



Sustainability: words or do we really teach the engineers effectively?

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Brief summary of School activities

- around 200 UG students on MEng/BEng chemical engineering
- new MEng/BEng in Biopharmaceutical Technology, MEng/BEng Drug Development
- around 90 PgR students
- six MSc courses with around 60-80 students annually
- MSc Clean technology long history, very good reputation

Sustainability provision

- specialised MEng with Sustainable engineering
- sustainability integrated throughout the MEng / BEng degrees
- enquiry based learning introduced to enhance the integration and develop professional skills
- case studies combining material from a range of subject specific modules
- incorporate sustainability considerations

'Fuelling a manned mission to Mars'

- case study introduced in 2009 to Stage 1
- working in small groups, students investigate a range of alternative fuel sources, e.g. direct methanol, molten carbonate, phosphoric acid, alkaline and proton exchange fuel cells
- tutorial sessions and practicals
- report and group presentation of solution

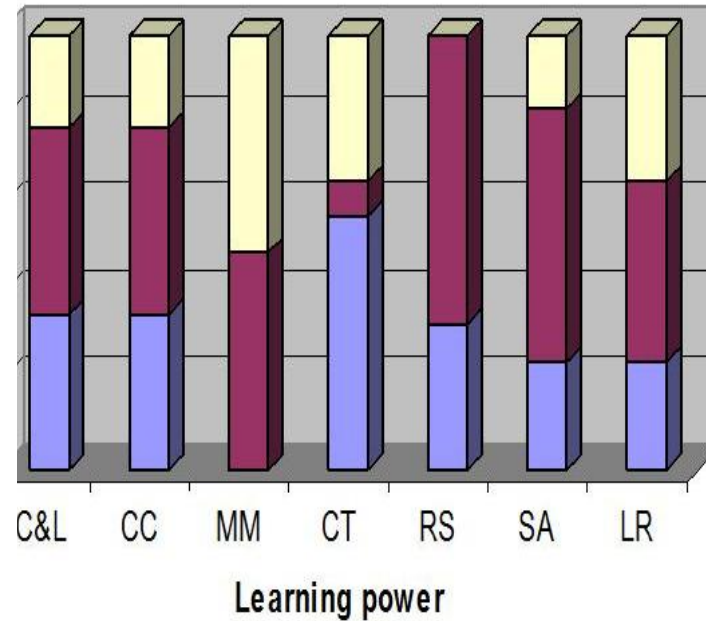
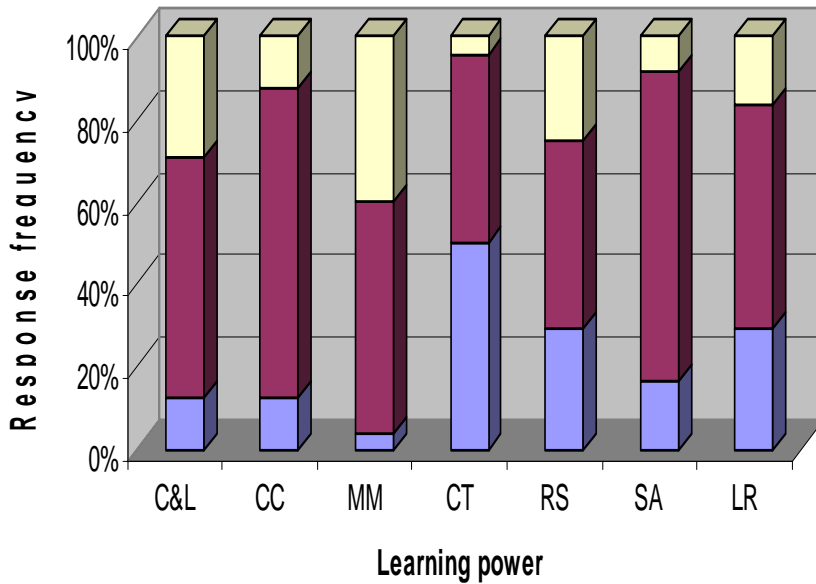
Impact of case studies

- Elli questionnaires administered to 72 Stage 1 students and 47 Stage 2 students (no case studies used in curriculum)
- seven dimensions of learning power:
 - *changing and learning* (C&L)
 - *critical curiosity* (CC)
 - *meaning making* (MM)
 - *creativity* (CT)
 - *resilience* (RS)
 - *strategic awareness* (SA)
 - *learning relationships* (LR)

Outcome

Stage 1 (n=24)

Stage 2 (n=12)



Focus groups

- 14 Stage 3 and Stage 4 students working in pairs using diamond ranking to answer the following question:
What modes of delivery promote deep learning and professional skill development?
- 9 Stage 1 students participated in a semi-structured interview
- this focus group was facilitated by a researcher external to the school and in complete anonymity

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

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

Memorising formulae is a waste of time in many cases as crammed
 more should know where to find info. for exams
 Presentation Skills
 Difference in requirements Operators, Mgmt, 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/separator etc should I choose at the start?

plant visit with more hands on large chem plant

Practical skills

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

limited modelling functions just Distillation

Modelling

Flow sheeting

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

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

Do control of unit 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?)

amalgamating filtering/distillation/liq/liq + particles

use of this sort of brainstorming exercises and makes skills useful but flip charts/limited available for this. use in industry as professionals contracted in.

Reactor Engineering

Mathematics

Very infrequently used unless in specialist design office.

these skills are easily forgotten after exam but I think that skills are needed for course

useful for understanding course but use in industry is limited at best. Boss in industry good to have appreciation but a professional chemist is consulted from years!

Chemistry

Biggest theme is gaining know and how

Endnote



Focus group outcomes

- small group real life problem solving, hands-on sessions, supported by practicals identified as critical to deep learning by students
- issues with group work and contribution
- resource implications – increased student numbers

Concluding Comments

- Pre-intervention ELLI results show most marked differences between the two cohorts in meaning making (MM), creativity (CT) and resilience (RS)
- ELLI procedure issues prevented a full post-intervention comparison
- Plans to investigate long-term effects
- Continue EBL case base delivery, extending into Stage 2

Acknowledgements

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Questions?

