

Teaching and Learning Models for Electronics and Communications Engineering

Dr. K.R. Chowdhary, Professor
Director, JIETSETG

JIET School of Engineering & Technology for Girls (JIETSETG)

Email: kr.chowdhary@jietjodhpur.ac.in

Web-Page: <http://www.krchowdhary.com>

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Teaching/Learning Approaches

Inductive v/s deductive:

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

Example: double the voltage across a resistance, the current also doubles : is inductive

- Traditional college teaching method is **deduction**, starting with “fundamentals” and proceeding to applications

Example: the flow of charge carrier is proportional to the potential difference, and charge carrier flow rate is current: ($\therefore I \propto V$,) is deduction.

- Problem 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 or most 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.
- Information transmission that is not clear ? (written prose).
- The written text is perceived visually. Hence, **but neither perfectly visual or 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, and to **verbal learner** word are important
- Making the learning style pair the **visual** and **verbal** solves this

Students learn in many ways - by

- seeing and hearing;
- reflecting and acting;
- reasoning logically and intuitively;
- memorizing and visualizing and 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 given student learns in a class is governed in part by that student's native ability and prior preparation but 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.

Learning style is defined by answers to five questions:

- 1 What Type of information does a student prefer to perceive? **sensory** - sights, sounds, physical sensations, or **intuitive**
- 2 Through what Channel it is effectively perceived ? **visual** - pictures, diagrams, graphs, demonstrations, or **auditory** - words, sounds
- 3 With what type of "information organization" he/she is comfortable ? facts and observations are given, principles are inferred

inductive, or principles are given, consequences and applications are inferred **deductive**

- 4 In what way he/she prefer to process the information ? **actively** - through engagement in physical activity (reflect on actions) or discussion, or **passively** - through introspection
- 5 What is 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

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

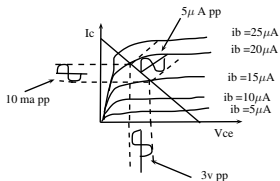
- 1 The usual methods of engineering education adequately address five categories (intuitive, auditory, deductive, reflective, and sequential),
- 2 **Visual and Auditory Learners:** As the name suggests.

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**, and
- **90 percent** of what they **say as they do something**.

Some examples of Teaching:

- 1 **Concrete:** Telling facts, data, doing experiments. And, conclude that transistors are current amplifiers.



- 2 **Abstract:** h-parameters model of transistor; for a $R - C$ circuit the voltage across capacitor is $V_o = V_i(1 - e^{-\frac{t}{RC}})$
- 3 **Visual:** drawing a flow-chart for some thing, explaining

through diagrams, showing a video of assembling of computer hardware.

- 4 **Verbal/auditory:** the standard way of lecturing, and most common, (but not correct!)
- 5 **Inductive:** Use observable phenomena to explain: e.g., when light falls on the surface of green color material, we see the green color because it reflects back only the green spectrum, and rest is absorbed. Here we observed **phenomena**, and inferred **principle**.

Examples of Teaching ...

- 6 **Deduction:** Theorem proving steps, program steps, calculation steps, programs, are all deductions.
- 7 **Active: Doing** experiment “common-emitter characteristics of transistor amplifier”, and learning by identifying in the graph plotted, the cut-off, active, and saturation regions, is active learning. Also, asking a question during the class teaching, like, “what is

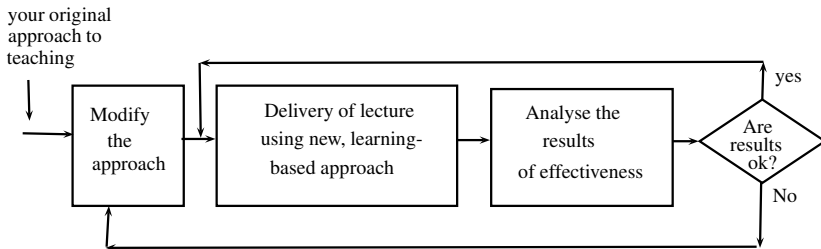
medium-wave frequency band”? And, then let the students of each bench discuss about the answer among themselves, is also active learning. **Do** → **what** → **why**.

- 8 **Passive:** The regular class teaching is passive. The students **reason** about what the teacher told, and each absorb the material in their **own way**.

- 9 **Sequential:** The lecture topic when presented in logically ordered progression, i.e., next topic or discussion requires the understanding of previous, leads to sequential learning. It is common and results to make good engineers.
- 10 **Global:** When a problem is assigned to students, for which they spend time in days

or weeks, and then discover a solution in full-form, as partial solution has no meaning, like in chess game, sudoku, puzzle solving. These are examples of teaching using global method and correspondingly, the learning acquired is also called global. The *global teaching and learning makes great theoreticians and researchers !!*

Practice, Practice, Practice !!



Testing of results: through tests, quizzes, open book exams, assignments, surprise tests.