

Problem Based Learning And Team-work in Chemical Engineering

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Outline

- Motivations for change
- The change process
- Problem based learning
- Teamwork
- Accreditation
- Conclusions

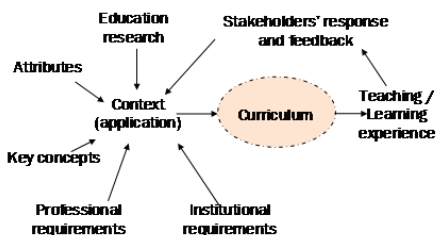
Where We Started

- Traditional curriculum
- Representative of program style followed internationally
- Based on standard format (1970s):
 - 1st yr: Science and mathematics
 - 2nd yr: Science/Math + Intro to discipline
 - 3rd yr: Main disciplinary subjects
 - 4th yr: Design, thesis, electives.

Why Change

- Compartmentalised curriculum;
- Students lacking basic competencies;
- New developments within discipline;
- Other developments:
 - IT / Web availability;
 - Combined degrees;
 - Part-time work;
 - Professional requirements, etc.

Curriculum design process



New Curriculum structure

- Four key categories:
 - **core subjects:** to provide concepts;
 - **enabling technology subjects:** to help apply concepts and solve problems;
 - **engineering practice subjects:** (based on PBL) to provide context and practical skills;
 - **elective subjects:** to enable specialisation.

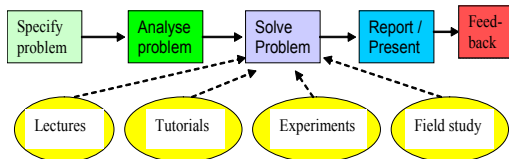
New Curriculum

Year 2 Sem 1	CHNG 2801 Conservation and Transport Processes	CHNG 2802 Applied Maths for Chemical Engineers	CHNG 2803 Analysis Practice 1 – Energy & Fluid Systems	CHEM 2 (E) Physical Chemistry for Chemical Engineers
Year 2 Sem 2	CHNG 2804 Chemical and Biological Systems Behaviour	CHNG 2805 Industrial Systems & Sustainability	CHNG 2806 Analysis Practice 2 – Treatment, Purification & Recovery Systems	CHEM 2 (E) Chemistry of Biological Systems
Year 3 Sem 1	CHNG 3801 Process Design	CHNG 3802 Operation, Analysis & Improv of Indl Systems	CHNG 3803 Design Practice 1 – Chemical & Biological Processes	CHNG 3804 (E) Biochemical Eng
Year 3 Sem 2	CHNG 3805 Product Formulation & Design	CHNG 3806 Management of Industrial Systems	CHNG 3807 Design Practice 2 – Products & Value Chains	CHNG 3808 (E) Polymer Eng
Year 4 Sem 1	CHNG 4801 ChE Thesis A	CHNG 4802 ChE Design A	CHNG 5001 Process Systems Eng	CHNG 5002 (E) Environmental Decision Making
Year 4 Sem 2	CHNG 4805 ChE Thesis B	CHNG 4806 ChE Design B	CHNG 5003 (E) Green Eng	CHNG 5004 (E) Particles & Surfaces

Problem-based learning (PBL)

- Pedagogical strategy for posing significant, real world problems.
- Problems provide focus and motivation for learning.
- Resources/guidance to help develop problem-solving skills.
- Student-centered learning, carried out in small groups.
- Students identify the need for new information.
- Help students know when and how to use knowledge.

PBL strategy



Goals of PBL

- Provide an opportunity to study a complex contemporary problem
- Foster critical thinking and analytic interpretation
- Improve oral and written communication skills
- Enhance research skills
- Provide experience with group dynamics and collaborative exploration of problems
- Enhance ethical foundations and a sense of social responsibility.

Problems / projects

- Manufacture of soap
- Designing an artificial heart
- Manufacture of suite of products, eg, bio-ethanol, styrene, beverages.
- **Integrated web-plant:** source of multiple problems & projects.

Pilot-plant



Virtual-plant



Teamwork

- Form teams: heterogeneous / homogeneous.
- Facilitate teamwork: group constitution; work out decision making process; participation; accountability;
- Monitor teamwork: run workshops, intermediate reports, presentations.

Facilitating Teamwork

- Working in groups does not happen naturally
- Establish an environment of mutual respect and acceptance of differences
- Promote positive interdependence
- Support collaborative skills
- Promote individual accountability
- Provide assistance to teams having difficulty working together
- *In science & eng, criticism is the measure of friendship* (Francis Crick).

Benefits of Teamwork

- Brainstorming: members offer complementary and supplementary perspectives and opinions;
- Spurs one to think harder and more creatively;
- Mistakes by the group are more likely to be detected by a group member than individual mistakes are to be detected by an individual;
- Members become active learners as they are required to pursue problem solving.
- Increases their sense of independence and responsibility.

Graduate attributes

- Research & Inquiry
- Information Literacy
- Intellectual Autonomy
- Ethical, Social & Professional Understanding
- Communication

Assessments

- Assess team performance: group reports, workshops, presentations.
- Assess individual performance: contribution statements, interviews, peer reviews.
- Written exam: appropriate weightage for components.



Key Features

- Completed program
- Range of assessments.
- Team and individual assessments
- Internally integrated
- Team teaching, highly problem-based practice courses.



Positive Features

- Improved attendance & engagement
- Cultural change; team teaching.
- Positive accreditation report: exemplar in Faculty; staff commitment to explore different ways to encourage student learning.



Conclusions

- Underlying problems motivated change; Resulted in a more integrated curriculum;
- PBL is a key element;
- Teamwork is crucial: development of appropriate assessments;
- Accreditation: documented the process of change; motivations, methods, outcomes.



Acknowledgements:

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