

Teaching and Learning Models for Science & Technical Education

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- ▶ **FDP Objective:** Provide inputs on process and practice of Personal development development, communication and inter-personal skills, creativity, problem solving, achievement motivation training, inputs on resource and knowledge.
- ▶ **Training methodology:** Includes case studies, group discussion, simulation exercise, field visits and classroom lectures.

Goals of this Presentation

- ▶ To introduce with effective approaches to teaching and also help teachers to identify their own strengths and areas for improvement.
- ▶ To introduce with teaching methodologies in Engineering and science education.
- ▶ Improving one's classroom delivery both as a teacher and trainer.

Teaching and Learning Approaches

Inductive v/s Deductive:

- ▶ The “best” method of teaching at UG is **induction**, whether it be called problem-based learning, discovery learning, or inquiry learning.

Examples: We note doubling the voltage across a resistance, the current also doubles : is inductive learning / teaching.

- ▶ Traditional college teaching method is **deduction**: “basic principles” → “applications”.

Example: Principle - flow of charge carrier is proportional to the potential difference. We learn: for V as 100 volts, if I is 5 *Amp*, then if V is 200 Volts, I will be 10*Amp*.

- ▶ Challenge with inductive presentation:

It is not concise and prescriptive - you have to take an appropriate example or a collection of observations or data, and try to make sense of it.

- ▶ Many students would say that they prefer deductive presentation

Change of the visual/Auditory dimension to the visual/verbal dimension

- ▶ “Visual” information clearly includes Pictures, diagrams, charts, plots, animations, etc.,
- ▶ “auditory” information clearly includes spoken words and other sounds.
- ▶ Written Prose: information transmission that is not clear.
- ▶ The written text is perceived visually, and, **cannot be categorized as auditory !!**
- ▶ Cognitive scientists have established that our brains generally convert written words into their spoken equivalents
- ▶ To a **visual learner**, a picture is truly worth a thousand words,
- ▶ Making the learning style pair the **visual + verbal**, solves the problem

Students “learn” in many ways, by

- ▶ seeing and hearing
- ▶ reflecting (passive) and acting
- ▶ reasoning logically and intuitively
- ▶ memorizing, visualizing, drawing, analogies, and building mathematical models

“Teaching” methods also vary:

- ▶ Some instructors lecture
 - ▶ others demonstrate or discuss
 - ▶ some focus on principles and others on applications
 - ▶ some emphasize memory and others understanding.
- ▶ How much a particular student learns in a class is: governed in part by that student’s native ability and prior preparation, and also by the compatibility of his or her learning style and the instructor’s teaching style.

- ▶ **Mismatches exist** between common learning styles of engineering students and “traditional” teaching styles of engineering professors. In consequence, students become bored and inattentive in class, do poorly on tests,
- ▶ **Professors, confronted by low test grades**, unresponsive or hostile classes, poor attendance and dropouts, **think something is not working**;

We will explore:

1. Which aspects of learning style are particularly significant
2. Which learning styles are preferred by most students ?
3. What can be done?

Dimensions of Learning Style

- ▶ Learning in a structured educational setting is a two-step process:
 1. Reception, 2. Processing of information (learning).
- ▶ A learning-style model classifies students according to where they fit on a number of scales pertaining to the ways they receive and process information.

Models of Learning

Learning style is defined by answers to five questions:

1. Type of information a student prefer to perceive: **sensory** - sights, sounds, physical sensations, or **intuitive**
2. Channel from it is effectively perceived : **visual** - pictures, diagrams, graphs, demonstrations, or **auditory** - words, sounds
3. With what “information organization” one is comfortable : facts and observations are given, principles are inferred
4. Way he/she prefer to process the information : **actively** - through engagement in physical activity or discussion, or **reflectively (passively)** - through introspection
5. Progress toward understanding is effective : **sequentially** - in continual steps, or **globally** - in large jumps, holistically

Teaching style is defined in terms of answers to five questions:

1. What type of information is emphasized by instructor?
concrete - factual, or **abstract** - conceptual, theoretical.
 2. What is mode of presentation?
visual - pictures, diagrams, films, demonstrations, or **verbal** - lectures, readings, discussions.
 3. What is Organization of presentation?
inductively - phenomena leading to principles, or **deductively** - principles leading to phenomena?
 4. What is presentation induced student participation?
active - students talk, move, reflect, or **passive** - students watch and listen.
 5. What type of perspective is used in the presentation?
sequential - step-by-step progression (the trees), or **global** - context and relevance
- Thus, teaching styles are:
concrete, . . . , global

The hypothesis: Engineering instructors who adapt their teaching style to include both poles of each teaching style are popular teachers !

1. **Visual and Auditory Learners:** As the name suggests.

A study carried out by the Socony-Vacuum Oil Company:

- ▶ students retain 10 percent of what they read,
- ▶ 26 percent of what they hear,
- ▶ 30 percent of what they see,
- ▶ 50 percent of what they see and hear,
- ▶ 70 percent of what they say (table learning), and
- ▶ 90 percent of what they say as they do something.

Resources for teachers learning and preparation of class notes

- ▶ Text books (prescribed by RTU)
- ▶ From mentors
- ▶ Internet (WWW)
 1. OCW MIT
 2. Wikipedia
 3. pdf lectures notes of other professors
 4. pdf exercises by other professors
 5. Taking online courses:
 - ▶ <https://www.edx.org/> (EdX offers free online courses and classes. Find the latest MOOC from the world's best universities including MIT, Harvard, Berkeley, UT and others. Topics ...)
 - ▶ <https://www.coursera.org/> (Take free online classes from 140+ top universities and educational organizations. We partner with schools like Stanford, Yale, Princeton, and others to offer.)

Preparation of lecture notes & Delivery

- ▶ First time prepare on A4 plain paper sheets, onside only, with margin in all four sides for updates
- ▶ Add lot of exercises after each topic is complete, both memory-based as well practice, and some skill of reasoning
- ▶ Give a brief introduction before each topic starts and summary after it finishes
- ▶ Refer to many books, websites, wiki, etc. for preparation of notes
- ▶ Every thing which is written in notes, should be understand fully
- ▶ For each lecture, take a brief note of notes to refer during the course of lecture delivery. This brief note can be maximum of one-page, manly with points and exercises.

Delivery of lecture

- ▶ you should appear cheerful and energetic, because, your pattern will be followed by students while learning
- ▶ In the begin of lecture, spend 2-5 minutes to connect what you have taught in the previous class
- ▶ Next, spend about 2-3 minutes about what you (students) are going to study in today's class
- ▶ Do not dictate in the class
- ▶ make use of black board enough
- ▶ Do not face towards the black board only for a long time (i.e., your back towards the students)
- ▶ Make use of English communications as far as possible.
- ▶ Keep small sense of humor (if possible) to reduce the monotonousness.
- ▶ To test how much the students have learned, ask occasionally some questions to the students

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