



# ***OUTCOME-BASED CURRICULUM DESIGN***

Centre for Educational Technology  
Indian Institute of Technology Kharagpur

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# Tomorrow's World of Education

## Outcome-based Learning

- *At the end of a four year program of study, graduates need to demonstrate the mastery of not only a well chosen set of domain specific learning objectives, but also a set of domain independent learning outcomes*

# *The Challenge*

- ① *How to ensure mastery over not only the domain knowledge but also over the knowledge, skills and attitudes needed for the 21<sup>st</sup> century*

*Learning Outcomes*  
*[Washington Accord—Graduate\_Profiles]*

*Knowledge and skills for the 21<sup>st</sup> century*

**1. Academic Education**

*Completion of an accredited programme of study typified by four years or more of post-secondary study*

**2. Knowledge of Engineering Sciences**

*Apply knowledge of **mathematics**, **science**, **engineering** fundamentals and an **engineering** specialization to the **conceptualization of engineering models***

### **3. Design / development of solutions**

*Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.*

### **4. Investigation**

*Conduct investigations of complex problems including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.*

## **5. Modern Tool Usage**

*Create, select and apply appropriate techniques, resource, and modern engineering tools including prediction and modeling, to **complex engineering activities**, with an understanding of the limitations.*

## **6. Individual and Team work**

*Function effectively as an individual and as a member or leader in diverse teams and in multi-disciplinary settings*

## **7. Communication**

*Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation make effective presentations, and give and receive clear instructions.*

## **8. The Engineer and Society**

*Demonstrate understanding of the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to engineering practice.*

## **9. Ethics**

*Understand and commit to professional ethics and responsibilities and norms of engineering practice.*

## **10. Environment and Sustainability**

*Understand the impact of engineering solutions in a societal context and demonstrate knowledge of and need for sustainable development*



## **11. Project Management and Finance**

*Demonstrate a knowledge and understanding of management and business practices, such as risk and change management, and understand their limitations*

## **12. Life Long Learning**

*Recognize the need for, and have the ability to engage in independent and life-long learning*

## ***Modern Approach to Curriculum Design***

- ❑ ***Select course objectives which promote higher order thinking skills such as Analysis, Synthesis, Evaluation and Creativity***
- ❑ ***Express the objectives as knowledge, skills and attitudes which the students should be able to demonstrate on successful completion of the course, using measurable Action Verbs.***
- ❑ ***Take advantage of ICT tools to make these available to everyone concerned well in advance.***

*DOMAINS OF  
LEARNING  
&  
INSTRUCTIONAL  
OBJECTIVES*

A group of college and university professors led by Benjamin S Bloom published a handbook in 1956 called

*Taxonomy of Educational Objectives –  
The classification of Educational Goals*

Bloom's Taxonomy is used extensively for planning of teaching / learning activities

# *Domains of Learning*

*Benjamin* Bloom asserted that all learning can broadly be classified into one of the following three domains :

- ❑ **COGNITIVE DOMAIN** : → **Involves Thinking**
- ❑ **PSYCHOMOTOR DOMAIN** : → **Involves Action**
- ❑ **AFFECTIVE DOMAIN** : → **Involves Feelings / Attitudes**

## **Sub classification of learning domains**

- **Each domain of learning has 5 or 6 levels**
- **The lowest level needs to be learnt before learning the next higher level**
- **Achievement at a higher level implies achievement at all lower levels**
- **Most levels are divided into multiple categories**

# *Cognitive Domain*

## *Thinking skills*

- ❑ The domain most involved in higher education.
- ❑ Includes all learning that deal with - recall / recognition / development of intellectual abilities & skills
- ❑ Six major categories / levels- Starting from **Knowledge / Recall (lowest)** ending in **Evaluation / Creation (highest)**

# *Cognitive Domain*

## *Sub classification into levels*

Highest level

EVALUATION

SYNTHESIS

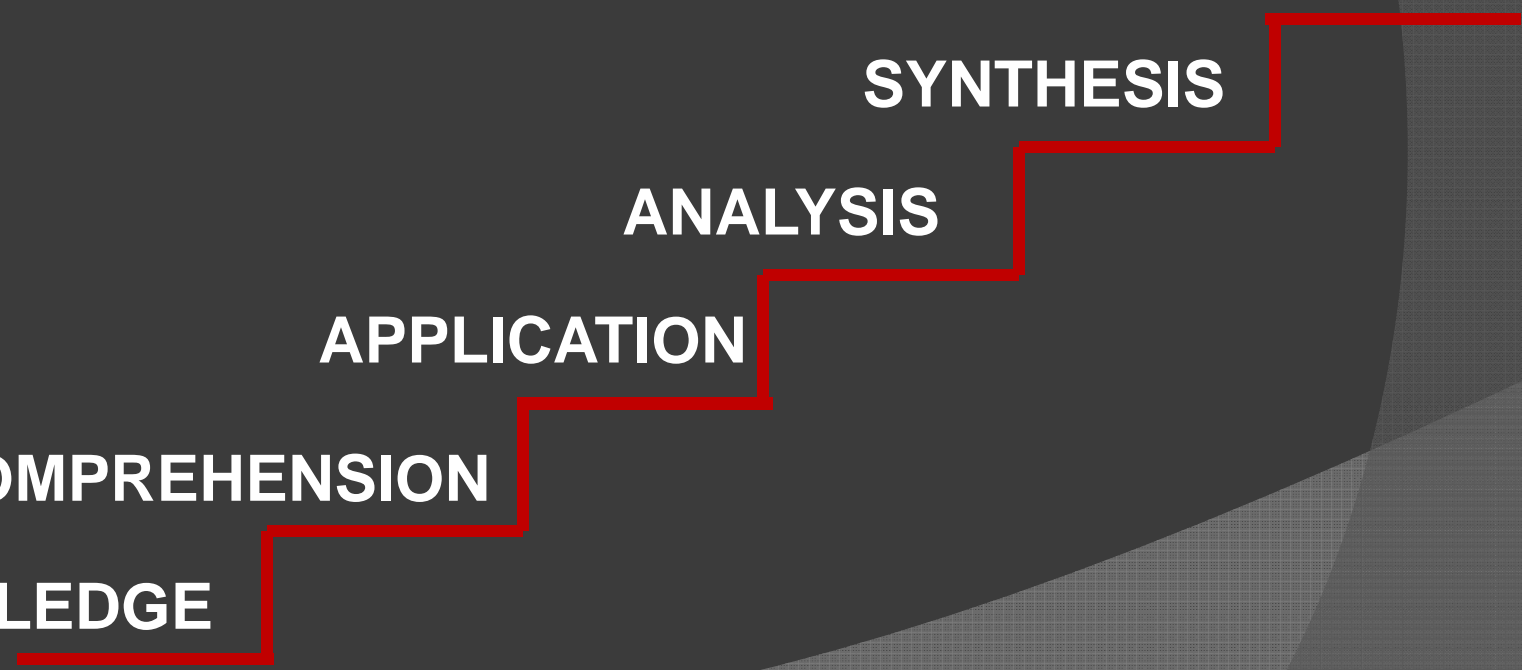
ANALYSIS

APPLICATION

COMPREHENSION

KNOWLEDGE

Lowest level






# *Psychomotor Domain*

## *Action*

- Includes physical movement, coordination, and use of the motor-skill areas.

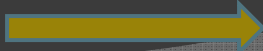
- Requires practice

- ✓ **Naturalization**  Highest level

- ✓ **Articulation**


- ✓ **Precision**

- ✓ **Manipulation**

- ✓ **Imitation**  Lowest level

# *Affective Domain*

## *Feelings / Attitudes*

- **Characterizing**  **Highest level**
- **Organizing**
- **Valuing**
- **Responding**
- **Receiving**  **Lowest level**

# Cognitive Domain

## 1. Knowledge:

Recall of data. Remembering previously learned material [as defined by Bloom]

## 2. Comprehension:

Ability to grasp meaning of material.

## 3. Application:

Use a concept in a new situation

## 4. Analysis:

Ability to break down material into its component parts so that its organizational structure may be understood

## **5. Synthesis:**

Ability to build a structure or pattern from diverse elements.

Put parts together to form a whole, with emphasis on creating a new meaning or structure.

## **6. Evaluation:**

Make judgments about the value of ideas or materials

# *Types of Knowledge*

## **Knowledge of Terminology**

Define technical terms / range of meanings of words (as in dictionary) / terms & concepts in science

## **Knowledge of “Specific Facts”**

About Cultures / organisms / major natural resources / properties of elements & compounds / data

## **Knowledge of Conventions**

Conventional symbols used in the domain area / rules of social behaviour / forms in scientific papers / rules of circuit drawing / protocols / standards

## **Knowledge of trends & sequences**

Trends in data compression, sequence of a given process or operation

## **Knowledge of classifications & categories**

Types of semiconductor devices, EM wave range names

Please name some more

## **Knowledge of criteria**

Please name some

## **Knowledge of Methodology**

Methods of inquiry / techniques / procedures

## **Knowledge of Principles & Generalizations**

Recall of principles (in learning / biology etc...)

## **Knowledge of Theories & Structures**

Recalling major theories in any area  
(civilization / science etc)

# *Types of Comprehension*

## **Translation**

- Into other language
- Into other forms of communication (data to graph)
- state in own words / explain

## **Summarization**

Generalization

## **Extrapolation**

- Making predictions – based on understanding of trends / consequences of actions described in a communication



# *Types of Application*

- Be able to apply principles , concepts, methods, techniques , procedures , theories , information etc. learnt under knowledge and comprehension categories earlier in a new situation

# *Types of Analysis*

*(Fuzzy line between Comprehension on  
and Evaluation)*

## **Analysis of Elements**

- Recognizing
- Hypothesis
- Conclusions from statements,
- Unstated assumptions
- Statement of facts, values etc...

## **Analysis of Relationships**

- ❑ Comprehending inter-relationships between ideas
- ❑ Distinguish cause-effect relationship
- ❑ Detect logical fallacies
- ❑ Check consistency of hypothesis with given information

## **Analysis of Organizational Principles**

- Arrangement / structure / form / pattern
- Ability to infer author's point-of-view

## Types of Synthesis

- Drawing elements from many sources & putting them together into a new structure
- Production of a unique communication (allowing different solutions by different people)
- Creative writing (within set limits)/ extempore
- Skill in writing – through using organization of ideas & statements
- Produce a plan or proposed set of operations
- Propose ways of testing hypothesis / modifying hypothesis
- Integrate results of an investigation into an effective plan for problem solving
- Design tools to perform specific operations / design building

# Instructional Objectives

A statement of something which is **SPECIFIC, MEASURABLE, ACHIEVABLE** that students should be able to **DO** after receiving instruction if it

*Three Important features of a well-written Instructional Objective*

- A. The performance component
- B. The condition component
- C. The criterion component

# The performance component

**Performance** describes what the learner is expected to be able to **DO** to demonstrate his mastery over the content. It is the “**main intent**” of the objective directly.

Performance may be “overt” → where it can be readily seen / heard (dance / draft a report).

Performance may be “covert” → It is not a visible performance

*Such performances often describe something a learner can “BE” instead of something a learner can “DO”.*

## The condition component

**All conditions** – that make a significant difference to the nature of the performance” should be stated

Describes **actual conditions** under which the task will occur or be observed.

Also identifies :

**Tools, procedures, materials, aids, or facilities** to be used in performing the task. (“without reference to a manual” or “by checking a chart”.)

**Audience - target of objective, and learner's characteristics**

(Given a list of chemical elements be able to write valences of each)

## The Criterion component

help to gauge quality of performance

- A **standard** against which to judge success of instruction **Students will know** if they have met / exceeded expectations
- A “**criteria of acceptable performance**” **increases the communicating power of objectives**
- This component tells the learner – **How often / how well / how much / how will we know it is OK? His performance – to be considered competent**
- Only those criteria should be used that are “**important / indispensable**” in evaluating the performance



➤ **Course description:** tells you something about the content & general aims of a course.

➤ **Syllabus:** provides a “Topic List”.

### Disadvantages

❑ Students cannot make out from it the depth / breadth of coverage of the topics

❑ The depth / breadth of coverage often varies from teacher to teacher

❑ Syllabus does not provide external examiner with the depth / breadth of coverage

➤ **Course Objective:** describes the “desired outcome” of a course

## Examples of learning objectives :

*A. Write a customer reply letter with no spelling mistakes by using a word processor.*

- ❖ **Observable Action:** write a customer reply letter
- ❖ **Measurable Criteria:** with no spelling mistakes
- ❖ **Conditions of Performance:** using a word processor

*B. Copy a table from a spreadsheet into a word processor document within 3 minutes without reference to the manual.*

- ❖ **Observable Action:** Copy a table from a spreadsheet into a word processor document
- ❖ **Measurable Criteria:** within 3 minutes
- ❖ **Conditions of Performance:** without referencing the manual.

# Basic Characteristics Of Instructional Objectives :

**Action Oriented Statements** – describing what is to be achieved by the learner.:

# **Related to “intended Learning Outcomes” -NOT - the process for achieving those outcomes (bread & baking)**

# **Specific, measurable and Achievable** – NOT – broad and intangible (understand algebra / know your enemy / be able to internalize a sense of confidence)

# **Concerned with the “learner”** – rather – than the “teacher” (Lecture on the theory of Relativity / Arrange field trips)

## Instructional Objectives & ACTION VERBS

- Instructional objectives should not be formulated with **vague statements** like “the student would understand / appreciate” etc
- Instructional objectives are to be formulated with the help of “**Action verbs**”
- Action Verbs indicate what the student **will be able to actively do**, like – “identify”, “assess”, “list”, “solve”, “analyse”, “design”, “compare”, etc.

## Examples: Use of inappropriate verbs

1. Student will **know** Newton's Laws of Motion
2. The teacher will **tell** why..... Or how.....
3. Using the given data in table 1 **show** .....
4. **Feel** a strong commitment to professional ethics
5. Student will **understand** how to operate a ..... machine to .....
6. Student will **appreciate** the concepts of sustainable development to engineering design
7. The teacher will **teach** the perspective view of .....using .....
8. **Learn** the best design for a given application

# Need for Instructional Objectives

**In Design :** Brings focus, objectivity to instruction –

- ❑ It provides the **teacher** - with clear focus on:-
  - what he needs to teach & the **depth** of his teaching
  - **how** to teach it
  - how he has to **evaluate** what he taught
- ❑ It provides the **student** with a clear understanding of what he is **expected to learn and what he will be tested on**
- ❑ It provides the **future employer** of such students with clear idea of exactly what the student has learned from the course.

## In Planning :

- It guides selection of “**proper tools**” for the instruction ( example of surgeons).
- **Mode of teaching** (lecture / demonstration / hands-on exercises / problem solving) will depend on “what the learner needs to achieve” after the instruction
- It allows **instructor ingenuity**. Once objectives are fixed, instructor is free to attain the goal in his own way
- It allows **consistent results** from learners – across instructors – across years

## In Evaluation :

- ❖ It calls for “**measurable results**” in tests – making tests very focused and uniform
- ❖ It allows “**goal posts**” for students. They know exactly what they will be tested on and do not have to second guess instructors regarding test questions
- ❖ It provides **benchmark** to determine whether the main intent has been achieved
- ❖ It provides **criteria to judge** whether learners are competent enough in a particular area



## COURSE OBJECTIVES- SAMPLES

### INTRODUCTION TO ALGORITHM DESIGN

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1. Given an English language problem description, **define** the problem precisely with input/output requirements, **examine** its inherent complexity and **develop** a generic or set of initial solutions (**which can be explored for various design options**) and **justify** their correctness