Teaching & Learning Engineering: a tango

Teaching & Learning Styles



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the Way they Learn & the Way we Teach: Bridging the Gap

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Kierkegaard

Instruction begins when you, the teacher, learn from the learner. Put yourself in his place, so that you may understand what he learns and the way he understands it.

Session Objectives



the various characteristics of different learning styles Discuss instructional methods that address the needs of students with different
learning styles

What is Learning Style?

A student's consistent way of responding to and using stimuli in the context of learning.
A student's preferred way of processing information.

Facts:

- 1. Students learn < what we teach !
- 2. How much they learn depends on :
 - a. Native ability.
 - b. Background.
 - c. Motivation.
 - d. Attitude.

e. Match between their learning style and our teaching style.

3. We can't do much about their ability, background, or learning style.

Conclusion :

To maximize student learning we must:1. Motivate (engage) them!2. Change their attitudes!

3. Teach to their learning needs (work on our teaching style)!

Learning Styles Models

- Myers-Briggs Type Indicator
- □ Kolb' s Learning Cycle
- Hermann Brain Dominance Model
- Grasha-Riechmann Teaching / Learning Styles
- Productivity Environmental Preference
- Howard Gardner's Multiple Intelligences
- Felder-Silverman Learning Style Model
- □ Hill's Cognitive Style Mapping
- Dunn and Dunn Learning Styles
- Gregorc Learning Styles

Questions to be explored :

• What are the different ways students process information? (LS) □ Which LS are favored by most students ? □ Which LS are favored by most professors? What are the consequences of mismatches between TS and LS? □ What can we do to reach students with the full spectrum of LS?

LS Dimension : Perception

SENSING LEARNER
Focus on sensory input
Practical
Observant
Concrete: Facts + Data
Repetition

INTUITIVE LEARNER
Focus on subconscious
Imaginative
Look for meanings
Abstract:
Theory + Models
Variety

LS Dimension : Perception

SENSING LEARNER
Methodical
Detail work
Complaint :
 "Not the real world !"
Tests : runs out of time

INTUITIVE LEARNER
Quick
Concept work
Complaint :
 "Plug and chug"
Tests : carelessness



"Algebra class will be important to you later in life because there's going to be a test six weeks from now."

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What kind of learner are you Sensor (S) or Intuitor (N) ?

strong moderate mild mild moderate strong

N

S

How strong is your preference?

What kind of learner are you Sensor (S) or Intuitor (N) ?

- 1. Sensor =
- 2. Intuitor =
- 3. Balanced (can learn either way) =

LS Dimension : Perception

• Everyone is both S and N • Everyone prefers one or the other Most undergraduates are S Most professors are N MISMATCH ! □ S-N balance depends on field, situation □ Both S and N make good professionals

Statistics from engineering courses, 1999

	S very strong	S moderate	Balanced	N moderate	N very strong
E 10	4	12	18	6	0
(N=40)	(10%)	(30%)	(45%)	(15%)	
ME 111	9	16	26	8	2
(N=61)	(15%)	(26%)	(43%)	(13%)	(3%)
Mat.E 153 (N=127)	13 (10%)	42 (33%)	64 (50%)	7 (5.5%)	2 (1.5%)

LS Dimension : Input Modality

VISUAL LEARNER

- "Show me"
 - ✓ pictures
 - ✓ diagrams
 - ✓ sketches
 - \checkmark schematics
 - ✓ flow charts✓ plots

VERBAL LEARNER

- "" "Explain it to me
 - \checkmark spoken words
 - \checkmark written words

What kind of learner are you Visual or Verbal ?



How strong is your preference?

What kind of learner are you?

- 1. Visual =
- 2. Verbal =
- 3. Balanced (can learn either way) =

LS Dimension : Input Modality

 You learn more when information is presented in your preferred modality.
 You learn even more if you get it in both.
 Most people are visual learners.
 90-95 % of most course content is verbal. <u>MISMATCH !</u>

Statistics from engineering courses, 1999

	Visual very strong	Visual moderate	Balanced	Verbal moderate	Verbal very strong
E 10 (N=40)	12 (30%)	19 (48%)	9 (22%)	0	0
ME 111 (N=61)	21 (34%)	22 (36%)	17 (28%)	1 (2%)	0
Mat.E 153 (N=127)	32 (25%)	40 (32%)	46 (36%)	7 (5.5%)	2 (1.5%)

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General Principle, Axiom

Induction

Deduction

Specific Observation, Data

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INDUCTIVE LEARNER □ Start w. observation □ Infer, explain

DEDUCTIVE LEARNER
□ Start w. principles
□ Deduce, derive

INDUCTION is

- the natural human LS
- better for long-term retention, transfer
- □ Other names:
 - ✓ Problem-Based Learning
 ✓ Inquiry-Based Learning
 ✓ Discovery Learning

DEDUCTION is

 the natural college TS
 better for short-term retention of more information

 Everyone learns both ways
 Everyone has a preference
 Most students learn better inductively
 Most professors teach deductively MISMATCH !

SJSU Faculty Survey – F06

Question 28 (n = 17): Please select either a OR b: When I introduce complex principles in my classes:

a. I usually start with specific examples that are easy to grasp, I continue with more complex examples, and finally, I generalize the principle 23.5 %

b. I usually start with the general principle, I continue by making simplifying assumptions, and finally, I present specific examples.
 76.5 %

Purely deductive teaching makes students think the material is
 ✓ straightforward for author / instructor
 ✓ impossible for them

Both ideas are wrong !

LS Dimension : Processing

ACTIVE
LEARNERS
Process actively
Think out loud
"Let's try it out !"
Jump in prematurely
Like group work

REFLECTIVE LEARNERS
Process introspectively
Work quietly
"Let's think about it !"
Delay starting
Like solo or pair work

What kind of learner are you Active or Reflective ?

A ____

strong moderate mild

mild

moderate strong

R

How strong is your preference?

What kind of learner are you?

- 1. Active =
- 2. Reflective =
- 3. Balanced (can learn either way) =

LS Dimension : Processing

Most classes have both active and reflective learners
Most classrooms are passive
Active learners don't get to act
Reflective learners don't get to reflect MISMATCH !

Statistics from engineering courses, 1999

	Active very strong	Active moderate	Balanced	Reflect. moderate	Reflect. very strong
E 10	1	14	19	6	0
(N=40)	(2%)	(35%)	(48%)	(15%)	
ME 111	3	18	34	4	2
(N=61)	(5%)	(30%)	(55%)	(7%)	(3%)
Mat.E 153 (N=127)	8 (6%)	23 (18%)	75 (59%)	17 (13%)	4 (3%)

SJSU Faculty Survey – F06

Question 14 (n = 18): I lecture for most of the class period: □ In every class session 22.2 % • Once or more times a week 38.9 % Once or more times a month 16.7 % 16.7 % • Once or more times per semester □ Never 05.6 %

SJSU Faculty Survey – F06

Question 26 (n = 18): I use in-class small group (cooperative learning) activities: 27.8 % □ In every class session • Once or more times a week 11.1 % 38.9 % Once or more times a month 16.7 % • Once or more times per semester □ Never 05.6 %

LS Dimension : Understanding

SEQUENTIAL LEARNER Can function w. partial understanding Steady progress Explains easily Likes analysis, details (the trees)

GLOBAL LEARNER Needs the big picture to function □ Initially slow, then major leaps Can' t explain easily Likes synthesis, systems-ecological thinking (the forest)

What kind of learner are you Sequential or Global ?

strong moderate mild mild moderate strong

S

How strong is your preference?

G

What kind of learner are you?

- 1. Sequential =
- $2. \quad \text{Global} =$
- 3. Balanced (can learn either way) =

LS Dimension : Understanding

□ Most students, instructors, courses, curricula are sequential. BUT Global minority is \checkmark extremely important ✓ systematically weeded out □ Serious loss to society !

Statistics from engineering courses, 1999

	Seq. very strong	Seq. moderate	Balanced	Giobai moderate	Global very strong
E 10 (N=40)	0	8 (20%)	27 (68%)	5 (12%)	0
ME 111 (N=61)	4 (6%)	12 (20%)	38 (62%)	6 (10%)	1 (2%)
Mat.E 153 (N=127)	6 (5%)	34 (27%)	71 (56%)	10 (8%)	6 (5%)

Consequences of LS & TS mismatches

- 1. Many students can't get what's being taught. They may...
 - ✓ become bored, inattentive, disruptive
 - \checkmark do poorly on tests
 - ✓ get discouraged about the course, the program, and / or themselves
 - change majors or drop out

Consequences of LS & TS mismatches

 Low test scores, unresponsive or hostile classes, poor attendance, dropouts. Professors know something's wrong.
 They may

✓ get defensive or hostile, making things worse✓ question their teaching ability

Consequences of LS & TS mismatches

3. Society loses potentially excellent professionals

- ✓ visual, active learners (most students)
- \checkmark sensing, inductive learners
- ✓ global learners

Summary

Students may be
Sensors or Intuitors
Visual or Verbal
Inductive or Deductive
Active or Reflective
Sequential or Global
All types are needed in every profession !

Summary

Most teaching is

 Abstract (intuitive)
 Verbal
 Deductive
 Sequential

 Most classrooms are passive
 We are essentially addressing ONLY ONE out of 32 possible learning styles !

Reflection

❑ What are some of the things you can do in your classes to accommodate
 ✓ Sensing and intuitive learners?
 ✓ Active and reflective learners?
 ✓ Verbal and visual learners?
 ✓ Sequential and global learners?

Teaching Objective : Balance !

- Professionals need to function on BOTH sides of ALL dimensions (S+N, A+R, ...
- If we teach only in students' less preferred modes ineffective learning
 - \checkmark students will end up weak in both categories
- If we teach only in students' preferred modes
 imbalance
 - student will end up strong in one category, weak in less preferred one

Teaching Objective : Balance !

Solution : Teach to BOTH sides of EACH dimension
 balanced strength
 student will end up strong in both categories



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1. Establish relevance and provide applications for all course material. Before presenting theoretical material, provide graphic examples of the phenomena the theory describes or predicts

- sensing, inductive, global -

2. Balance concrete information (facts, observations, data) *sensing*and abstract information (principles, theories, models) *intuitive*in all courses.

 Make extensive use of pictures, schematics, graphs, and simple sketches before, during, and after presenting verbal material

- sensing, visual -

4. Use multimedia presentations.5. Provide demonstrations, hands-on if possible

- sensing, visual -

6. Use some numbers in illustrative examples, not just algebraic variables

- sensing -

7. Give students time to think about what they have been told. Assign "minute papers" : \checkmark what was the main point of the lecture ? ✓ what was the muddlest point of the lecture ? ✓ write down one outstanding question you have ! Require "learning logs" - reflective -

8. Give small-group exercises in class.

- active, reflective, verbal -

9. Use computer-assisted instruction (if software is available that allows for experimentation and provides feedback)

- sensing, active -

10. Assign some drill exercises in homework

- sensing, active -

but don't overdo it.

- intuitive, reflective -

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 Assign some open-ended problems / questions and exercises that call for creative thinking and critical judgement.
 Ask students to cooperate on homework.

- all styles -

13. Limit new material, surprises, twists, etc., on timed tests and minimize speed as a critical factor.

- sensing -

14. Recognize and encourage creative solutions, even wrong ones.

- all styles -

15. Encourage students to assess their learning styles:
http://www.engr.ncsu.edu/learningstyles/ilsweb.htm 1
http://www.keirsey.com/cgi-bin/keirsey/newkts.cgi
http://www.hbdi.com

Reflection on the workshop

3 interesting ideas you' re taking away.
2 things you' re ready to try in your class next week.
1 unanswered question ?

Peter G. Beidler Prof. of English, Lehigh University 1983 U.S. Carnegie Professor of the year

The trouble with exciting teachers is that they are almost always mavericks, trotting blithely off into some distant sunset, where no one can brand them.The trouble with inspiring teachers is that they won't stay put long enough to be measured, perhaps because they know that if they did, they would be expiring teachers.

Damn.