Tips for Waking Up Your Students

THE LEARNING STYLES OF ENGINEERING STUDENTS

Engineering is traditionally and most often taught via lectures, tutorials and laboratories with long contact hours. Although in the recent times, more innovative pedagogies are being employed such as field experiential learning, project and problem based learning, however, lectures, tutorials and laboratories are inevitable in the delivery of any engineering degree programme. With the long contact hours and most of the subjects are hard-science and mathematical based, engineering students often find it hard to concentrate at all times. Thus, understanding engineering students and their preferred adapted learning styles are important.

Every student has their own learning style. Felder and Silverman (1988) introduced a learning style model which consists of four dimensions – active versus reflective, sensing versus intuitive, visual versus verbal and sequential versus global. It was proposed that most engineering students are in general - active, sensing, visual and sequential learners. In other words, for engineering students, they learn by actively trying things out with the help of working with one another; they draw on physical sensation, facts and practice and prefer repetition work; they prefer understanding visually than by words; and they learn by understanding step by step in a sequential manner. The table below shows a summary of the different learning styles.

Complementary Learning Styles	
Active • 'Let's try it out' • Process information by physical activity • Learn by working with others	Reflective • 'Let's think it through' • Process information introspectively • Learn by working alone or in pairs
Sensing • Draws on physical sensation • Practical and observing • Prefer the concrete: facts and data • Prefer repetition	Intuitive • Draws on insight • Imaginative and interpretive • Prefer the abstract: theory and modelling • Prefer variation
Visual • 'Show me how' • Prefer pictures and diagrams	Verbal • 'Tell me how' • Prefer written and spoken explanations
Sequential • Understand in continual and incremental steps • Linear reasoning process • Convergent thinking and analysis	Global • Understand in large leaps • Tacit reasoning process • System thinking and synthesis

(Accessed from Kolmos & Holgaard, 2008)

LEARNING ACTIVITIES IN RELATION TO LEARNING STYLES

Based on Felder and colleagues' research, E3R Asia has come up with the following table which introduces the use of learning activities that target engineering students' learning styles.

Examples of active learning activities	Description
Brainstorming	• Present students with a question or issue that you would like them to contribute their idea on. • Use a few minutes for students to write down their ideas before hearing from them.
In-class writing exercises	Students can be asked to write a short paragraph to: • Apply a concept or principle to their own experience (application). • Compare concepts from today's lesson to those in previous lessons (analysis, synthesis). • Develop a list of examples to illustrate a concept (comprehension). • Summarize the main points of the lecture (comprehension).
Think-Pair Share	• Pose a question/problem to the class. • Give students 1-3 minutes to think about it individually before dividing them into pairs. • Have them discuss their answer in pairs for 2-3 minutes. • Invite students to share responses with the entire class.
Student response systems (i.e. Clickers)	• Use clickers for multiple choice questions to encourage student participation.
Concept Sketches	• Ask students to draw a sketch or diagram that is concisely annotated with short statements describing the processes, concepts, and interrelationships. • Have students discuss with their fellow classmates about the concepts within their drawn sketch or diagram.

Examples of active learning activities	Description
Concept Tests	• Design the concept tests to focus on students' attention on developing their conceptual understanding instead of memorization. • Pose a question/problem in multiple-choice format at intervals of approximately every 15 minutes in class. • Have students discuss with the person sitting next to them until a common answer has been reached.
Reading Quizzes	• Formulate the questions for the purpose of identifying who has read the material and whether they are able to get the gist of the reading. • Pose questions about the assigned reading materials in class. • Have students write out the answers to the questions.
Visual Lists	• Ask students to construct a list on paper or on the blackboard that asks them to compare views or to list the pros and cons of an issue in groups. • Have students analyze the list with questions related to the exercise. • Invite students to share their views in class.
Buzz Group (McKeachie, 2006)	• When the lecturer reaches a concept that he or she thinks is worth • discussing about) Ask students to form groups of 5 – 8 people and discuss about the concept. • Make sure each member of the group contribute at least one idea in the discussion. • Select some groups to report their findings to the class after 10 minutes. • Record the main-points that the group has shared on the board and incorporate those points into a possible future lecture. • Encourage students to raise their hands when they have questions during the sharing.

In addition to being active and visual, engineering students also tend to be sequential learners who are more comfortable with learning in continual and incremental step. In another words, they learn best when given clear, step-by-step instruction. Thus, in a long hour laboratory class, teachers may consider presenting experiment procedures step-by-step, where students are asked to make a prediction of the end result. Such method facilitates engineering students "linear reasoning processes" (Felder & Silverman, 1988) when solving problems.

TIPS FOR "WAKING UP" YOUR STUDENTS

1. Be expressive: the use of vocal variation, facial expression, movement and gesture enhances communication and facilitates student comprehension.
2. Be active: move around the classroom and invite participation.
3. Don't overload students, space out activities
   - Include an activity after every 15-20 minutes of presentation, which require students to use the information/concepts presented
   - Consider spacing demonstrations, student participation activities, and multimedia (e.g. music, video clips or computer simulations) throughout your lecture, to revive students' attention.

Web Reference & Resources

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