

Innovative Methods for Teaching Science to UG Engineering

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Students learn in many ways - by

- ▶ seeing and hearing;
- ▶ active and passive;
- ▶ 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. Type of “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
2. **Abstract:** (i.e. mathematical models)

$$f = am$$

$$v = ut + \frac{1}{2}at^2, v^2 - u^2 = 2as$$

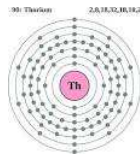
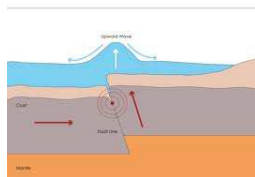
$$y = ax + b$$

$$x + y + z = 10, x - y - z = 20,$$

$$2x + y - 5z = 30$$

$$\frac{dy}{dx} = ax^2$$

3. **Visual:** drawing a flow-chart for some thing, explaining through diagrams, showing a video of some process/phenomena.



4. **Verbal/auditory:** the standard way of lecturing
5. **Inductive:** Use observable phenomena to explain: Why?



6. **Deduction:** Deduction in maths, and others.
7. **Active:** Doing experiment, learning by identifying in the graph plotted, is active learning. Also, asking a question during the class teaching, like, "Why"? 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. 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



Modern Tools for Management

- ▶ Documentation (open office)
-libre office
 - ▶ Data analysis (open sheet)
 - ▶ Presentation
 - ▶ Desktop publishing: Scribus
 - ▶ Accounting (TurboCASH)
 - ▶ Planning
 - ▶ Diagram creation: Dia
 - ▶ Market Analysis
 - ▶ Backup & recovery
- ▶ Calendar
 - ▶ Collaboration & Document sharing
 - ▶ Email (thunderbird)
 - ▶ Project management (OpenProj)
 - ▶ Customer & cust-relationships: SugarCRM
 - ▶ Invoicing: Simple Invoices

Think over ...

1. In a moving car in rainy season, the inner surface of windshield gets fogged. Why?
2. The orbits of electrons in an atom are titled as K, L, M, N, ... Why not a, b, c, d... ?
3. How do planes take-off and land in shorter run-ways of aircraft carriers?
4. Is there any possibility of using magnetic lines of force of earth, to produce electricity, using magnetic induction?
5. How scientists find out that universe is expanding?
6. Why do tears come when when we peel the onion?
7. Radio stations have better reception in night?
8. Why earth rotates in west to east?
9. Why it is cool in hilly areas?
10. Is the set $\{1,3,5,7,\dots\}$ infinite? How ?
11. Is the set $\{0,2,4,6,\dots\}$ infinite? How ?
12. Is the set $\{0,1,2,3,4,\dots\}$ infinite? How?

13. Can we order the travel of 100 cities, and find out the shortest way to travel?

Total routes = $100! > 10^{100}$. If 10^{12} routes can be computed in a second, it would take $\frac{10^{100}}{10^{12} * 3600 * 24 * 365} > 10^{75}$ yrs.

14. Given a set of integers $\{100, 123, 34, 26, \dots\}$ with 10 numbers, possess a subset having sum 3486 (say)?
15. Is a given large integer, say of about 100 digits, factorable (prime)? How much time need to find out ?
16. If some one makes a sound, can you say it is vowel or consonant? (linguistic)
17. How many maximum possible moves are there in chess? (10^{130}) !!