



## Using crash courses to promote active engagement and develop problem solving skills

# ERGA 2009

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## What is the teaching context?

'Engineering Mechanics: Statics' (EMS) is presented to most [Level I engineering](#) degrees ([550+ students](#) in 2009). Based on Newtonian mechanics (i.e. [physics and mathematics](#)) to analyse bodies under static equilibrium. [Prerequisite](#) for other [civil engineering](#) courses.

However, students study many [different engineering disciplines](#), so some concepts may not be relevant later in their degrees. Hence, need to develop the key graduate attributes of:

- [problem solving](#)
- [critical and independent thinking](#)
- [time management](#)

[Getting the attention of large classes](#). Teaching of large class sizes is often presented with the difficulties of (e.g. AUTC, 2002; 2003; Iaria and Hubball, 2008):

- [engaging student interest](#)
- [facilitating interaction](#)

## What is the teaching strategy?

To address these issues and develop the graduate attributes, I developed '[crash courses](#)' as a teaching strategy.

[Crash courses](#) provide a concise explanation of the main theory at the start of the lecture, so that the more complicated theory can build on this later.

Crash courses are delivered (e.g. [document camera](#)) before using the lecture slides to:

- [promote active engagement in large class sizes](#)
- [develop problem solving accuracy and efficiency \(i.e. time management\)](#)
- [improve student understanding](#)

## What are Crash Courses?

[Crash courses](#) [summarise the key concepts](#) of each lecture in a simplified manner. This lets students [know what they are working towards and why](#), i.e. the goal of a lecture, before discussing the complex detail.

Most EMS topics are based on the assumed knowledge of previous topics. Crash courses re-establish the initial material that forms the [building blocks of knowledge](#) of the new material. [Highlighting the links between topics](#) allows students to envisage them as integral parts of a [continuous learning process](#), not as isolated modules of theory.

Crash courses [stimulate interest](#) by promoting active participation where students [interact](#) with questions. When delivered in conjunction with traditional slides (e.g. by using a document camera) they [vary the presentation style](#), which helps to [focus attention](#) and [maintain concentration levels](#).

## What are Crash Courses?

(1) [Highlight the goal of the topic](#) and the main steps in the analysis, i.e. show the objective of a question using figures.

(2) Where possible, [indicate the links](#) to previous topics (i.e. the building blocks of knowledge).

(3) [Summarise the new concepts](#) used to solve problems.

(4) [Engage students in discussion](#) through [multiple choice questions](#) and queries to encourage interaction and gauge understanding.

A 50 minute lecture starts with a 5-10 minute discussion (crash course) using the document camera to reiterate past content and summarise new material. For the remainder of the lecture, the [presentation screen alternates between the lecture slides and crash course](#). This clarifies difficult concepts to improve student understanding.

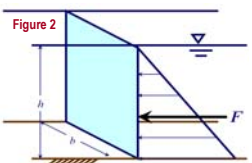
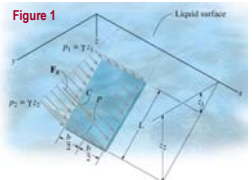
## Crash Course example

To start the lecture topic 'hydrostatics':

[Figure 1](#) ([lecture](#)) shows a plate subjected to a water pressure. [Complicated](#) as it is in three dimensions, is submerged, and is oriented at an angle. (Hibbeler, 2007)

[Figure 2](#) ([crash course](#)) [simplifies](#) the theory by having a vertical plate with a point of contact at the water level. Pressure distribution is a simpler shape (i.e. triangular not trapezoidal). Correlates to a previous topic on 'distributed loading' ([building blocks of knowledge](#)).

Once the basic theory is established using Figure 2, Figure 1 can be discussed more easily.



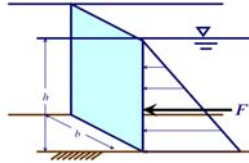
## Crash Course example

(1) The magnitude and location of the hydrostatic force (created by the average water pressure acting over a surface area) form the [basis of the theory](#). Then, typical static equilibrium equations can be used to solve any question.

(2) [Previous topics](#) of distributed loading and centroids are essential. The concepts that the magnitude and location of the resultant force are given by the area under the distributed loading diagram and the centroid, respectively, underpin the new topic.

(3) The previous concept of distributed loading relates to a force per unit length, however for hydrostatics, the pressure is given as a force per unit area. The other [new concept](#) is the calculation of the pressure, based on the fluid density.

(4) Students [ask questions](#) to clarify the crash course before the lecture slides are presented. Multiple choice questions promote active engagement and survey student understanding. This feedback determines the detail for discussion.



## Why use Crash Courses?

(1) [Promote active engagement](#). Interact and participate through [multiple choice questions](#) that monitor student understanding. Students actively copying new material (e.g. FBD via the document camera) reduces the passive nature of amending prepared notes. Mix of media varies the presentation style, to [focus](#) student attention. Important for [large class sizes](#) where strong [engagement](#) is essential to ensure successful learning.

(2) [Develop problem solving skills](#). Promotes [critical thinking](#) and discourages rote learning. Each crash course highlights the goal of the topic and the tools to solve the problem. Demonstrates how to develop a [plan](#) for an efficient solution, with the objective of performing a [self-check](#) where possible.

(3) [Include all student backgrounds](#). Crash courses discuss general engineering concepts rather than technical details. By [avoiding technical 'jargon'](#), the material is less dependent of the students' competence in physics or mathematics. Crucial for some students with ESL, to understand the theory before applying it to numerical examples. [This can alleviate transition concerns](#) for students.

## Feedback

[Positive student feedback](#) has been received via [SELT](#) responses.

	EMS (2009)		EMS (2008)		School Avg (2008)		Difference (2008)
	Mean	% BA	Mean	% BA	Mean	% BA	
1	6.5	99	6.3	96	5.2	73	23
2	6.6	99	6.4	96	5.7	84	12
3	6.2	94	5.7	82	5.4	75	7
4	6.3	96	6	90	5.4	75	15
5	5.7	85	5.9	87	5.2	70	17
6	6.1	92	5.8	86	4.8	64	22
7	6.6	98	6.6	96	5.2	70	26

- Effectiveness as a university teacher.
- Well organised.
- Shows concern for students.
- Shows enthusiasm for encouraging student learning.
- Encourages [student participation](#).
- Stimulates my interest in the course.
- Gives [clear explanations](#).

% BA = Broad Agreement (%)

Qu. 1:

- 1 = Very Poor
- 7 = Outstanding

Qu. 2-7:

- 1 = Strongly Disagree
- 7 = Strongly Agree

## Feedback

[Best aspects of teaching \(SELT\):](#)

- [crash courses](#)
- [good interaction and student participation](#)
- [explanation of concepts in a logical, clear and concise manner](#)
- [identification and reiteration of key difficult areas](#)
- [connection of concepts between topics](#)
- [encouragement of student understanding](#)

[Peer evaluation of teaching \(2009\):](#)

- [level of engagement was excellent](#)
- [clear descriptions](#)
- [good practice reminders \(stress the need and way to make checks\)](#)
- [tied in this topic with previous ones](#)
- [maintained good control](#)
- [working through an example shows the method very clearly](#)

## Student testimonials

The crash courses in various Statics topics in our lectures lately have been [very useful in understanding](#) the concepts. Hearing a clearer version and briefly learning the topic again has helped me [understand](#) how to answer the questions. Thanks.

Your crash courses both during new material and recapping old material were [extremely helpful](#). Your revision of key points on 3D moments was [very understandable and helpful](#). Thank you.

Please keep up the crash courses; they are [extremely helpful](#), and while in most cases so far I've understood how to get to the end result, and usually the correct answer, your crash courses [help greatly](#) in learning the correct paradigms for solving these problems. Learning the specific questions and tips/tricks, produces for me at least, a result that allows me to [understand](#) and complete the exam-type questions in a much more complete fashion, and in the end it also [helps understand](#) the overall content with decent worked examples. Thanks.

Just a quick note to say that your crash courses have [helped me a lot](#). I find your crash courses very useful and it has [helped me understand](#) many of the previous ideas. Thanks.

## Summary

[Crash courses](#) are used as a teaching strategy to [improve student understanding](#).

Benefits:

- promotion of active engagement
- development of problem solving skills
- inclusive of all student backgrounds

Steps:

- highlight the goal of the topic
- show the links to previous topics
- summarise the new concepts used to solve problems
- engage students in discussion through multiple choice questions and queries

[Positive student feedback](#) strongly supports the use of this teaching strategy. Applied to a numerical course, but could be [extended to other course types](#).

## References

AUTC (Australian Universities Teaching Committee) (2002). *A Survey Of Large Class Teaching Around Australia*. Teaching and Educational Development Institute, The University of Queensland, Australia.

AUTC (Australian Universities Teaching Committee) (2003). *Teaching Large Classes Project 2001 - Final Report*. Teaching and Educational Development Institute, The University of Queensland, Australia.

Hibbeler, R. C. (2007). *Engineering Mechanics: Statics*, 11th SI Edition, Prentice Hall Publishers.

Iaria, G., & Hubball, H. (2008). *Assessing Student Engagement in Small and Large Classes*. *Transformative Dialogues: Teaching & Learning Journal*, 2(1), 1-8, Article 3.