

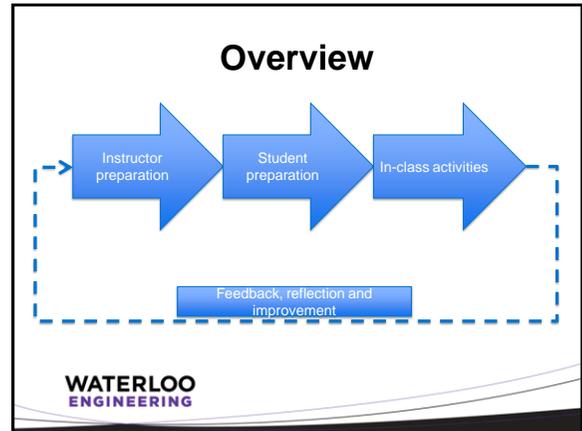
Case Studies as Open-Ended Problems for Student Deep Learning in Chemical Engineering

Implementation, Breakthrough, and Barriers

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OND Conference
University of Waterloo April 25, 2013



What is a case?

- There are different opinions on what a “case” is
- A real situation or problem
- Often ill-posed and open-ended
- Information and data may be missing, unavailable, hard to extract, wrong, etc.
- Often integrated with other parts of the curriculum

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Why cases?

- Promote student engagement and enjoyment and lead to deeper learning
- Enable students to develop critical analysis and research skills
- Provide an opportunity to demonstrate and enhance creativity
- Provides an opportunity to integrate different areas of the curriculum
- Leverage our students’ co-op experiences

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Course Contexts

Course	TE/ Core	Size	Content
ChE571 – Industrial Ecology	TE (4B)	65	Industrial metabolism, lifecycle assessment and environmental aspects of chemical engineering
ChE564 – Food Process Engineering	TE (4B)	17	Food characteristics, processing methods, preservation techniques, food safety
ChE360 – Bioprocess Engineering	Core (3A)	92	Components of a bioprocess, organism selection and characterization, bioprocess design, product recovery and purification

*TE: Technical elective, mostly students take these in 4B

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Learning Objectives

Course	Objective
ChE571	To reinforce knowledge of environmental law in Canada and to explore and understand the concept of due diligence
ChE564	To conduct a critical analysis of the manufacture of ready-to-eat meat products by considering the 2008 Canadian Listeriosis outbreak with respect to one of the following topics: Listeria growth prediction Environmental testing Meat equipment operation and cleaning Hazard Analysis Critical Control Point (HACCP) plan
ChE360	To gain an understanding of what an organism is able to produce, how it's able to produce it, and how we can the recover the product

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Pre-Case Course Material

Course	Case-related material presented
ChE571	Present lecture on environmental law (1 h)
ChE564	Present lecture on Listeria, microbial growth predictions, HACCP (2 h) Present HACCP example in class (1 h)
ChE360	Present lecture on related material

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Instructor Preparation

Course	Case-related material presented	Est. time
ChE571	Developed the case Defined learning goals and discussion plan	2 d 1-2 h
ChE564	Provided feedback to a case writer developing the case study Prepared documentation	2 h 2 h
ChE360	Team development of the case with a TA Prepared presentation and follow-up questions	2 d 2-3 h

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Student Preparation

Course	Case-related material presented	Est. time
ChE571	Read case and prepare for in-class discussion Note: directed not to do any additional research	2 h
ChE564	Conduct critical review of case as presented Consult scientific resources, regulations, web resources In groups of 2 or 3, prepare a presentation to deliver to the class	10 h
ChE360	Case introduced in class	0 h

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In-Class Delivery

Course	Case-related material presented	Est. time
ChE571	Discuss case with instructor facilitating Additional information presented during class	2 h
ChE564	Student group presentations Instructor listens, grades, asks questions	2 h
ChE360	Instructor presents case, explain subtleties Students listen and respond to questions testing their understanding	1 h

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Post-Class Activities

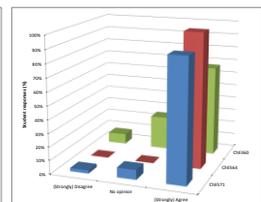
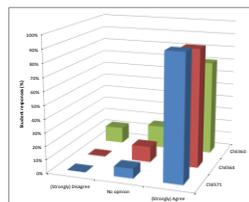
Course	Case-related material presented	Est. time
ChE571	None	-
ChE564	Instructor grades presentations	2 h (instructor)
ChE360	Students complete on-line questionnaire Students go on to complete a related term project in groups of two	1 h 10 h (per student)

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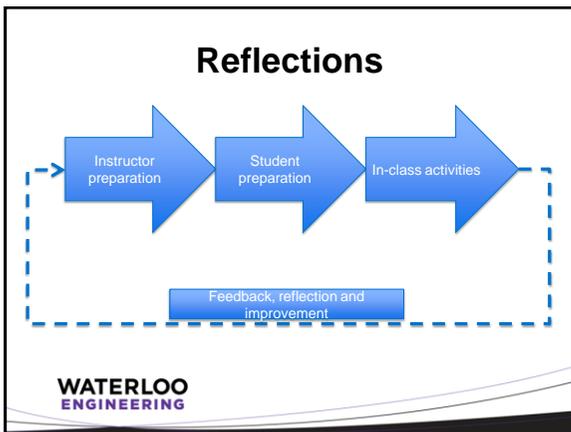
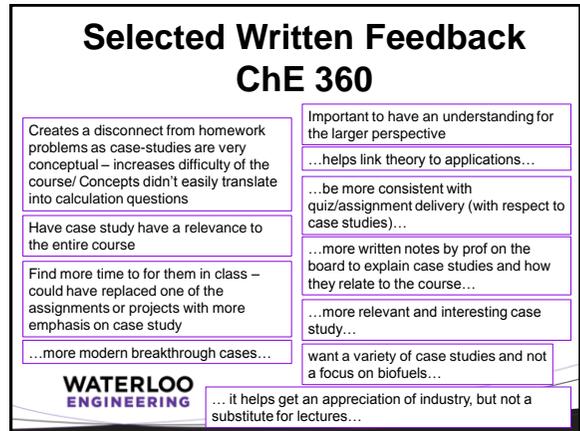
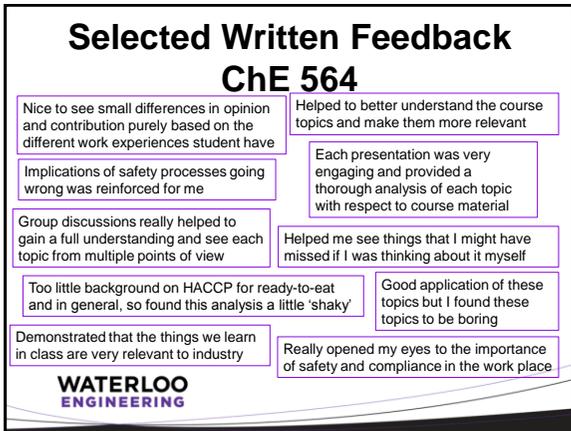
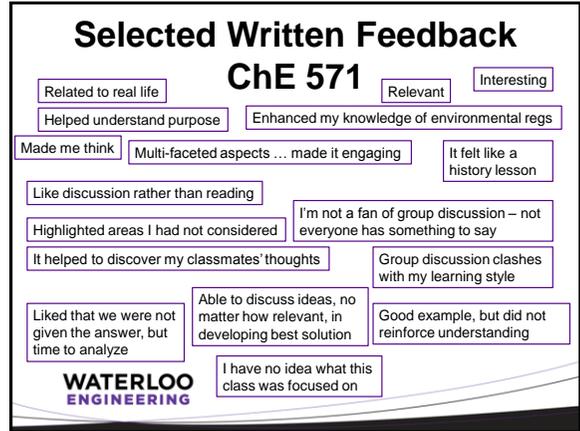
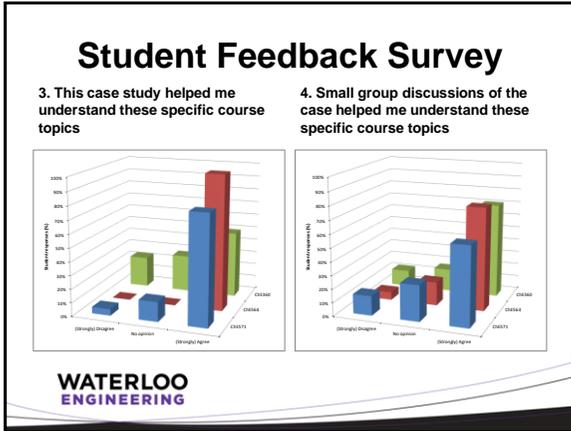
Student Feedback Survey

1. This case study was an engaging application of these specific course topics

2. This case study improved my appreciation of the relevance of these specific course topics



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- ### Reflections: Instructor Preparation
- Cases for courses
 - Three very different applications of case studies; cases have specific teaching purposes (though one case may have multiple potential uses)
 - Manage student expectations
 - Clear communication required
 - Directed preparation: questions to consider, additional resources required, etc.
 - Consider student maturity and familiarity with cases
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Reflections: Student Preparation

- Essential component – students need to buy-in
 - “Learning contract”
- Directed preparation
- Use small-group discussion before (or at start of) class
 - Makes it more difficult for students not to prepare
 - Opportunity for everyone to speak

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Reflections: In-Class and Post-Class Activities

- Students were generally engaged and interested
 - successful peer-learning / -teaching!
- Follow-up
 - Conclusions (instructor or student?)
 - Opportunities for related assignment, projects, etc.
 - Align with learning objectives
 - Provide feedback after the case study

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Acknowledgements

- Kajan Srirangan and Lamees Akawi
- Cheryl Pearce and Steve Lambert,
[Waterloo Cases in Design Engineering](#)

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