalization-** When the performance is automatic without any physical or mental exertion.

Classification by E.G. Simpson: He specified following 5 levels in conative domain:

1. **Perception:** It includes activities relating to the senses.
2. **Set:** It includes adjustment at mental, physical and emotional levels.
3. **Guided response:** It includes developing practical skills.
4. **Mechanism:** It means helping to respond properly.
5. **Complex Overt Response:** It means acquiring efficiency and skill to accomplish the most complex task with minimum time and energy.

Classification by Harrow: Harrow has modified the Simpson's classification into 6 levels, as under:

1. **Perception:** It means ability to make preparatory adjustments.
2. **Initiation:** It means ability to follow directions.
3. **Manipulation:** It means ability to perform according to given instructions.
4. **Precision:** It means ability to perform complex tasks.
5. **Articulation:** It means ability to establish sequence and harmony i.e. to perform with

accuracy, speed and time.
 6. Naturalization : It means ability to perform naturally, naturally, automatically spontaneously.

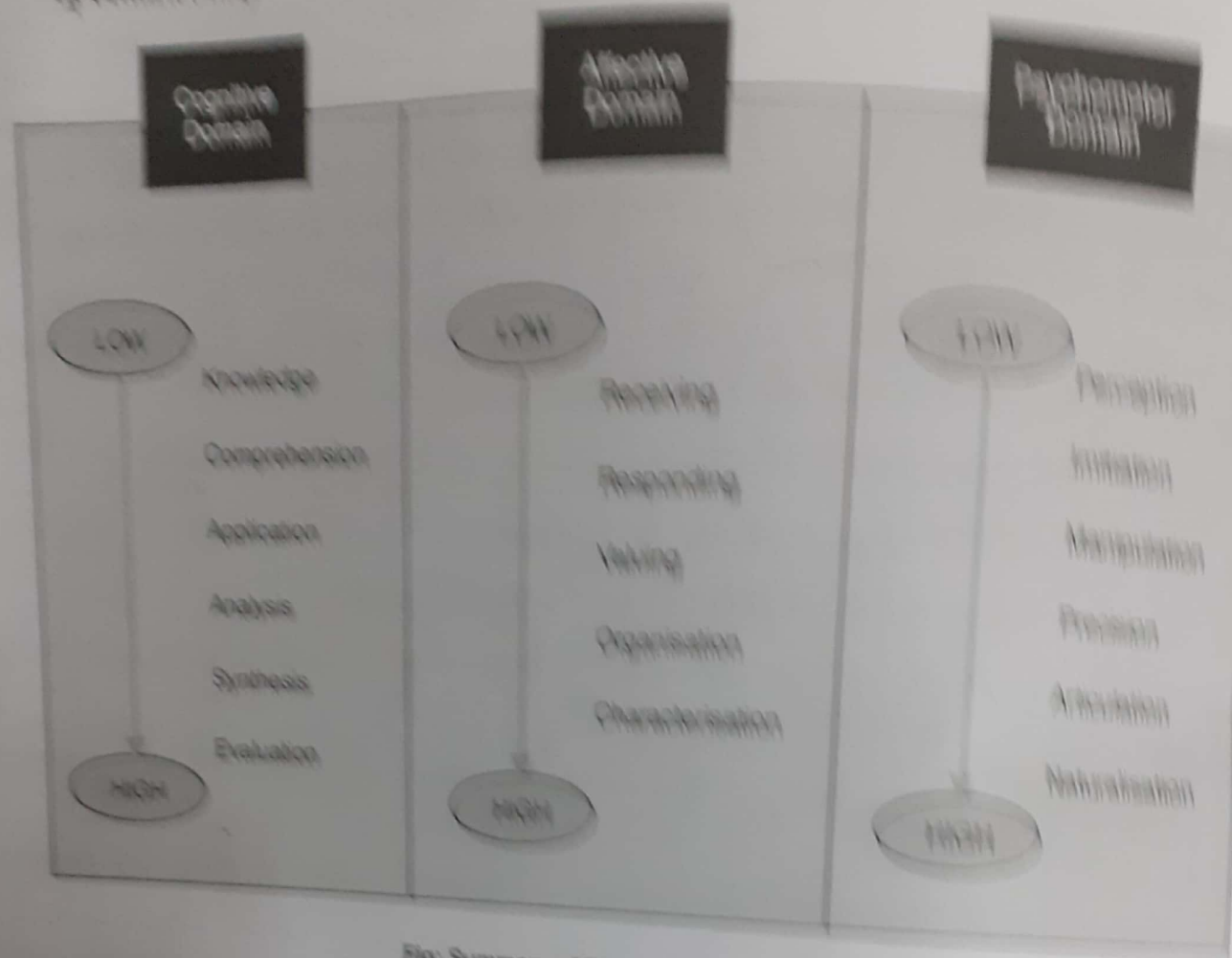


Fig: Summary of Bloom's Taxonomy

REVISED BLOOM'S TAXONOMY

In 1980's, Lorin Anderson, a former student of Bloom, along with David Krathwohl, one of Bloom's original partners, worked to revise the original taxonomy. The Anderson and Krathwohl's Taxonomy was published in 2001 in the book "A Taxonomy for Learning, Teaching and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives." Revised Bloom's Taxonomy employs the use of 25 verbs. It has been adopted as a planning tool. It provides a way to organise thinking skills into 6 levels, from the basic to more complex level of thinking. In this Nouns are changed to verbs, as the taxonomy reflects different forms of thinking and it is an active process.

- For e.g. Knowledge category was renamed as Remembering:
- In the revised taxonomy, following changes have been made in cognitive domain
- Remember- Using memory to recall facts and definitions.
 - Understand- Constructing meaning from information.

accuracy, speed and time.

6. **Naturalization** : It means ability to perform smoothly, naturally, automatically and spontaneously.

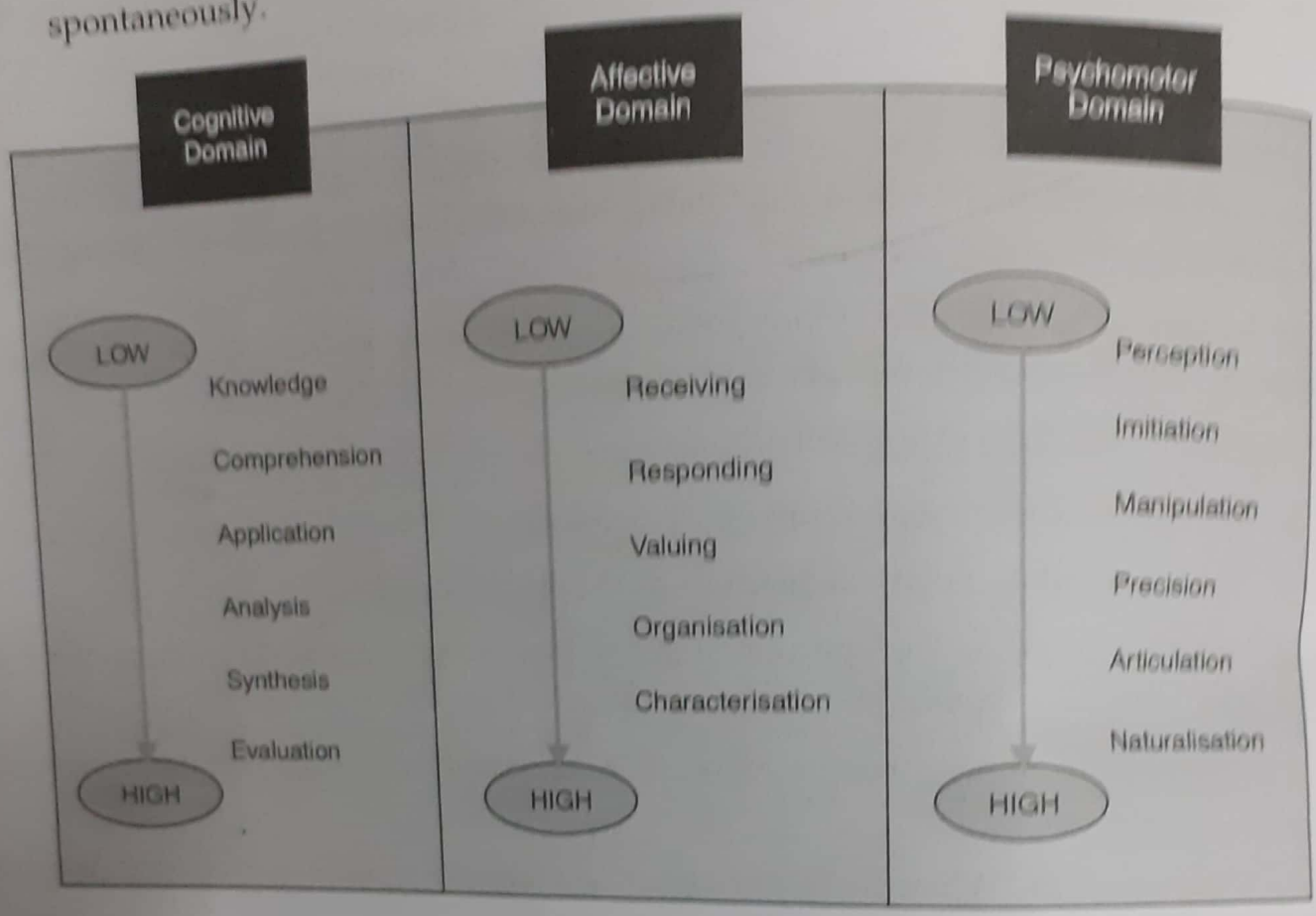


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For e.g. Knowledge category was renamed as Remembering.
In the revised taxonomy, following changes have been made in cognitive domain.

- **Remember-** Using memory to recall facts and definitions.
- **Understand-** Constructing meaning from information.

- **Apply**- Using procedures to carry out a task.
- **Analyze**- Breaking materials into parts to determine structures and relationships.
- **Evaluate**- Making judgments based on checking against given criteria.
- **Create**- Putting materials together to form a unique product.

These are illustrated in the following figure.

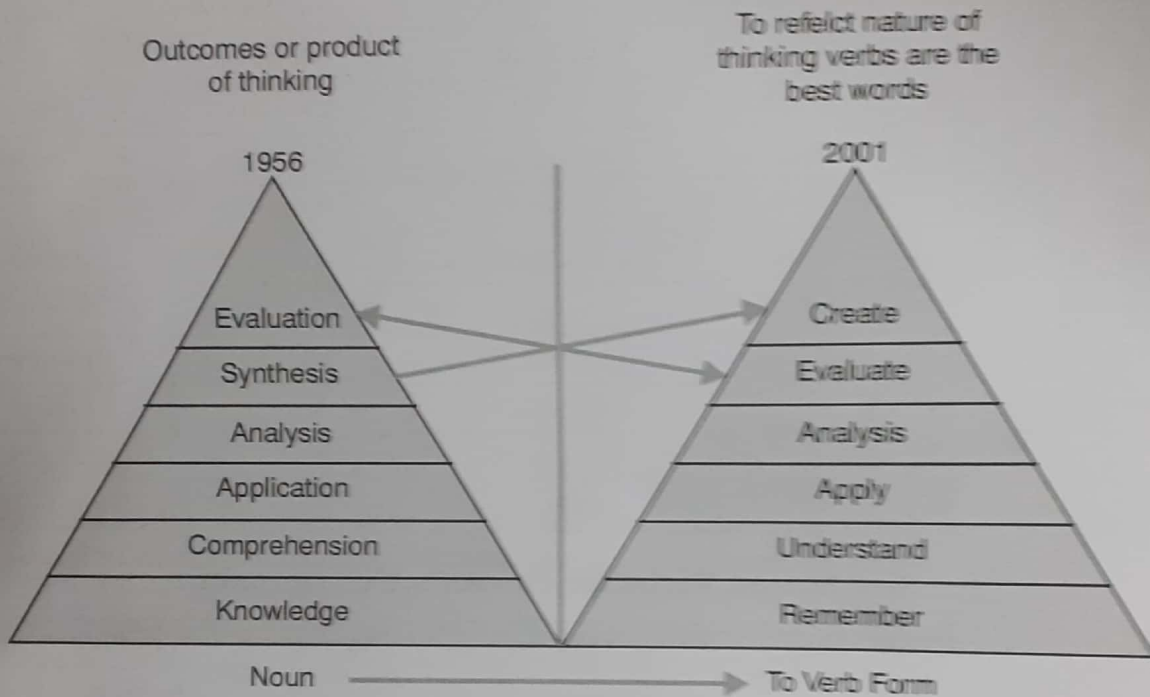


Fig. : Cognitive Domain as per Revised Bloom's Taxonomy

Key Action Verbs for the Cognitive Domain (ORIGINAL AS WELL AS REVISED)

Whichever taxonomy you prefer, there are key verbs for each level you can use when writing cognitive objectives.

Remember	Understand	Apply	Analyze	Synthesize	Evaluate	Create
Describe	Explain	Complete	Compare	Combine	Choose	Plan
Name	Compare	Use	Contrast	Organize	Evaluate	Invent
Find	Discuss	Examine	Examine	Select	Select	Compose
List	Predict	Illustrate	Explain	Discuss	Criticize	Design
Relate	Outline	Classify	Identify	Relate	Identify	Construct
Write	Restate	Solve	Categorize	Synthesize	Support	Imagine
Define	Classify	Assess	Investigate	Restate	Judge	Produce
Select	Identify	Show	Analyze	Summarize	Determine	Make
Label	Judge	Choose	Justify	Precise	Recognize	Build

Recall	Contract	Find	Conclude	Argue	Defend	Develop
Recognize	Illustrate	State	Identify	Derive	Criticize	Shape
Reproduce	Represent	Predict	Separate	Conclude	Avoid	Mould
Measure	Justify	Compute	Criticize	Generalize		

Key Action Verbs in Psychomotor Domain

Imitation	Manipulation	Precision	Articulation	Naturalisation
observe	complete	arrange	conduct	
attend to	demonstrate	choose	construct	Builds
ask	replicate		design	Combines
participate	share		integrate	
answer	point out	integrate	organize	creates
tell	break down		perform	
give examples	put together	refine	modify	initiates
express confidence		mixes		makes
		respond		Originates
		vary		

Key Action Verbs for the Affective Domain

Receiving	Responding	Valuing	Organizing	Characterization
Accept	Answer	Choose	Associate	Decide
Identify	Develop	Indicate	Organize	Face
Discover	Complete	Attain	Change	Judge
Listen	Obey	Demonstrate	Find	Prove
Attend	State	Accept	Judge	Revise
Prefer	Complete	Recognize	Relate	Change
Receive	Select	Participate	Find	Accept
Perceive	List	Increase	Determine	Judge
Aware	Write	Develop	Correlate	Develop
Favour	Record	Indicate	Associate	Demonstrate
	Derive	Influence	Form	Identify

ASSIGNMENT QUESTIONS

- Write short notes on the following :
 - Differences between aims and objectives
 - Difference between educational and instructional objectives.