

Learning Domains, Bloom's Taxonomy and Learning Strategies

There are two approaches to teaching and learning philosophies in Education. They are "Content Based (Input based/Traditional)" and "Outcome (Competency) Based (OBE)".

Outcome based education prepares a student to achieve a set of stated learning outcomes and measures the extent of achievement right through the learning period. The subject/module tutor writes a set of learning outcomes under each learning domain that a student should be able to perform after learning a given subject/course; the learning outcomes are measured using innovative assessment methods. The learning outcomes are written using the keywords (verbs) that describe various categories under each learning domain.

The learning domains in education include

- 1 Cognitive: mental skills (Knowledge)
- 2 Affective: growth in feelings or emotional areas (Attitude or self)
- 3 Psychomotor: manual or physical skills (Skills)

The writing of learning outcomes is guided by Bloom's taxonomy (Bloom & Krathwohl, 1956).

1. Cognitive Domain:

The cognitive domain involves knowledge and the development of intellectual skills. The cognitive domain has been categorised into **Knowledge, Understanding, Application, Analysis, Synthesis and Evaluation**.

These categories are explained with a simple illustration given here: a gas when compressed, the gas pressure and temperature may increase- is **knowledge**; why and under what conditions the gas temperature may increase is **understanding**; How to perform compression of gas is **application**; predicting or estimating the pressure and temperature rise of the gas under different operating conditions of compression machine is **analysis**; designing, building components and putting them together to get the gas compression machine is **synthesis**; and performing the gas compression process to know the pressure and temperature rise under different operating conditions of a gas compression machine is **evaluation**.

To describe the various categories under cognitive domain, Bloom's taxonomy is used. The bloom's taxonomy that are quite popularly used under each category are listed below and are explained with example.

Knowledge- arrange, define, **describe**, identify, know, label, list, match, name, outline, recall, recognize, reproduce, select, state

Example: **Describe** –gas compression process; here how the compression of gas happens with an increase in pressure and temperature of the gas is described (**What and how**)

Understanding- comprehend, convert, defend, distinguish, estimate, **explain**, extend, generalize, infer, interpret, paraphrase, predict, rewrite, summarize, translate

Example: **Explain** –temperature rise of a gas during compression; here the scientific reason for increase of temperature of air be explained (**why**)

Application- Apply, change, compute, construct, **demonstrate**, discover, manipulate, modify, operate, predict, prepare, produce, relate, show, solve, use

Example: **Demonstrate** a gas compression process

Analysis: analyse, break down, **compare**, contrast, deconstruct, differentiate, discriminate, distinguish, identify, illustrate, infer, outline, relate, select, and separate

Example: **Compare** temperature rise of a gas during an adiabatic compression process to that of polytropic compression

Synthesis/create: categorize, combine, compile, compose, create, devise, **design**, explain, generate, modify, organize, plan, rearrange, reconstruct, relate, reorganize, revise, rewrite, summarize

Example: **Design** a single stage compressor for compressing air

Evaluate: appraise, compare, conclude, contrast, criticize, critique, defend, describe, discriminate, evaluate, explain, **interpret**, justify, relate, summarize.

Example: **Interpret** the compressor characteristics that have been obtained by testing the compressor

The tutor is advised to use Bloom's taxonomy while writing the outcomes of a subject/module he/she would like to teach.

2. Affective Domain

The affective domain (Krathwohl, Bloom, Masia, 1973) in an educational literature include attitudes, motivation, communication styles, classroom management styles, learning styles, use of technology in the classroom and non-verbal communication. It is also important not to turn off students by subtle actions or communications that go straight into the affective domain and prevent students from becoming engaged.

The five major categories of affective domain are: **Receiving Phenomena, Responding to Phenomena, Valuing, Organization and Internalizing values.**

Receiving Phenomena is awareness and willingness to hear; the keywords are ask, choose, describe, follow, give, hold, identify, locate, name, point to, select, sit, erect, reply

Example: **Follow** every lecture with Care and Attention

Responding to Phenomena is willingness to respond, or satisfaction in responding (motivation); the keywords are answer, assist, aid, comply, conform, discuss, greet, help, label, perform, practice, present, read, recite, report, select, tell, write.

Example: **Present** the concept lucidly

Valuing is the worth or value a person attaches to a particular object, phenomenon, or behaviour. The keywords are: complete, demonstrate, differentiate, explain, follow, form, initiate, invite, join, justify, propose, read, report, select, share, study, work.

Example: **Differentiate** between good and popular lecture

Organization is organizing values into priorities by contrasting different values, resolving conflicts between them, and creating a unique value system. The emphasis is on comparing, relating, and synthesizing values. **The keywords are:** adhere, alter, arrange, combine, compare, complete, defend, explain, formulate, generalize, identify, integrate, modify, order, organize, prepare, relate, synthesize.

Example: **Adhere** to the project schedules and **defend** the costing

Internalizing values (characterization): Has a value system that controls their behaviour. The behaviour is pervasive, consistent, predictable, and most importantly, characteristic of the learner.

The key words are: act, discriminate, display, influence, listen, modify, perform, practice, propose, qualify, question, revise, serve, solve, verify.

Example: **Displays** a professional commitment to ethical **Practice** on a daily basis

3. Psychomotor Domain

The psychomotor domain (Simpson, 1972) includes physical movement, coordination, and use of the motor-skill areas. Development of these skills requires practice and is measured in terms of speed, precision, distance, procedures, or techniques in execution. The seven major psychomotor categories are: **perception (awareness), set, guided response, mechanism (basic proficiency), complex overt response (Expert), adaptation and origination.**

Perception (awareness): The ability to use sensory cues to guide motor activity. The keywords are: choose, describe, detect, differentiate, distinguish, identify, isolate, relate, select.

Example: **Identify** the parts of an Engine, **Detect** current flow in a given wire, **choose** the material for handle of a rice cooker

Set: Readiness to act. It includes mental, physical, and emotional sets. These three sets are dispositions that predetermine a person's response to different situations. The keywords are begin, display, explain, move, proceed, react, show, state, volunteer.

Example: **Explain** the working of a CNC Lathe, **Move** the material for melting casting

Guided Response: The early stages in learning a complex skill that includes imitation and trial and error. Adequacy of performance is achieved by practicing. The Key Words are copy, trace, follow, react, reproduce, respond.

Example: **Follow** instructions to build a model

Mechanism (basic proficiency): This is the intermediate stage in learning a complex skill. Learned responses have become habitual and the movements can be performed with some confidence and proficiency. The key words are **assemble, calibrate**, construct, dismantle, display, fasten, fix, grind, heat, manipulate, measure, mend, mix, organize, sketch

Example: **Calibrate** an Instrument; **assemble** a gear box

Complex Overt Response (Expert): The skilful performance of motor acts that involve complex movement patterns. Proficiency is indicated by a quick, accurate, and highly coordinated performance, requiring a minimum of energy. This category includes performing without hesitation, and automatic performance. The keywords are: **assemble**, builds, **calibrate**, construct, dismantle, display, fasten, fixe, grind, heat, manipulate, measure, mend, mix, organize, sketch.

Example: **Calibrate** an Instrument accurately; **assemble** a gear box quickly

Adaptation: Skills are well developed and the individual can modify movement patterns to fit special requirements. The keywords are: adapt, alter, **change**, rearrange, reorganize, revise, and vary.

Example: **Change** the instruction to the Robot Manipulator for gripping different Jobs

Origination: Creating new movement patterns to fit a particular situation or specific problem. Learning outcomes emphasize creativity based upon highly developed skills. The keywords are arrange, build, combine, compose, construct, create, design, initiate, make, originate.

Example: **Create** a new robot gripper

4. Summary:

Learning Domains	Categories					
Cognitive: mental skills	Knowledge	Understanding	Application	Analysis	Synthesis	Evaluation
	Critical, Analytical, Problem Solving , Innovative Skills					
	Sample keywords to be used while writing outcomes					
	arrange, define, describe , identify, know, label, list, match, name, outline, recall, recognize, reproduce, select, state	comprehend, convert, defend, distinguish, estimate, explain , extend, generalize, infer, interpret, paraphrase, predict, rewrite, summarize, translate	Apply, change, compute, construct, demonstrate , discover, manipulate, modify, operate, predict, prepare, produce, relate, show, solve, use	analyse, break down, compare , contrast, deconstruct, differentiate, discriminate, distinguish, identify, illustrate, infer, outline, relate, select, and separate	categorize, combine, compile, compose, create, devise, design , explain, generate, modify, organize, plan, rearrange, reconstruct, relate, reorganize, revise, rewrite, summarize	Appraise, compare, conclude, contrast, criticize, critique, defend, describe, discriminate, evaluate, explain, interpret , justify, relate, summarize.
Affective: growth in feelings or emotional areas (Attitude or self)	Categories					
	Receiving Phenomena	Responding to Phenomena	Valuing	Organization	Internalizing values	
	Transferable/Capability skills					
	Sample Keywords to be used while writing outcomes					
	asks, chooses, describes, follows , gives, holds, identifies, locates, names, points to, selects, sits, erects, replies	answers, assists, aids, complies, conforms, discusses , greets, helps, labels, performs, practices, presents, reads, recites, reports, selects, tells, writes.	completes, demonstrates, differentiates , explains, follows, forms, initiates, invites, joins, justifies , proposes, reads, reports, selects, shares, studies, works.	Adheres, alters, arranges, combines, compares, completes, defends, explains, formulates, generalizes, identifies, integrates, modifies, orders, organizes, prepares, relates, synthesizes.	Acts, discriminates, displays , influences, listens, modifies, performs, practices , qualifies, proposes, qualifies, questions, revises, serves, solves, verifies.	

Psychomotor: manual or physical skills (Skills)	Categories						
	Perception (awareness)	Set	Guided Response	Mechanism (basic proficiency):	Complex Overt Response (Expert)	Adaptation	Origination
	Practical Skills						
	Sample Key words to be used while writing outcomes						
	chooses, describes, detects, differentiates, distinguishes, identifies, isolates, relates, selects	Begins, displays, explains, moves, proceeds, and reacts, shows, states, volunteers.	copies, traces, follows, react, reproduce, responds	assembles, calibrates, constructs, dismantles, displays, fastens, fixes, grinds, heats, manipulates, measures, mends, mixes, organizes, sketches	assembles, builds, calibrates, constructs, dismantles, displays, fastens, fixes, grinds, heats, manipulates, measures, mends, mixes, organizes, sketches	adapts, alters, changes, rearranges, reorganizes, revises, and varies	arranges, builds, combines, composes, constructs, creates, designs, initiate, makes, originates

5. Learning or Instructional Strategies

Learning strategies are used by students to help them understand information and solve problems. Learning or instructional strategy focuses on making the students more active learners by teaching them how to learn and how to use what they have learned to solve problems and be successful.

The Instructional Strategy Selection Chart shown below is a general guideline for selecting the learning strategy. It is based on Bloom's Taxonomy (Learning Domains). The matrix generally runs from the passive learning methods (top rows) to the more active participation methods (bottom rows). Bloom's Taxonomy runs from top to bottom, with the lower level behaviours being on top and the higher behaviours being on the bottom.

Instructional Strategy	Cognitive Domain (Bloom, 1956)	Affective Domain (Krathwohl, Bloom, & Masia, 1973)	Psychomotor Domain (Simpson, 1972)
Lecture, reading, audio/visual, demonstration, or guided observations, question and answer period	Knowledge	Receiving phenomena	Perception Set
Discussions, multimedia CBT, Socratic didactic method, reflection. Activities such as surveys, role playing, case studies, fishbowls, etc.	Understanding Application	Responding to phenomena	Guided response Mechanism
On-the-Job-Training (OJT), practice by doing (some direction or coaching is required), simulated job settings (to include CBT simulations)	Analysis	Valuing	Complex response
Use in real situations. Also may be trained by using several high level activities coupled with OJT.	Synthesis	Organize values into priorities	Adaptation
Normally developed on own (informal learning) through self-study or learning through mistakes, but mentoring and coaching can speed the process.	Evaluation	Internalizing values	Origination

6. Media, Strategies, and Methods

Media, strategies, and methods are the various tools that not only deliver the instruction, but also foster the acquisition of performance.

Media

Media in learning and training environment, is the means of communicating and transferring a learning concept or objective to another individual. The various media are classrooms, Distance Learning, eLearning, Lecture, mLearning, On-The-Job-Training, Performance Aids, Social Learning & Social Media, and Video

Methods

Learning methods are the conditions which can be implemented to foster the acquisition of competence. The various learning methods are Action Learning, Boot Camp, Coaching, Fishbowls, Lockstep, Mentoring, Personalized System of Instruction, Programmed Learning, 70-20-10 Learning and Training Model

Strategies

Learning strategies basically encompass the entire spectrum of learning environment, to include processes, such as media, methods, technologies, and styles. The strategies are: Active Learning, Blended Learning, Just in Time Learning, Learners' Framework, and Formal and Informal Learning.

For details visit: <http://www.nwlink.com/~donclark/hrd/bloom.html>

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