OUTCOME-BASED CURRICULUM DESIGN

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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

- How to ensure mastery over not only the domain knowledge but also over the knowledge, skills and attitudes needed for the 21st century
Learning Outcomes
[Washington Accord—Graduate_Profiles]

Knowledge and skills for the 21st 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.
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  Lowest level
  - ✓ Imitation
Affective Domain
Feelings / Attitudes

- Characterizing
- Organizing
- Valuing
- Responding
- Receiving

Highest level
Lowest level
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)
TheCriterion 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 “criterion 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 criterion 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.
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.