Preparing Open Book Examination for Engineering Courses

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Aim of presentation:
Focus on the "how to" for preparing open book written exams

Outline

- Introduction and guiding principle

- Translating principle into practice and examples

- Final tips

- Q&A

Have you given or taken open book exams?

Please go to www. menti.com
and type in this code:

50 373

Open book exams …

Assess functioning knowledge – assess what students can do with concepts

Have answers that cannot be found in books, or searched on-line

Can be task based, such as decision-making, problem-solving and design type questions – higher level complex activities

Usually given when students need to refer to standards, tables or charts, long equations, etc.

Are most suitable with open ended questions that mimic real-world situations or scenarios

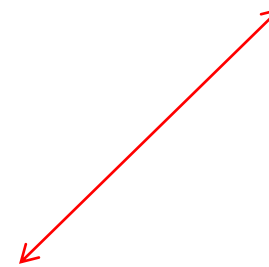Take-home exam is a subset of open-book exam, which usually take more than a day
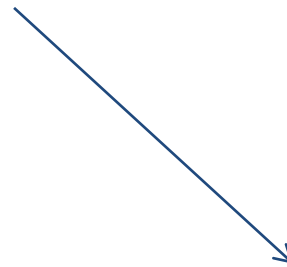
Guiding principle:
Constructive Alignment (John Biggs, 1999)

Intended learning outcomes (ILOs) must clearly be indicated

Teaching & learning activities (TLAs) match outcomes

Lecturer's Intention → Student's Activity

Assessment

Assessment Tasks (ATs) to assess ILOs

Assessment drives learning

Students learn according to how we assess them

Things to think about in deciding assessment approach...

Purpose of the assessment – to assess attainment of ILO (feedback from tests)

What to assess – functioning knowledge / active verb in ILO

How to assess – open-book exam question

Who will do the assessment – lecturer

Suitability of the assessment for the students –support to undergo the assessment and attain the outcomes

Outline

- Introduction and guiding principle
- Translating principle into practice and examples
- Final tips
- Q&A

How can we properly prepare open book exams?

1. Determine the ILOs to be attained & design instruction

2. Students "activate" the verb of the ILO in the TLAs

3. Provide formative assessment (ATs)
- Open-book quizzes
- Open-book tests

4. Prepare and administer the open-book final exam (include rubric)
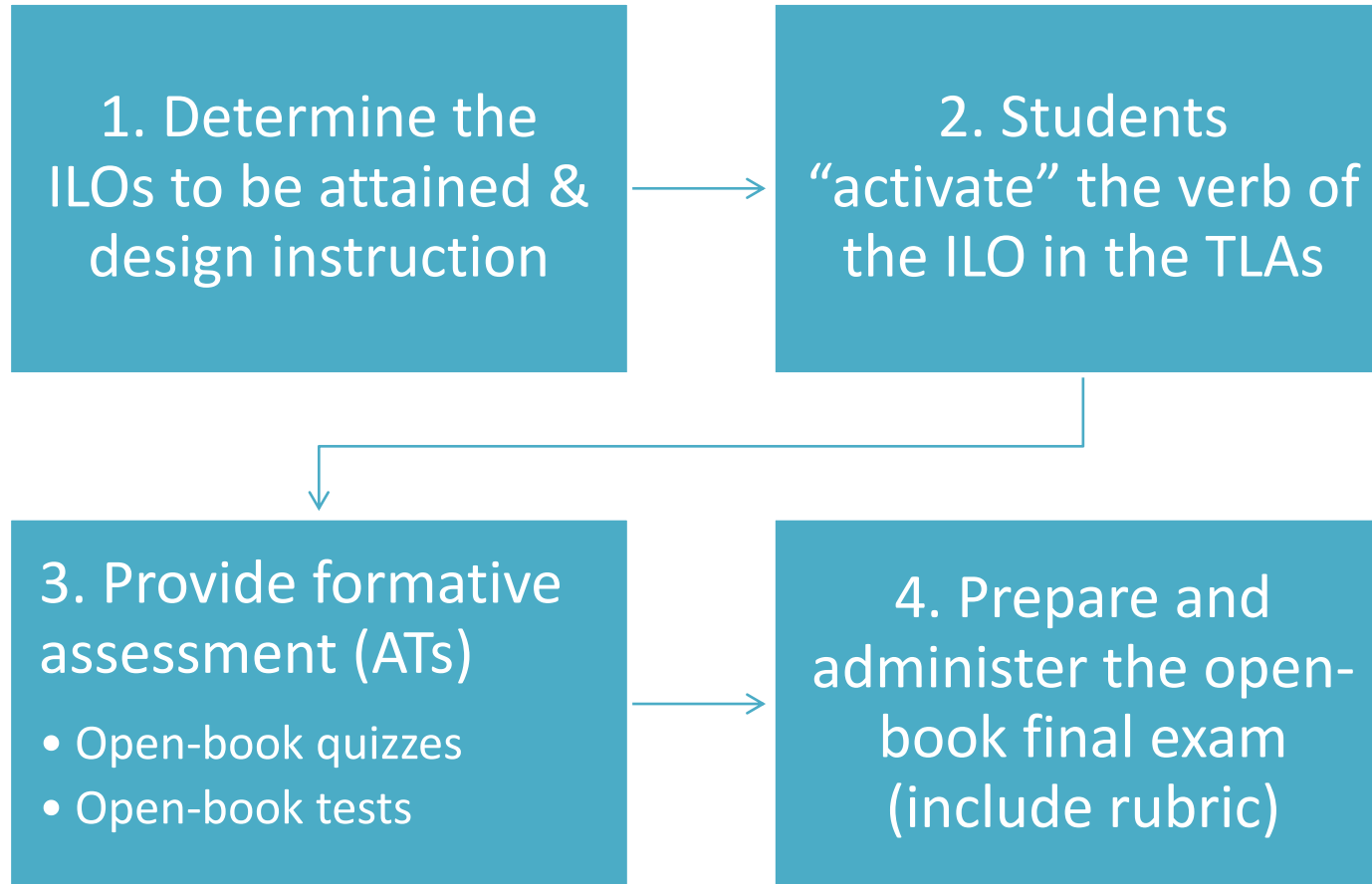
Steps in preparing students for open-book exams

The SOLO Taxonomy with sample verbs indicating levels of understanding

Competence

Analyze
Apply
Argue
Compare/
contrast
Criticize
Explain causes
Relate
Justify

Create
Formulate
Generate
Hypothesize
Reflect/Theorize

Combine
Describe
Enumerate
Perform serial skills
List

Identify
Name
Follow simple procedure

Fail
Incompetent
Misses point

Incompetence

| one relevant aspect | several relevant independent aspects | integrated into a structure | generalized to new domain |

Prestructural   **Unistructural**   **Multistructural**   **Relational**   **Extended Abstract**

Step 1 in preparing students for open-book exams

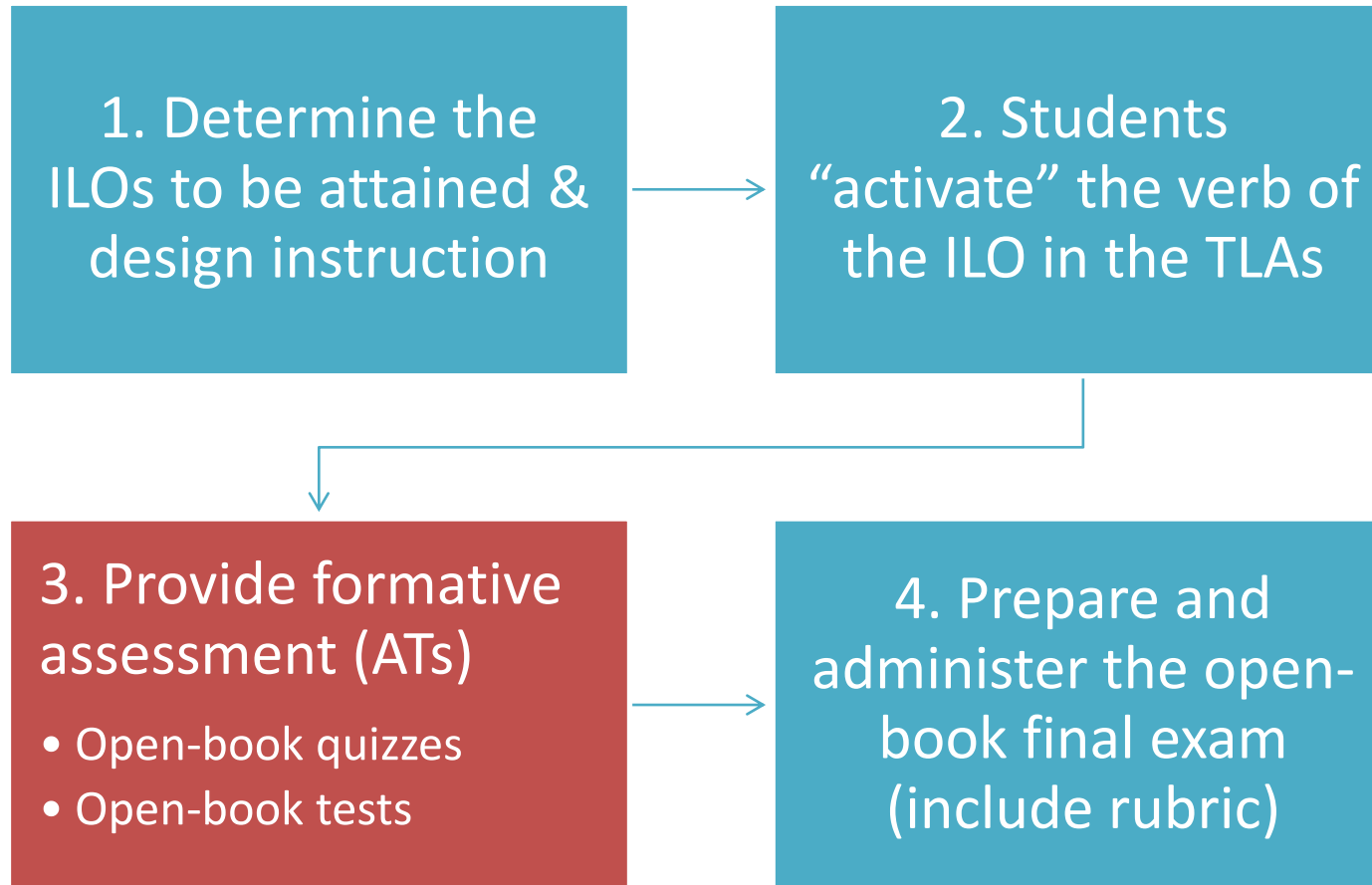|	
1. Determine the ILOs to be attained & design instruction	**2. Students "activate" the verb of the ILO in the TLAs**
3. Provide formative assessment (ATs) • Open-book quizzes • Open-book tests	**4. Prepare and administer the open-book final exam (include rubric)**

a. Standard at the taxonomy level to decide on level of attainment
b. Design and plan instruction based on real application – what is the function of the knowledge?
c. Cognitive outcomes should be based on the thinking processes involved – avoid being tied down by the verb

Step 2 in preparing students for open-book exams

1. Determine the ILOs to be attained & design instruction

2. Students "activate" the verb of the ILO in the TLAs

3. Provide formative assessment (ATs)
- Open-book quizzes
- Open-book tests

4. Prepare and administer the open-book final exam (include rubric)
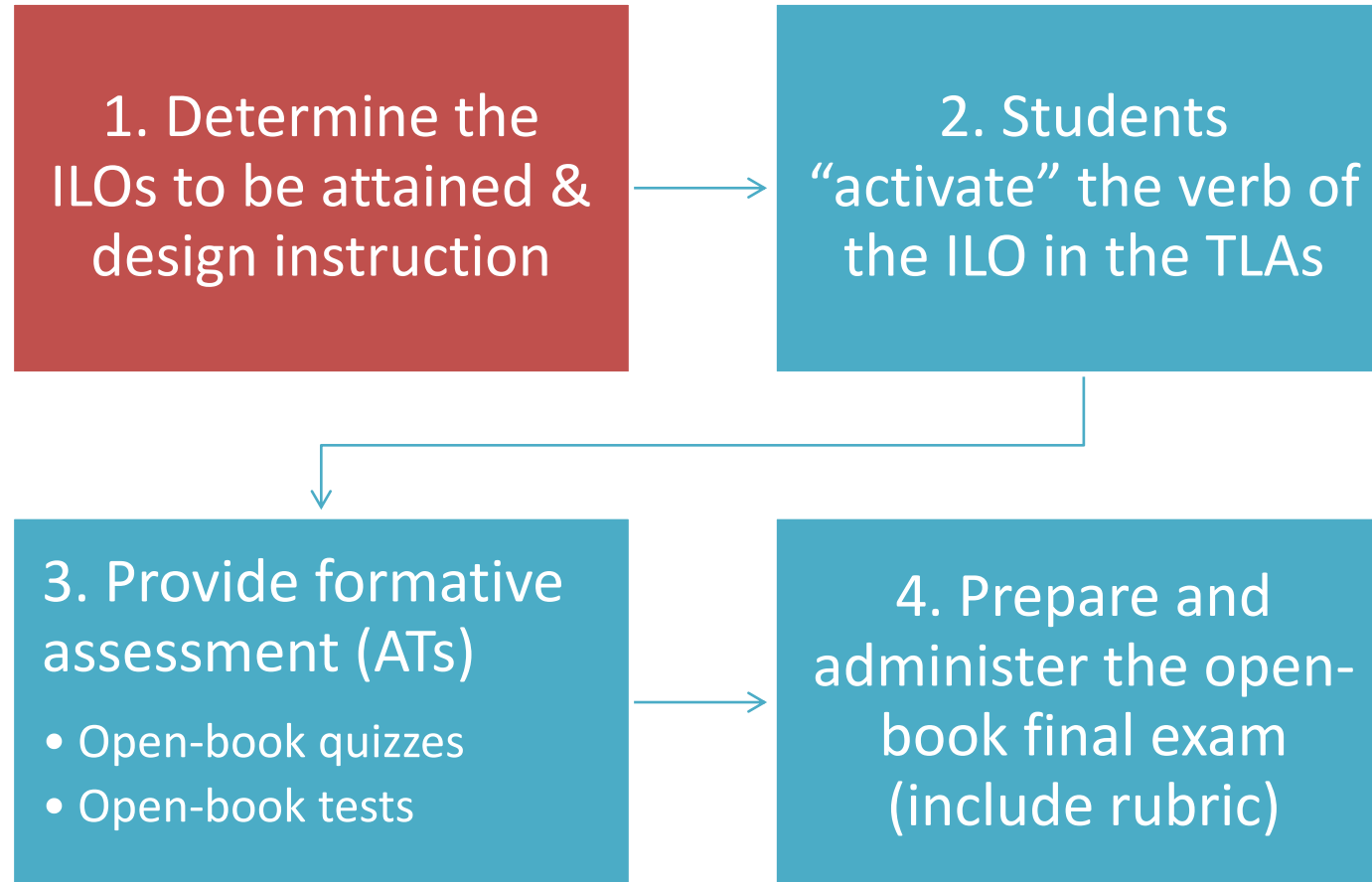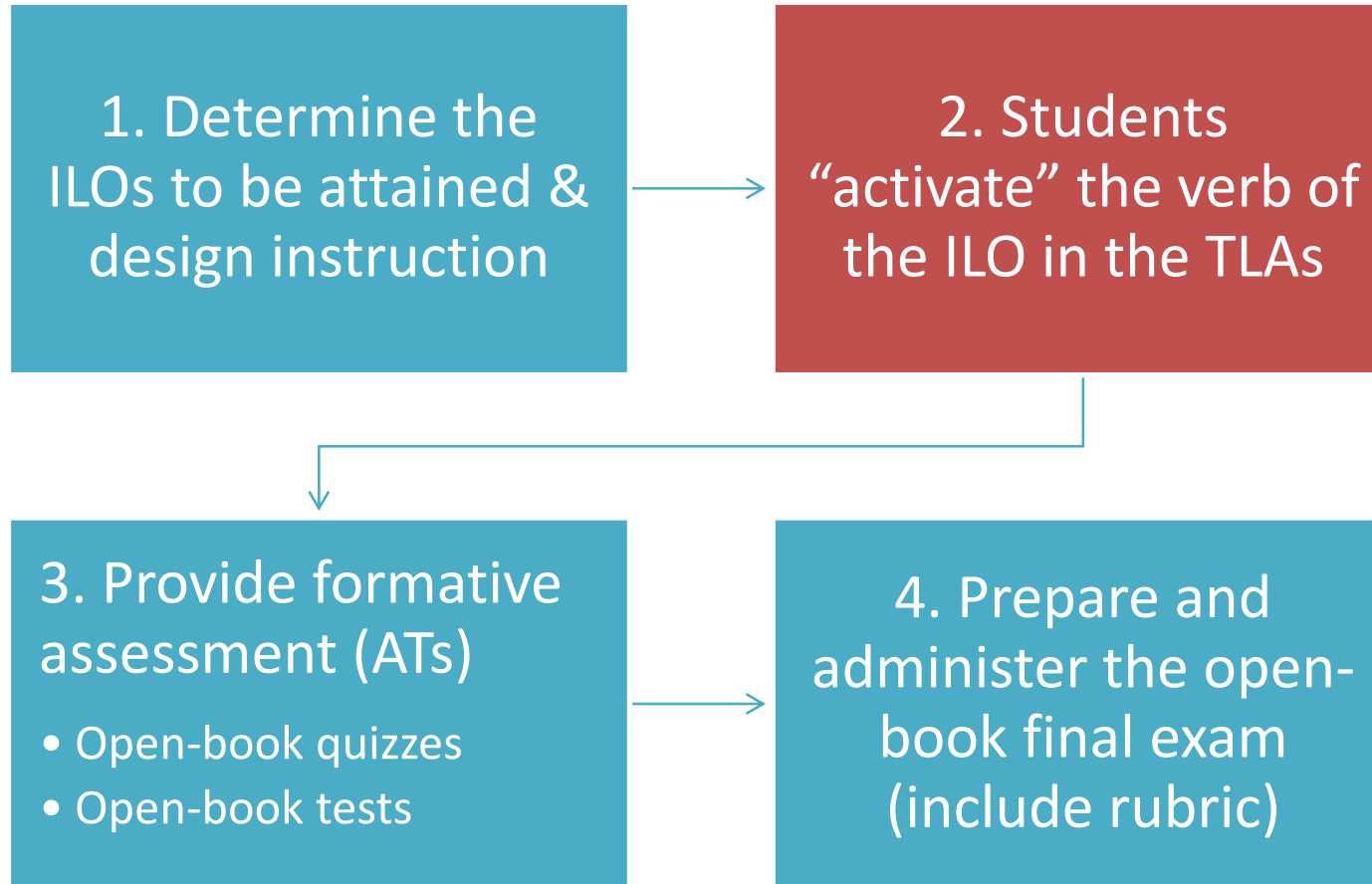
a. TLAs based on ILO
b. Support students to attain outcomes through learning by doing the active verb in the ILO
c. Add scaffolding where necessary
d. Make the connection to real situation and other topics learned

Step 3 in preparing students for open-book exams

1. Determine the ILOs to be attained & design instruction

2. Students "activate" the verb of the ILO in the TLAs

3. Provide formative assessment (ATs)
- Open-book quizzes
- Open-book tests

4. Prepare and administer the open-book final exam (include rubric)

a. Provide feedback on student performance and attainment during TLA
b. Prepare students for open-book written assessments (quiz, test)
c. Reflection and feedback on performance in open-book assessments

Step 4 in preparing students for open-book exams

1. Determine the ILOs to be attained & design instruction

2. Students "activate" the verb of the ILO in the TLAs

3. Provide formative assessment (ATs)
- Open-book quizzes
- Open-book tests

4. Prepare and administer the open-book final exam (include rubric)

a. Design questions based on ILO and TLA
b. Make rubric based on standard determined in ILO
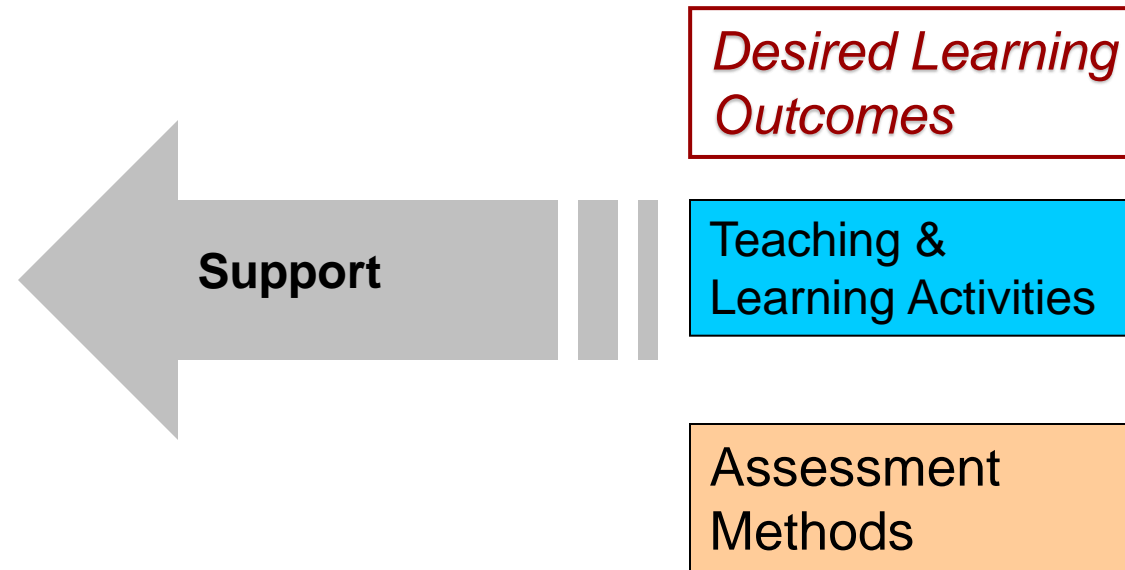c. Briefing for students and provide necessary forms
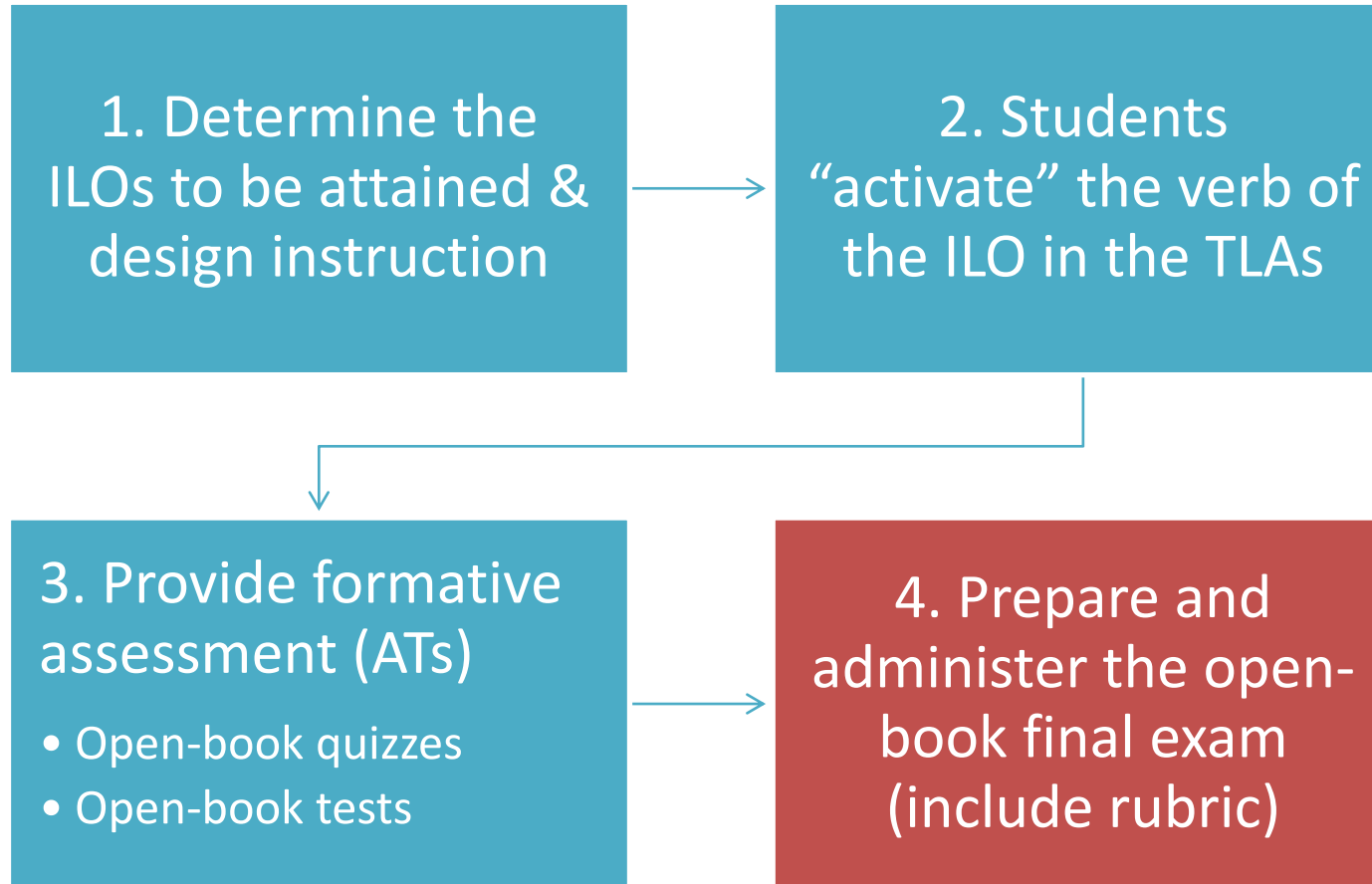
Example: a 3rd year course in Chem Eng

ILO: Ability to **evaluate** performance of three modes of feedback controllers by tuning and analysing the closed-loop responses for selecting the suitable ones.

TLA: PBL on feedback control of a chemical process

ATs: Both formative and summative

Constructive Alignment (Biggs)

Desired Learning Outcomes

Support

Teaching & Learning Activities

Assessment Methods

Ensuring learning outcomes attainment

From Strobel, 2008

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FINAL CASE STUDY

Design of Automatic Control System for CCM Chemicals (M) Sdn Bhd

The Scenario

Now that you have experience as a process engineer, you have decided to join a process control consultancy firm, PARAGON Consulting Sdn. Bhd.. You are hired because of your knowledge in chemical engineering, experience as a process engineer, and credentials. Since many of the firm's engineers are electrical and mechanical engineers, your job scope includes: i) provide expertise to other engineers to understand, describe and analyze chemical processes, and ii) design automatic control systems for chemical processes. One Tuesday morning, you received the following email from the general manager:

| Reply | Reply all | Forward | Delete | Print | Back | Next |

To: Design Team <design.team@paragon.my>
From: Abu Bakar Iman (abi@paragon.my)
Date: 29/03/2011   11:00AM
Subject: Design of automatic control system for CCM Chemicals

PARAGON
skills for industry

Good day engineers,

I had a meeting with CCM Chemicals' plant manager last week. They are now having problems with the existing control systems of their chlorine gas absorption processes. To be specific, they are facing difficulty to maintain the process variables at the desired operating conditions. Plus, they are experiencing inconsistencies in the online measurement of the product specs too. There are two chlorine gas absorption columns operating, as part of Chloralkali Process for chlorine production, in the company. At the moment, CCM Chemicals is urgently looking for a prospective consultancy firm to solve these problems. Due to our excellent track record in the previous consultancy projects, they've invited us to bid for this project. Therefore, I want your team to design/modify the

---

The Scenario

Your team managed to hand in a report
reactor. On the other hand, the problem
and this is due to the technical failure o
afternoon, you received a phone call from

TK-04002B
PURE METHANOL
INTERMEDIATE

TK-0

zone as undergraduate students. We're ru
fast. We are not only responsible for our o

MMH Process at

The Scenario

Due to your remarkable performa
during the second phase of GEC
proceed to the third phase of th
university's industrial training peri
demonstrate your capability to be G

Since you have learned about the M
Technical Services Department that
going over the complete P&ID o
manager, Mr. Mohd Fairus Asrom,
look on his face…

"Hi guys. How're you doing?" said Mr

"Very well, thank you", said all of you,

"Yesterday I was informed by the p
connected to the CSTR, is having pr

MM

The Scenario

You and your team
GEC's Sustainable Engine
challenge, which was cond
The second phase of the ch
grouped in sustainable indu
teams from other universit

The Sustainable E
principles, diversity, opera
energy industry. GEC real
the development of sustain
quality. The challenge is b
academic background of hi
high quality future enginee
divided into several phases
as providing detailed, struc
And at the end of the chall

Cooperative Problem-Based Learning (CPBL) Model

Phase 1

- Individual meet the problem, restatement & identification
- Team discussion & consensus in problem restatement & identification
- Overall class problem identification & analysis

Self-directed learning

Phase 2

- Individual notes, Peer teaching in team & overall class discussion
- Team synthesis & application for solutions formulation
- Team consensus on final solution generation

Phase 3

- Presentation, reflection & team feedback
- Closure

* Insufficient understanding of learning issues to solve problem
**Incomplete or misunderstanding of problem requirements

Preparing the open-book exam questions

- From the ILO and the fundamental knowledge associated, think about where it is normally used in everyday life or workplace that matches the outcome level

- Think about situations that students would know or be familiar with or those that they have learned in class

- Think about how the situation can lead to an open-ended question

Recycled Methanol stream from

FC

FT

Fresh

To the MTBE reactor

Example in the 3rd year Chemical Engineering Course

In the production of MTBE from Isobutylene and methanol, the access methanol recovered from the methanol-water distillation column is recycled back to the reactor at 80% purity. Based on the flow rate of the recycled methanol, fresh methanol feed is added to make up the required feed flow of methanol into the reactor using a flow control system, as shown in the P&ID in Figure 1-1.1. The flow sensor has a gain of 0.7 mA/(gallons/min), with negligible dynamics. The control valve can be approximated with first order dynamics, with a gain of (2 gallons/min)/min and time constant of 10 seconds.
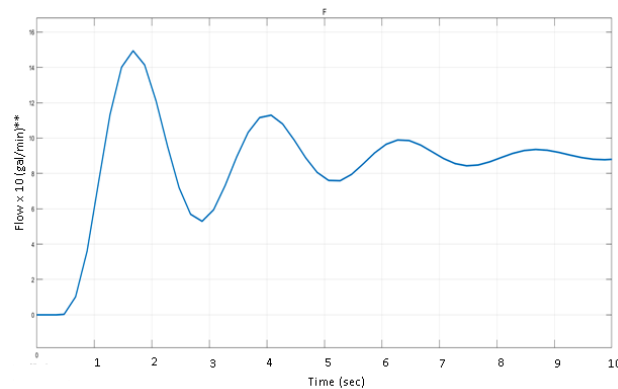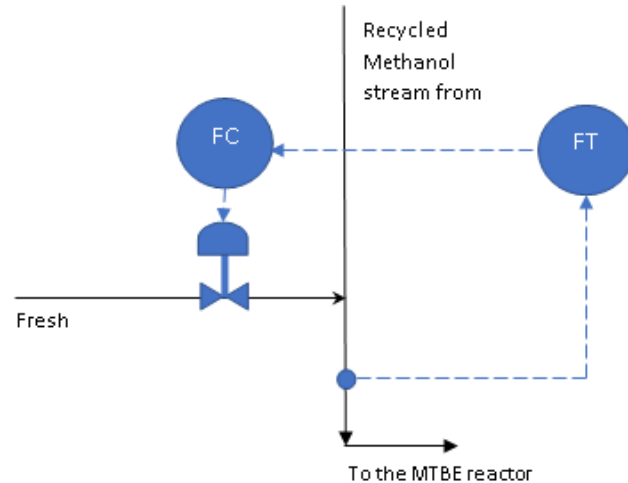
a. To make her job easier, the control engineer developed a simulation for the process. She made a step change in the fresh methanol feed in the simulation for the process from the initial nominal flowrate of 8.4 gallons/min to 9.3 gallons/min at time 0.5 seconds, resulting in the process response shown in Figure 1-1.2. Taking into account the instrumentation information from the plant, analyse the stability of the flow control system using the Routh-Hurwitz method if a proportional controller is used.

Example in the 3rd year Chemical Engineering Course (cont'd)

b. Using the information on the instruments from the plant and the simulated model, the control engineer developed a Simulink model of the flow control system. She increased the Kc value while making step changes in the setpoint in the flow to the MTBE reactor. Figure 1-1.3 shows the controlled variable when a set point change was made from 19 to 21 gallons/min. Tune the feedback controllers using the Ziegler-Nichols on-line method.

c. Knowing that flow control has fast dynamics and can normally be noisy, which feedback control system mode would you recommend and why? Justify your answer based on the controller behaviour which is related to the controller equations. Based on this, how should the controller be fine-tuned from the starting values found from part (b)?

d. Are the tuning parameters calculated for servo or regulatory control? Why? What will the control engineer have to do if the she wants to find the tuning parameters for other type of control? Describe the process clearly with proper reasoning Fresh Methanol Feed Recycled Methanol stream from surge tank FC

For on-line open-book quiz, test or final exams, we can also prepare several sets of questions

How?

Change the numbers on the question, or use different settings or processes or application based on the same fundamental concepts can be used to come up with different but equivalent questions

Sample question for a take-home quiz (3ʳᵈ year)

Outcome: able to **derive** lumped parameter dynamic models for analysing behaviour of chemical processes

- A pot of water is boiling on a stove. Calculate the degrees of freedom and develop a mathematical model.

What other setting can we use for an equivalent question to this boiling water problem? What about the feedback control problem?

Example Quiz for 1st year students

Outcome: students can perform calculations that involve 1) unit conversion, 2) density and specific gravity and 3) mass, force and weight

During the recent holidays, the head of the village asked for Ali's assistance to find the maximum capacity of cooking pot that can be used for a recently customized metal support for cooking outdoors. The village head is confident that Ali, as a student of engineering, can help him get a reasonable answer. The metal support is said to be able to withstand a maximum of 300 lb_f. The average density of food being cooked in the pot can be estimated to be about 5 to 10% more than the density of water, and weight of the pot itself can be neglected compared to the weight of the content. Find the answer if you were in Ali's position

**What other setting can we use for an equivalent question?**

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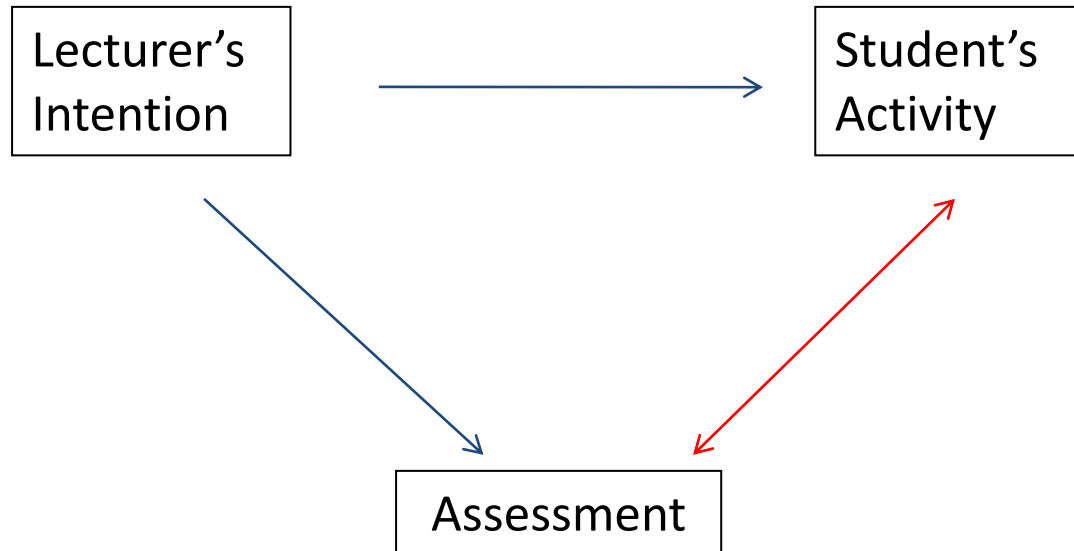
Assessment

Assessment Tasks (ATs) to assess ILOs

Final Tips

Understand and embrace the ILO
- Fundamental concepts
- Functioning knowledge (What is needed in life?)
- Standard

TLA and AT should support learning and attainment of ILO
- Alignment
- scaffolding

Understand and support learners
- Background, interests, motivation

Start before semester for proper design and plan
- Continuous improvement and reflection → write?

Thank you for your kind attention and participation!

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