

Innovative Methods for Teaching of Electrical Engineering Courses

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July 15, 2014

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.

Examples: 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, **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** 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.

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 **inductive**, or principles are given, consequences and applications are inferred **deductive**
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
6. 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, and
- ▶ 90 percent of what they say as they do something.

Examples of Teaching methods:

1. **Concrete:** Telling facts, data, doing experiments: examples
→ parameters values of transistors, transistors are current amplifiers, performing an experiment to obtain I_C v/s V_{CE} characteristics.
2. **Abstract:**

$$v_{BN} = v_{CN} = V_m \sin \alpha t; \quad V_m = \text{Max. Phase Voltage}$$

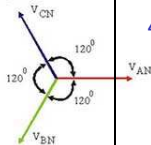
$$v_{BN} = v_{CN} = V_m \sin \left(\alpha t - \frac{2\pi}{3} \right)$$

$$v_{BN} = v_{CN} = V_m \sin \left(\alpha t - 120^\circ \right)$$

$$v_{BN} = v_{CN} = V_m \sin \left(\alpha t + \frac{2\pi}{3} \right)$$

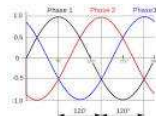
$$v_{BN} = v_{CN} = V_m \sin \left(\alpha t + 120^\circ \right)$$

$$v_{BN} = v_{CN} = V_m \sin \left(\alpha t - 240^\circ \right)$$



Vector diagram of 3-phase supply voltages

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

Examples of Teaching methods ...

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 the phenomena, and inferred the principle.
6. **Deduction:** The black-holes in the universe, have so high gravitational field that even light also will not reflect back once it has fallen on a black-hole. Hence, we deduce that black-holes cannot be seen by any mechanism !!
7. **Active:** Doing experiment

“Finding out the Iron and Copper Losses of Transformer”, and learning by identifying in the graph plotted, is active learning. Also, asking a question during the class teaching, like, “Why copper losses increase with load”? And, then let the students of each bench discuss about the answer among themselves, is also active learning.

8. **Passive:** The regular class teaching is passive, otherwise. 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 !!

1. Email, groups
2. Presentation: through PP, Beamer (Linux), Moodle
3. Web-conferencing: DimDim, WebEx, CourseLab
4. DimDim:
 - ▶ DimDim Provides free web conferencing service where users could share desktops, show slides, collaborate, chat, talk and broadcast via webcam.
 - ▶ Dimdim can be integrated with the e-learning platforms Moodle, Claroline
5. Moodle
 - ▶ Moodle (acronym for Modular Object-Oriented

Dynamic Learning Environment) is a free software e-learning platform, also known as a Learning Management System, or Virtual Learning Environment (VLE).

- ▶ As of June 2013 it had a user base of 83,008 registered and verified sites, serving 70,696,570 users in 7.5+ million courses with 1.2+ million teachers.
- ▶ Moodle was developed to help educators create online courses with a focus on interaction and collaborative construction of content, and is in continuous evolution.

6. CourseLab

- ▶ CourseLab is a powerful, yet easy-to-use, e-Learning authoring tool that offers a programming-free WYSIWYG environment for creating high-quality interactive e-Learning content that can be published on the Internet, and Learning Management Systems (LMS).
- ▶ CourseLab is available as a commercial product (version 2.7) and as freeware (version 2.4). Refer <http://courselab.com/en>.

[courselab.com/samples/
Electro/8/start.html](http://courselab.com/samples/Electro/8/start.html)

7. Claroline: Claroline is a collaborative eLearning and eWorking platform under the GPL Open Source license. It allows hundreds of organizations worldwide ranging from universities to schools and from companies to associations to create and administer courses and collaboration spaces over the web. The platform is used in more than 100 countries and is available in 35 languages.