

21ST CENTURY TEACHING & LEARNING KOLB CYCLE & REFLECTIVE THINKING AS PART OF TEACHING, CREATIVITY, INNOVATION, ENTERPRISE AND ETHICS TO ENGINEERS



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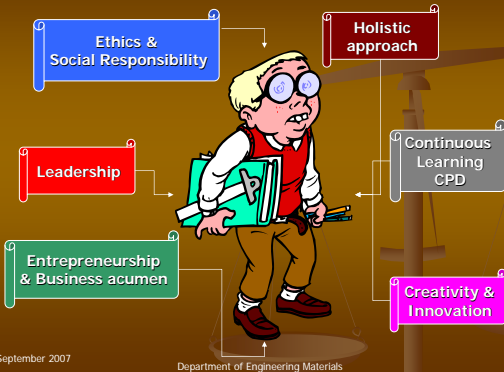
- Twenty-first century engineers should be well-rounded, well-balanced individuals who are capable of relating to people from a variety of backgrounds. They should not be driven by monetary reward alone but by the pride, satisfaction and enjoyment that comes from doing things that are particularly useful. Although their day-to-day work might involve solving very specific technical problems, they should be aware that their work is part of a 'bigger picture'.

M. Chang, "Engineers in the 21st century," IEEE Journal on Selected Topics in Quantum Electronics, vol. 6, no. 6, 2000.

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Values of the 21st century engineer



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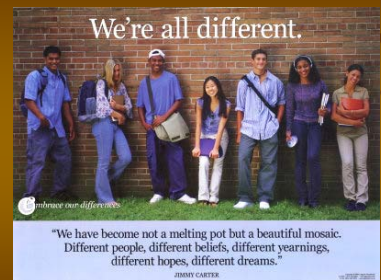
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Learning and teaching styles

"I am someone's son or daughter, someone else's cousin or uncle, I am a citizen of this or that city, a member of this or that guild or profession, I belong to this tribe, that clan, this nation. I inherit from the past of my family, my city, my tribe, my nation, a variety of debts, inheritances, rightful expectations and obligations."

These constitute the given of my life, my moral starting point. This is the part what gives my life its own moral particularity"

Alasdair MacIntyre

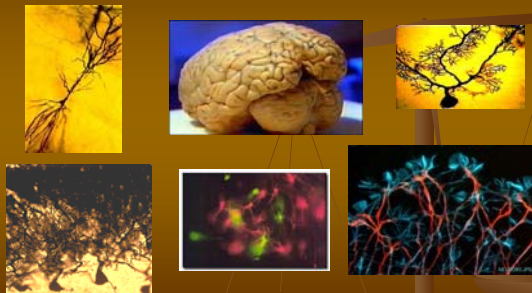


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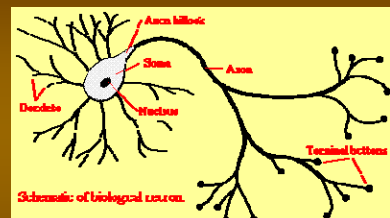
Brain: the most complex thing in the Universe (Sir Robert Winston)



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The brain contains 100 billion neurons

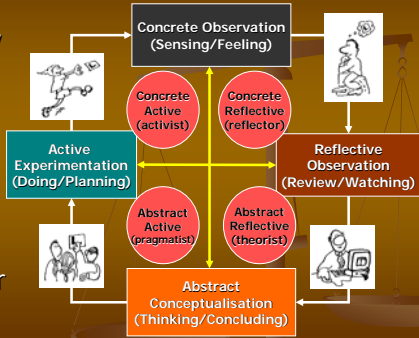


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Kolb's experiential learning model

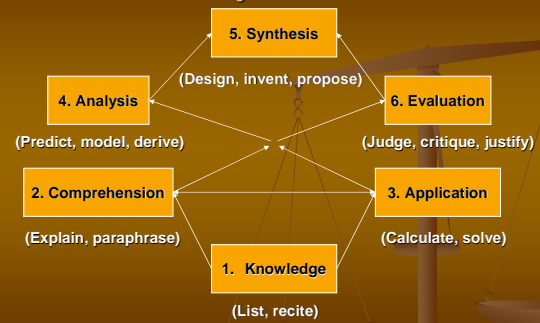
- We learn by experience, and
- Our individual experiences colour the way we perceive our world



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Bloom's taxonomy of educational objectives



Bloom BS & Krathwohl DR, *Taxonomy of Educational Objectives*, NY, Addison Wesley, 1984

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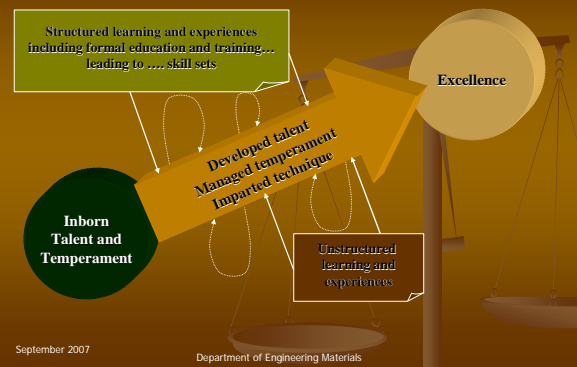
The Reflective Practitioner

- Donald Schön studied the learning process of engineers, managers, architects and psychotherapists
- In general, competent practitioners know more than they can say (tacit knowledge)
- When someone reflects in action they become a researcher in practice
- The reflection of a practitioner can serve as a corrective element for the learning process

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Nature-Nurture model



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Students learn by:

- Seeing
- Hearing
- Reflecting and acting
- Reasoning logically or intuitively
- Memorizing
- Visualising
- Drawing analogies
- Building mathematical models
- Steadily and in fits and starts

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Teaching methods also vary:

- Some of us 'lecture'
- Others demonstrate and discuss
- Some focus on principles and others on applications
- Some emphasise memory and others understanding
- How much the student learns is governed by their abilities, preparation but also by compatibility between their learning style and our teaching style

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Learning style models:

- What type of information does the student preferentially perceives: *sensory* or *intuitive*?
- Through which sensory channel is this information most effectively perceived: *visual*, *auditory*, *other*?
- Which organisation of information is the student most comfortable: *inductive* or *deductive*?
- How does the student prefer to process information: *actively* or *reflectively*?
- How does the student progress towards understanding: *sequentially* or *globally*?

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Teaching style models:

- What information is emphasised by the teacher: *concrete* or *abstract*?
- What mode of presentation is stressed: *visual* or *verbal*?
- How is the presentation organised: *inductively* or *deductively*?
- What mode of student participation is promoted by the presentation: *active* or *passive*?
- What type of perspective is provided for the information being presented: *sequential* or *global*?

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What does that mean for us:

- There are 32 (2^5) classroom learning style combinations in the proposed framework
- Most of us would be intimidated by the prospect of trying to accommodate 32 diverse styles in a given class
- FORTUNATELY, engineering education adequately addresses five categories (intuitive, auditory, deductive, reflective and sequential), and use of effective teaching techniques can substantially overlap the remaining categories.
- It would seem valid to say that with the addition of a relatively small number of teaching techniques in our repertoire we should be able to accommodate the learning style of every student in our classes.

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Sensing and intuitive learners

- Sensors like facts, data and experimentation; intuitors prefer principles and theories
- Sensors like solving problems by standard methods and dislike 'surprises'; intuitors like innovation and dislike repetition
- Sensors are patient with detail but do not like complications; intuitors are bored with detail and welcome complications
- Sensors are good at memorizing facts; intuitors are good at grasping new concepts
- Sensors are careful but may be slow; intuitors are quick but may be careless

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Visual and auditory learners

- Visual learners remember best what they see, if something is said to them they probably will forget it; auditory learners remember much of what they hear and more of what they hear and say
- Auditory learners get a lot out of discussion, prefer verbal explanation to visual demonstration, and learn effectively by explaining to others
- Most people of University age and older are visual learners
- Most HE teaching is auditory (lecturing) or a visual presentation of auditory information
- TEACHING/LEARNING mismatch!

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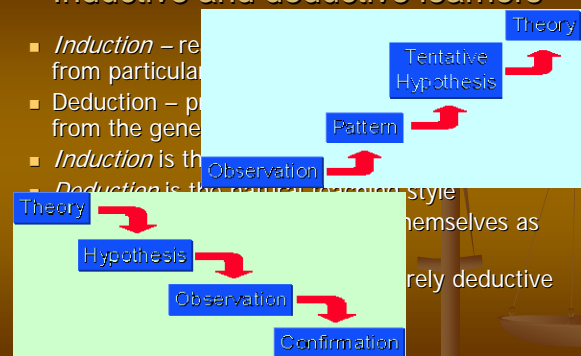


Inductive and deductive learners

- *Induction* – reasoning from particular to general
- *Deduction* – reasoning from the general to the particular
- *Induction* is the natural dominant style of the majority of learners; they see themselves as inductive
- *Deduction* is the natural dominant style of a minority of learners; they see themselves as purely deductive

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Active and reflective learners

- An 'active learner' is someone who feels more comfortable with, or is better at, active experimentation than reflective observation, and conversely for a 'reflective learner'
- Indications are that engineers are more likely to be active than reflective learners
- Active learners do not learn much in situations that require them to be passive (most lectures) and reflective learners do not learn much from situations that provide no opportunity to think about the information being processed (most lectures)
- Active learners work well in groups; reflective learners work better on their own or at most with another person
- Active learners tend to be experimentalists; reflective learners theoreticians



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Sequential and global learners

- Most formal education involves the presentation of material in a logically ordered progression, with the pace of learning dictated by the clock and the calendar.
- Some students learn sequentially, mastering the material more or less as it is presented, others learn in 'fits and starts'
- Sequential learners follow linear solving problem methodologies; global learners make intuitive leaps
- Sequential learners may be strong in convergent thinking and analysis; global learners can be better at divergent thinking and synthesis
- Sequential learners prefer a steady progression of complexity and difficulty; global learners sometimes do better by jumping directly to more complex and difficult material

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Teaching techniques to address all learning styles

- Motivate learning - Inductive/Global
- Provide a balance of factual information and abstract concepts - Sensing/Intuitive
- Balance practical problem solving methods with fundamental understanding - Sensing-active/Intuitive-reflective
- Provide illustrations of intuitive patterns and sensing patterns and encourage students to use both - Sensing/Intuitive
- Make use of pictures, schematics, graphs, simple sketches liberally before, during and after the presentation of verbal material - Sensing/Visual

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Teaching techniques to address all learning styles cntd.

- Show films, video clips - Sensing/Visual
- Provide demonstrations - Sensing/Visual, hands on if possible - Active
- Use computer assisted instruction - Sensing/Active
- Do not fill every minute of the lecture by writing on the board; provide brief intervals of student interaction - Reflective
- Use short brainstorming activities - Active
- Assign exercises to provide practice on what is being taught - Intuitive/Reflective/Global

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Teaching techniques to address all learning styles cntd.

- Provide open ended problems and exercises that call for analysis and synthesis - Intuitive/Reflective/Global
- Provide option for student collaboration whenever possible - Active
- Applaud creative solutions, even incorrect ones - Intuitive/Global
- Talk to students about learning styles. Students will be reassured to find that any academic difficulties may not be part of personal failings - All types
- Explaining to the students how they can learn more effectively can reshape their learning experience - All types

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Research has shown that: (Slife J.E.)

- Students retain:
 - 10% of what they read
 - 26% of what they hear
 - 30% of what they see
 - 50% of what they see and hear
 - 70% of what they say
 - 90% of what they say as they do something!



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Teaching for all – A study in Balance

- Using a combination of Kolb's experiential learning model, together with reflective thinking of our practice and adding some variation of teaching styles to accommodate the different learning styles of our student audiences can have a potentially dramatic effect on their quality of learning!



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'Creativity, Innovation, Enterprise & Ethics'

'Παν Μετρον Αριστον' -

'Balance & Optimisation'

Plato Kapranos K4
2007



Module 388

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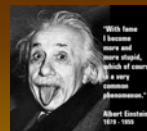
Outline

- What is this module about
- The Structure
- The Content
- The assessment

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What is this module about



•What engineers and scientists do

•The role that Creativity, Innovation, Enterprise and Ethics play in their jobs



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The Structure

•The module consists of series of 24 lectures

•My lectures are supported by the use of external speakers on specific topics

•There will be a written assessment at the end of the module & a group case study



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- Overview of the module
- How do we learn?
- What do Engineers do?

The Content

- Introducing the Concepts of Enterprise, Innovation and Creativity
- Economic aspects of Technology
- Introduce Decision making, Risk analysis and Problem solving
- Introduce TQM
- Engineering Ethics



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The module assessment

• Will be in the form of:

- **Group presentations:** You will develop a business plan for a UK based company
- **Written Assessment:** You will be asked to individually tackle a number of problems taken from various parts of the module

(NO Exam)

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In the hope that the module will make you see things from a different perspective

I wish that for just one time
You could stand inside my shoes
And just for that one moment
I could be you.....

Bob Dylan (Positively 4th Street)



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engineers are no different
than anyone else, they search
for the best possible solutions
whilst balancing a number of
conflicting demands



*‘Παν Μετρον Αριστον’ -
‘Balance & Optimisation’*

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Acknowledgements

- A number of slides in this presentation are based on work presented by R.M. Felder and L.K. Silverman, 'Learning and Teaching Styles In Engineering Education', Engineering Education, 78 (7), 678-681, 1988.

go raibh mile maith agat



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