



Tips for Waking Up your Students

Introduction

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. According to Felder and Silverman (1988), who have identified that most engineering students are in general - active, sensing, visual and sequential learners using the Index of Learning Styles (ILS) online survey. The model consists of four dimensions – active versus reflective, sensing versus intuitive, visual versus verbal and sequential versus global. 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, the following section introduces the use of learning activities that target the engineering students' learning styles.

Classroom in all disciplines, including engineering can be comprised of both active and reflective learners, and brainstorming is an activity which can be used to engage both types of learners. In organizing brainstorming activities, the teacher will present a question or issue of interest, where students contribute their thoughts. Individually, students may first reflect on what they have learnt and the teacher will randomly select a student to present his/her thoughts; alternatively, teachers may also organize students into groups to brainstorm on the question or issue and selected groups will be asked to present their thoughts.

Since engineering students tend to be active learners (Felder & Silverman, 1988), using clickers and forming "buzz groups" can encourage students' participation and keep them awake in large classes. Buzz groups are formed by 5 to 8 people, where they discuss about a concept of interest and where each member in the group contributes at least one idea in the discussion. Selected groups are then asked to come out to present their findings to the class. During the presentation, the teacher will make notes of their findings on the board and students are actively encouraged to raise their hands to ask questions.

Although engineering students are in general active learners, sometimes they are also reflective learners. To engage engineering students with reflective learning style, teachers may introduce activities such as in-class writing, think-pair share, concept tests and reading

quizzes during intervals of long lectures. In-class writing exercises, such as one-minute paper or one-sentence summary, offer engineering students opportunities to think and formulate questions about the material presented (to reflect on their learning) (Felder, 1993). While students usually work on writing exercises on their own, think-pair share requires students to work in pairs to discuss their answers after thinking individually about a question or problem posed by the teacher. This exercise can be best administered in tutorials where there are smaller groups of students. Concept tests also require students to discuss with the person next to them until a common answer has been reached, but unlike think-pair share, concept tests come in the form of multiple choice questions and are administered at intervals of approximately 15 minutes in class. On the other hand, reading quizzes serve the purpose of identifying students who have read the material and whether they are able to get the gist of the reading. Teachers will ask students questions regarding the reading, which encourages students to reflect on what they have read.

As engineering students tend to be visual learners who prefer visual presentation (diagrams or pictures) of materials (Dwyer, 2010), activities like constructing visual lists and drawing concept sketches can help them learn more effectively. Drawing concept sketches encourage engineering students to describe engineering process and concepts through the drawn sketch or diagram. Much like concept sketches, students constructing a visual list are invited to construct the list that asks them to compare views or to list the pros and cons of an issue on a piece of paper or on the blackboard in groups. The teacher will then ask students to analyze their constructed list with respect to some questions related to the list. Selected groups are then encouraged to present their findings.

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.



For further details regarding the activities, please refer to the table below.

Examples of active learning activities	Description
Brainstorming	<ul style="list-style-type: none">• 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	<p>Students can be asked to write a short paragraph to:</p> <ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• 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)	<ul style="list-style-type: none">• Use clickers for multiple choice questions to encourage student participation.
Concept Sketches	<ul style="list-style-type: none">• 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.



Concept Tests	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• 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)	<ul style="list-style-type: none">• (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.



For more ideas on how to make your lecture more interactive, see Derek Bok Center for Teaching and Learning (Harvard University). (n.d.). Twenty ways to make lectures more participatory. Retrieved 12 Mar, 2013, from <http://isites.harvard.edu/fs/html/icb.topic58474/TFTlectures.html>

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. .Be active: move around the classroom and invite participation.
2. 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 wake up students' attention.

Web Reference and Resources

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