

# ***ENQUIRY-BASED LEARNING IN ENGINEERING CURRICULUM:***

***Are we preparing graduates ready to  
face future challenges?***

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# Outline

- **Drivers**
- **Approach**
- **Does it work?**
- **Concluding remarks**

# Drivers



# Approach

- To review the teaching of chemical engineering Ug degrees to ensure that the curriculum is:
  - Compliant with external requirements (assessments, ILO), IChemE, InstMC & EI accreditation
  - Relevant to chemical engineers of the future
  - Integrated across years/subjects
  - Effective for larger cohorts of students
- Review started in 2007 taking into account input from all stakeholders

# Process

- ✓ Core curriculum design group convened (DPDs, industrial representative, staff with external experience) and facilitated by QuiLT rep
- ✓ Overview of UK competitor degrees, consultation where appropriate
- ✓ Consultations as detailed in next slide
- ✓ Feedback from Faculty
- ✓ Establishing a focus group of practising industrialists
- ✓ Away day
- ✓ Subject groups lead by future module leaders
- ✓ Preparation of the required documentation

# Consultations

- ✓ Accreditation discussions with IChemE
- ✓ Consultation with the External examiner
- ✓ HEA workshops on Enquiry based learning, assessment and feedback, curriculum review and ILO
- ✓ Observation of PBL in the Medical faculty, detailed discussions on the process, advantages, problems
- ✓ Meeting with student representatives on SSC and BoS
- ✓ Questionnaire sent to recent past graduates in a range of industries (consultancy, specialty and bulk chemicals, procurement, petrochemicals, etc.)
- ✓ Meeting with practising chemical engineers from a range of industries
- ✓ Discussions with the Ug Dean and Faculty administrator

# Accreditation framework

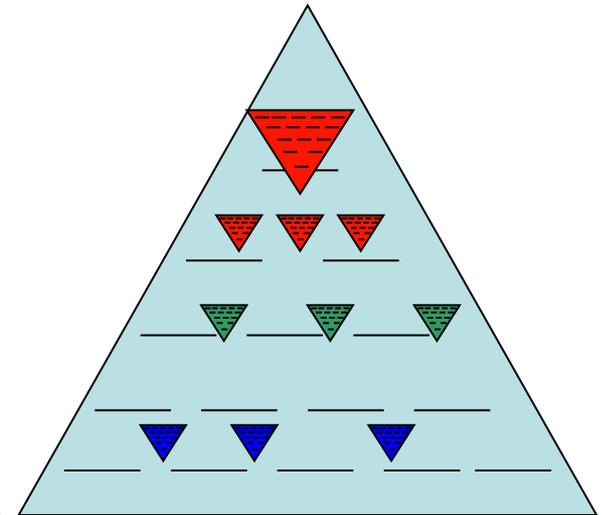
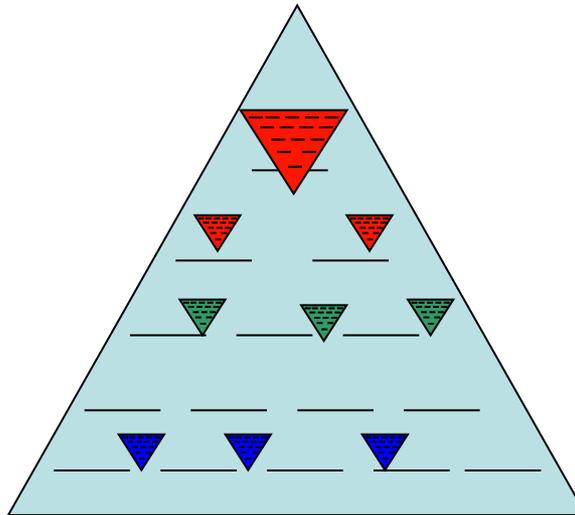
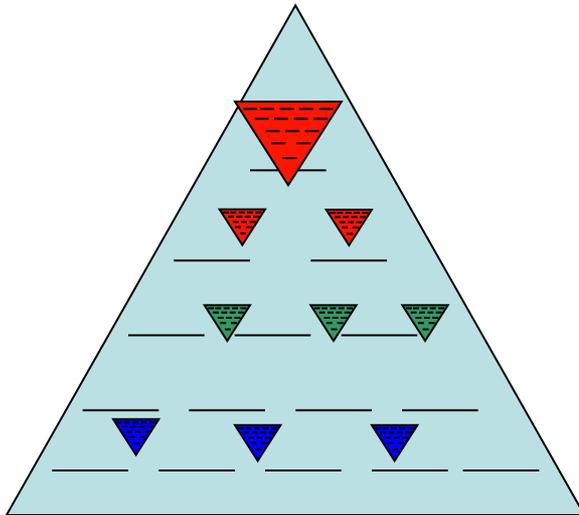
	Master Level	Bachelor Level	Further Learning to Master Level
Underpinning Mathematics and Science	20	20	
Core Chemical Engineering	85	85	
Engineering Practice	10	10	
Design Practice	10	10	
Embedded Learning (SHE, Sustainability)	Sufficient, clear demonstration <sup>#</sup>	Sufficient, clear demonstration <sup>#</sup>	Sufficient, clear demonstration <sup>#</sup>
Embedded Learning (Transferable Skills)	Sufficient, clear demonstration <sup>#</sup>	Sufficient, clear demonstration <sup>#</sup>	Sufficient, clear demonstration <sup>#</sup>
Advanced Chemical Engineering - Depth	30		30
Advanced Chemical Engineering - Breadth	15		15
Advanced Chemical Engineering Practice	10		10
Advanced Chemical Engineering Design Practice	5		5
<b>Total IChemE Specified Content</b>	<b>185</b>	<b>125</b>	<b>60</b>

# Broad areas of chem. eng. employment

Design Engineering

Operations & Management

Process/Product Development



▼ Case studies in different stages, integrating different subjects, culminating in the design project

# Case studies - benefits

- Critical to the aims of the curriculum restructuring
- Linking knowledge from a number of modules as well as developing professional skills in 'real life' scenarios
- Small group learning promoting problem solving, team working, initiative & leadership/negotiation skills, computing skills, data synthesis and critical analysis
- Assessment via more appropriate forms – reports (including reflective individual reports) and presentations promoting the development of presentation and report writing skills
- Promoting independence of learning and peer assisted learning

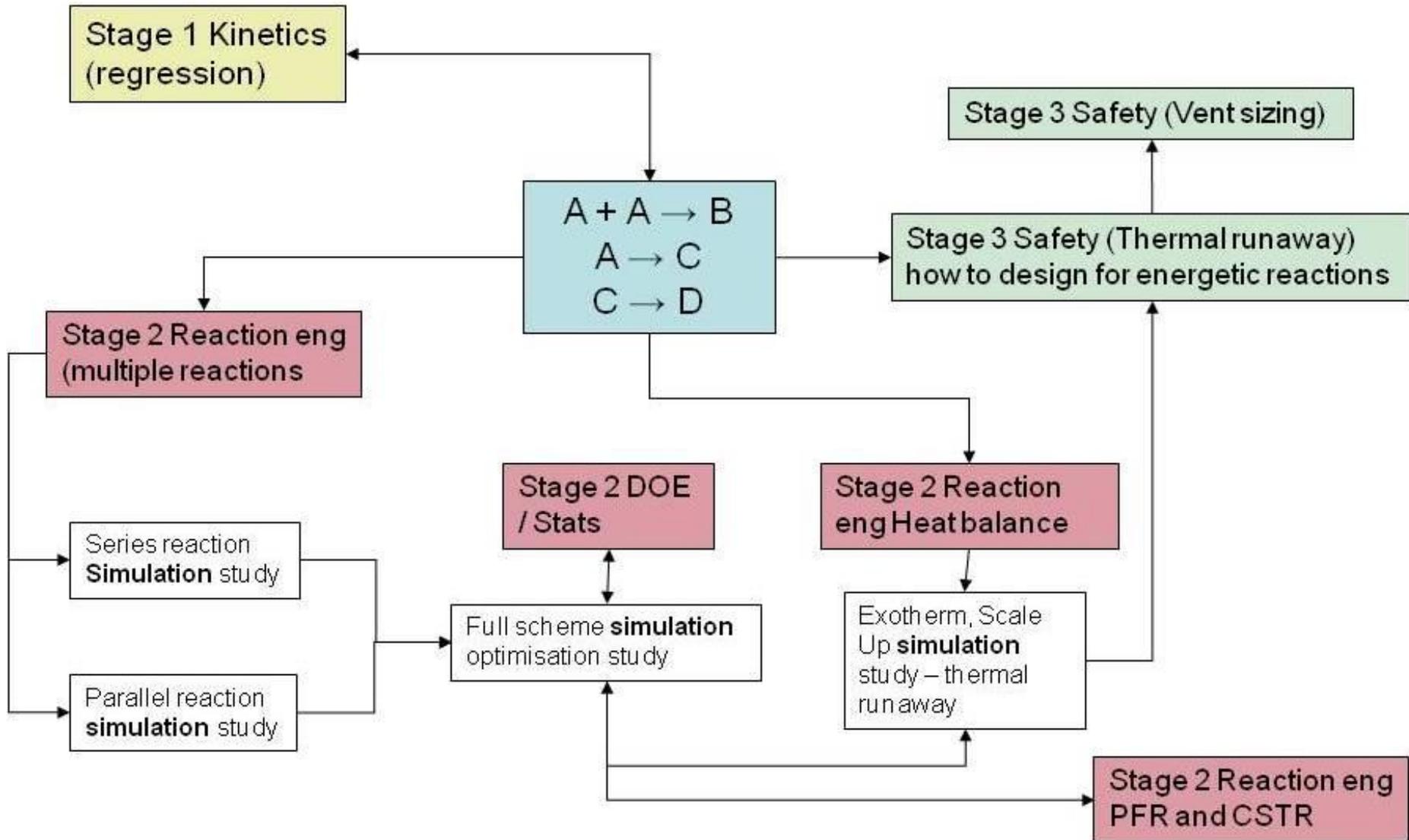
# Case studies – requirements

- Realistic case study scenarios – input of industrial contacts
- Development of case studies in student-friendly format
- Small group learning space
- Relevant computing packages and support
- Staff buy-in – restructuring lecture material in relevant modules so that it links closely with case studies (on demand) is seen as critical to the success of this scheme
- Transition to a different mode of delivery will require a period of adjustment and more support to both staff and students

# Case study example – Stage 1



# Case study example – Stage 2



# Does it work?

- Student focus groups on the effectiveness of different methods – diamond ranking
- Questionnaires on case study on reaction engineering in Stage 2 (66 students, 53 responding)
- Analysis of the self-reflection reports from case study in Stage 1 (103 reports analysed)

Most applications of Unit Operations are currently Petrochemical  
 Maybe try to pull on different industries?

Memorising formulae is a waste of time in many cases as crammed  
 more should know where to find info.  
 Presentation Skills  
 Difference in requirements Operators, etc.  
 None academic skills  
 Selection of Designs  
 rather than how to design a STR and then what is the difference in a PFR we should be taught to think, "I have a process, what reactor type/column type/size/seperator etc should I employ at the start"

plant visit with more hands on large chem plant

We should be taught how to use the programs on computer, not straight into doing projects on them

Practical skills

use of genuine industrial sites  
 proper P+IDs in Projects  
 appreciation of commissioning

limited modelling situations just Distillation

Modelling

Flowsheeting

Difference between this and a P&ID  
 Use of just drawing a quick Flow sheet

How to use the software Particularly Aspen Plus. (Extended Projects?)

Do control of units as you go through modules.

useful but often consulted with industrial professionals for advice.

more specific than subjects above

more assignments or design

Design principles for unit operations

Control

Separation Processes

again centred around distillation, maybe use different examples eg conc. Orange juice?

Streamline + amalgamate Control 1 and 2.

using more examples like Mark does (practical application)

How to select separation unit? (Project?)

amalgamate filtering/distillation/lig/lig + particles

use of this sort of brainstorming exercises

Reactor Engineering

Mathematics

very infrequently used unless in specialist design office.

these skills are easily forgotten after exam but I think they are needed for course in industry good to have appreciation but a professional chemist is consulted from

useful but limited/specialist use in industry as professionals contracted in.

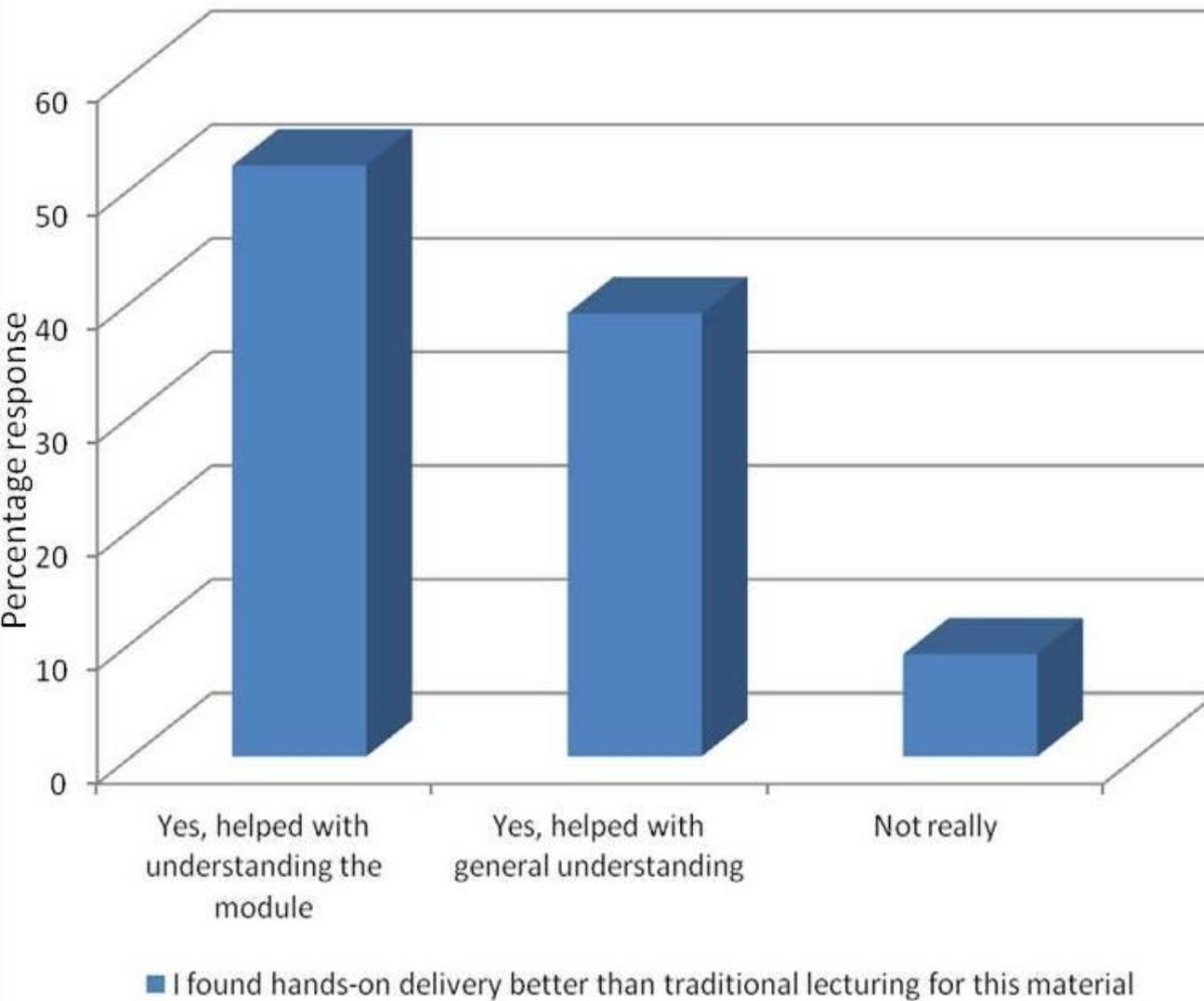
Chemistry

Endnote

Biggest theme is gaining where and how



# Stage 2 case study



# Evaluation of self-reflective reports

## Stage 1

...Unfortunately I did not feel like our group worked well towards the start of the project. However

...I honestly enjoyed working with such a group in which I have never thought that working on a case study or a report with a group would be easy and fun and would have no conflict such as this group

...we just met for the year enrolment and the fact that everyone comes from a different backgrounds. The thought of having hard time mixing around would always bug me up, but fortunately we all able to understand the situation...

... I was a pretty terrible group member if I'm honest, I wasn't very good attending meetings, and

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# Concluding remarks

- All stages of BEng course now revised with Stage 4 currently being finalised for MEng courses
- First BEng graduates from the revised course graduated this summer
- EBL taking both lecturers and students out of their comfort zone, but reinforcing in-depth learning of principles and professional skills
- Long-term process requiring full commitment and continuous re-evaluation

Thanks to all CEAM colleagues  
(academic and admin alike) involved  
in the curriculum re-structuring

Thank you for your attention

