Innovative Methods for Teaching Engineering Courses

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Teaching/Learning Approaches

Inductive v/s deductive:

- The "best" method of teaching at UG is **induction**
- Traditional college teaching method is deduction
- Problem with inductive presentation:

  It is not concise and prescriptive - you have to take a thorny problem 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 visual and verbal solves this

Learning and Teaching Styles

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.

Learning and Teaching Styles ..

- Mismatches exist between common learning styles of engineering students and traditional teaching styles of engineering professors.
- Professors, confronted by low test grades, unresponsive or hostile classes, poor attendance and dropouts, think something is not working;
- Most seriously, society loses potentially excellent engineers.

Learning and Teaching Styles ..

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 student prefer to perceive : sensory - sights, sounds, physical sensations, or intuitive
2. Channel through which effectively perceived : visual - pictures, diagrams, graphs, demonstrations, or auditory - words, sounds
3. 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. Prefer to process information : actively - through engagement in physical activity or discussion, or reflectively (passively) - through introspection
5. Progress toward understanding : sequentially - in continual steps, or globally - in large jumps, holistically

Teaching Styles

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

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

Models of Learning & Teaching Styles...

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

1. Sensing and Intuitive Learners: two ways in which people tend to perceive the world. Intuition involves indirect perception by way of the unconscious - speculation, imagination.
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.

Models of Learning & Teaching Styles...

- Inductive and Deductive Learners: Induction is a reasoning progression that proceeds from particulars (observations, measurements, data) to generalities (governing rules, laws, theories). Deduction proceeds in the opposite direction.
- Active and Reflective Learners: The complex mental processes by which perceived information is converted into knowledge can be conveniently grouped into two categories: active experimentation and reflective observation.
- Sequential and Global Learners: completing a semester's course syllabus v/s playing chess or Sudoku