Capturing evidence to inform scholarship on your teaching

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- What is (not) working for our students?
- How do we know that what we are doing is (not) making a difference to their learning?
- How do we know what is (not) effective?
- How do we test our assumptions?

[5 min] reflect on your teaching practice

Reflect on a learning programme/activity you have implemented in your teaching practice (or intend to implement).

How do you know it worked?

Informed thinking – informed practice

Commitment to using evidence to understand the learners we teach, train or supervise, and using that evidence to ensure they achieve the best possible learning outcomes

Collect and use data, in a **purposive way**, to understand how our teaching is impacting on students' learning

- Test, inform and adapt teaching practices.
- Demonstrate change and inform improvements

Share good practice with others

Teaching as an evidence-based practice

There are many occasions when your work as an educator will be based on the findings of educational research – you as a "consumer" of research **– research literacy**

Reflect on your teaching as a research activity – **action research**

Research in Education

- Question
- Theory
- Methods
- Reasoning
- Replicate and generalize
- Disclose

Integrated into your practice

Research in Education

- What is the teaching/learning issue or problem?
- Are the questions clear?
- What is the relevant literature/theoretical background?
- Consider ethical issues
- Design the study, appropriate methodology
- Collect and analyse the data
- Discuss and disseminate

Evidence in SoTL

- Systematic practice
- Clear goals
- Appropriate methodology – so that can be replicated or elaborated
- Documented – to be shared/disseminated

Collecting data – fit for purpose

Qualitative	Quantitative
• Interviews • Diaries/blogs • Focus groups • Participant observation • Emerging methodologies |Case & Light, 2011|	• Questionnaires/surveys • Student records (secondary data): grades, retention and completion rates

Your own reflective journal – narrative of the process of the research

What data is already available?

- From **whom** data is collected
- **Where** is collected/stored
- **What** kinds of data are available
- **When**, and **how often** data are collected

Image credit: tomsturm - Fotolia

- Identify gaps: what additional data might need to be collected?
- What are the limitations? (e.g. social desirability in self-reporting)
- **Data triangulation**

Type of data	Data sources
Who are my students? (demographics)	Institutional databases (e.g. enrolment data) Questionnaire/survey
What are my students expectations to study engineering?	Institutional surveys (e.g. entry to study) Questionnaires Focus groups
How engaged are my students?	Data on student engagement with VLEs Attendance rates Observation (e.g. peer-observation) Surveys
How are my students progressing in their learning?	Academic records (overall picture) Formative assessment Pre- and post- tests Observation Focus groups, interviews
How do I know my students have achieved the requirements of the course/module?	Summative assessment Portfolios
What do my students think about my teaching?	Questionnaire Focus groups (student-led or external-led)
How are my students using their skills?	Surveys Completion rates Career progression Employment questionnaires/employer surveys

First 3 years (2014-2017)

Survey based on NSSE

Focus groups (by year of study and discipline)

UCL Arena

Pre-IEP data (2012-2014)

First cohort (2014-2018)

Y1: survey & focus groups

Y4: survey & focus groups

IEP Minors

Choice and learning experience

Focus groups

DPS

Group work, authentic learning

Questionnaire

Moodle

IEP Integrated Engineering Programme

Longitudinal study

Y1 (2018-…)

IEP alumni

2019…

[10 min] institutional databases

Thinking about your institution:

- What data is already available about learners?
- How could you use it?
- What are the limitations?
- What additional data are you anticipating to collect?

Question	Data sources (at your institution)	(new) data collection required

Ethics

Aligned with POPIA/GDPR

Research ethics committee at your institution

Participant information and consent.

Useful resources (UCL) https://www.ucl.ac.uk/legal-services/research

Treat all information in confidence. Anonymise.

- Processing (collect, analyse, report)
- Storing
- Sharing and reporting
- Deleting

Research question(s)

Scope

- **Specific/narrow question**

  Useful for testing effects on specific treatments

- **Broad/global question**

  Useful for generating new knowledge

  - Identify common elements of effective programmes
  - Build better intervention theories to guide program development and evaluation design

Research question(s)

Intervention effects

“what is the impact of a PBL module in the academic performance of first year engineering students?”

Association

“how does self-efficacy relate to persistence in engineering studies?”

Diagnostic/prognostic

“which of the two factors (grades or self-efficacy) is a better predictor of pursuing an engineering-related career?”

Research question(s)

A few examples

- Does PBL increase student learning?
- Do students learn better in smaller classes?
- Can group work aid individual learning?
- Can technology help students do more than recall facts?

PICO(S)

Framing a research question

Population

- How could you describe the group in study?
- How could you describe this group/participants to a colleague?
- What are the important characteristics of this group/participant? (e.g. K12, HE, FE, combination?)

Intervention

- What to want to understand/explore? (e.g. which programme? PBL?; what technology? VLE, ITS, clickers?)

Comparison

- What is the alternative?
- Is a control group/condition required? (e.g. comparing tech with no tech; or tech A with tech B)

Outcome

- How will you evaluate an intervention/programme/technology? (e.g. student performance, retention rates)

[15 min] framing a research question

Think of an initiative you would like to implement that will impact your teaching practice.

- Write down a few thoughts about the initiative and turn it into a question using PICO's framework
- Share your question with your colleagues
  - Do they understand what you will be doing?
  - Is the question clear?
  - Reformulate your question.

Literature review

Table 3 Databases for Systematic Review Searches

Type of database	Examples
Subject specific databases	Education: ERIC, Education Full Text (EBSCO) Engineering: Compendex, Inspec Psychology: PyscINFO (ProQuest) Communication: Communication Abstracts (EBSCO), Communication & Mass Media Complete (EBSCO)
General databases	Academic Search Complete, JSTOR, Scopus
Journal databases	Science Direct, Wiley, Directory of Open Access Journals
Gray literature databases	Gray literature overall: OpenDOAR (Directory of Open Access Repositories), Open Grey, National Technical Information Service (NTIS), Google Conference papers: Conference Proceedings Citation Index (ISI), Proceedings First (OCLC) Dissertations/Theses: ProQuest Dissertations & Theses, Open Thesis Government documents: GOP Access, LexisNexis Books: World Cat, Google Books

|Borrego, Froster, & Froyd, 2014, p.56|

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EER societies and networks

- SASEE https://www.sasee.org.za/
- ASEE https://www.asee.org/
- SEFI https://www.sefi.be/
- AAEE http://www.aaee.net.au/
- REEN Research in Engineering Education Network https://www.reen.co/
- UK & Ireland EERN https://hefocus.raeng.org.uk/eern-home/

Who could you work with?

- at your own institution or other institutions?
- from the same/other engineering discipline, social sciences,…?

Reading key literature on your topic

- What is the purpose of the research?
- What is the context of the research?
- Is the research methods clear and relevant?
- What are the main findings? Are they valid and reliable?
- How did the researchers discuss the findings? What are the implications/contributions?
- Are there clear and reasonable suggestions for future work?

Final thoughts

- Data collections needs to be realistic and practical
- Use/adapt secondary data available at your institution
- Follow principles of research ethics
- Triangulate data
- Keep your procedures and reflections documented
- Work and discuss with other colleagues (engineering and non-engineering)

References

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[30 min] identifying your focus

Think of an initiative that will impact your teaching practice

- What else is being done in your area (research background and context)
- Do you need to collect data to answer the question? If not, who has or where are the data?
- Can you estimate how much time and what other resources would you need?
- If you need to collect data, how are you going to do it and when?
- Think of any ethical concerns arising from the collection and processing data.
- How are you going to analyse data?
- How will you present the data?
- Will you make changes in your practice? What are the opportunities and challenges to do it?
- How will you disseminate your findings?

What is the difference, if any, between SOTL and educational research?
An interactive talk

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Scholarship of teaching (and learning)

- Ernest Boyer (1990):
  - *Scholarship Reconsidered: Priorities of the professoriate*
- Enthusiastic reception …
  but from the outset this question:

What actually *is* SOTL?

- a form of teaching?
- a type of educational research?
- a bit of both?

Academic roles – Research & Teaching

- What matters in research?
  - That new knowledge is generated
- What matters in teaching?
  - That students learn

Bringing knowledge in

- (Education) research: production of new knowledge
- But what knowledge is needed for teaching? Is this a straightforward transfer from education research findings to teaching contexts?

A typology

- Scholarly Teaching
  - Excellent teaching + informed by literature /collects evidence / high level reflection
- Scholarship of Teaching & Learning
  - Deriving from scholarly teaching, develops this into knowledge – public / can be evaluated / can be built on
- Education Research
  - Research directed at building (often contextualised) knowledge about education systems, teaching and learning

Questions guiding this talk

- What are the big challenges in engineering education? What education questions should we be researching?
- What kind of excellent/scholarly teaching is needed to support high quality student learning?
- What knowledge is needed to practice excellent/scholarly teaching? Can education research or SOTL provide this knowledge?

Another way of looking at this (phronesis)

- Where are we going?
- Is this desirable?
- What should be done?

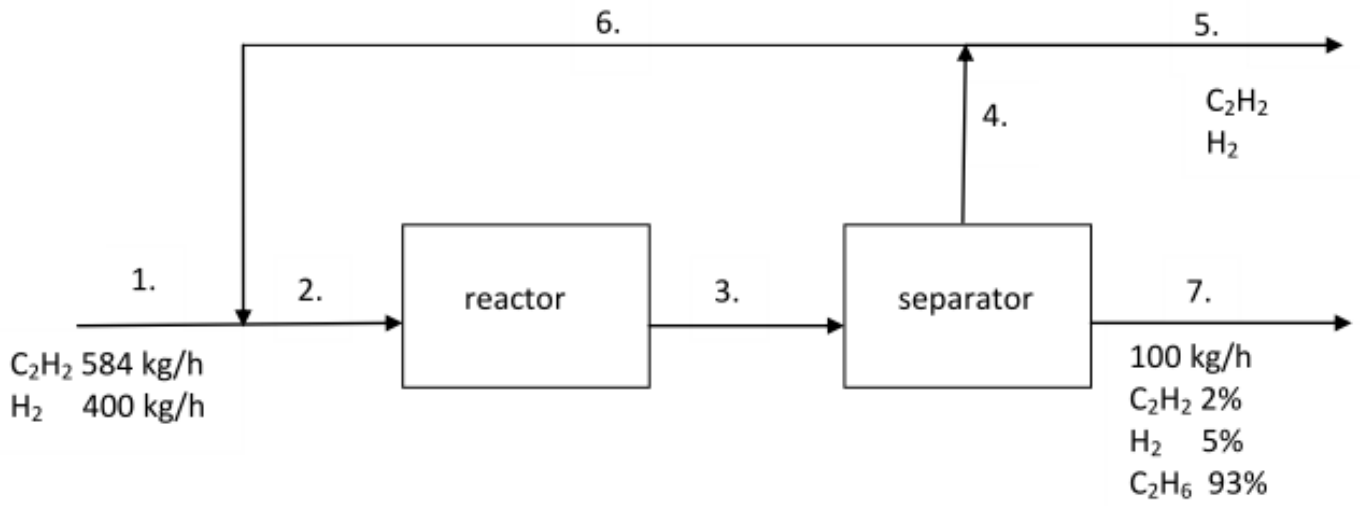
Flyvbjerg, B. (2001). *Making social science matter*. Cambridge: Cambridge University Press.

The course context

2nd year chemical engineering core course ("Material and Energy Balances")

Consider the following system designed for the hydrogenation of acetylene into ethane:

$2\,H_2 + C_2H_2 \rightarrow C_2H_6$



Calculate the overall and per pass conversion for this system.

1998-2000:
Research on student learning in the course

2009-2011:
Teaching the course

The research project 1998-2000

- Course lecturer was attempting to promote conceptual understanding in the course:
  - Reduced and more focused content
  - More interactive teaching
  - Reflective journal tasks
  - Conceptual assessment items
  - One unlimited time test
- Broad research question:
  What are students' experiences of this course?
  - What approaches to learning are prevalent?
  - Does metacognitive development take place?
  - How do these relate to student perceptions of the course?

Surface	Procedural	Deep
		Thabo
		John
		Eddy
		Mike
	Lindiwe	early →
	Geoff	late →
	Thembi	late →
	Andrew	midway →
Nomsa	Nomsa	
Maria		
Shakira		

→ : metacognitive development = shift in approach to learning

Implications

- Course did assess for understanding (no mean achievement)
- Course supported deep approach for those already using it
- BUT Course didn’t fully support metacognitive development towards deep approach

Interlude 2001-2008

- Research project in 3rd year chem eng
  - alienation vs engagement
  - Narrative analysis
- Teaching first year chem eng
  - Focus on building identity and community

Teaching 2009-2011

Teaching 2009-2011

- Reintroduced reduced and focused content
- Reintroduced journal tasks
- Continued with interactive teaching style
- Continued with regular assessment
- Did not change time pressured assessment
- Major innovations:
  - Integrated project
  - Podcasting

Integrated project

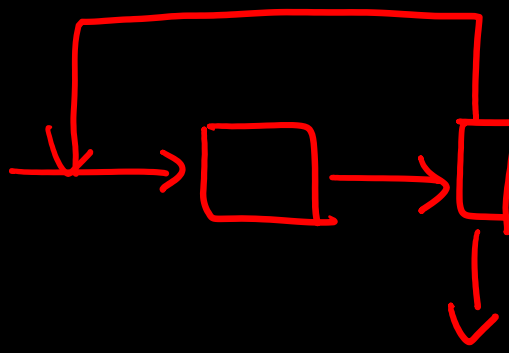
- Key challenge: Groupwork in context of diverse backgrounds
- Strategy devised: All group work sessions happening in class. Compulsory attendance.

It was a nice experience having to go home and have a real chem eng problem to deal with (how do we solve the scrubber).And it was nice to work with people you didn't even greet in class.

$\hat{H}_1 = 104.3\ kJ/kg$

$\hat{H}_2 = 2073\ kJ/kg$

Podcasting



- High verbal load of lecture, many students miss crucial parts of what is happening
- Podcasting
  - mp4 of audio and boardwork (using tablet)
  - used regularly by just over half the class

$\dot{m} = (n_{out} - n_{in})/t$

$\frac{dU}{dt} = \sum \dot{m}_{in} H_{in} - \sum \dot{m}_{out} H_{out}$

I think Prof Case is a fantastic lecturer, she connects very well with all of the students and takes time to understand everyone. I think she puts in lots of work to help us and ensure our understanding. The podcasts are a fantastic tool.

Ongoing challenge in the course

How to get students to achieve the necessary engagement with the material out of class

- Excellent lecture attendance and engagement
- Good use of podcasts for reviewing lectures where needed
- Limited engagement with practice problems until just before the test
- Biweekly tutorial tests do not stimulate focus in the same way that the class test does

On reflection

- Different activities:
  - Research focused on understanding; need to be able to communicate to wider audience
  - Teaching focused on getting learning to happen; need to be able to give evidence for my immediate community
- No simple direct ‘application’ of research findings in teaching
  - Focus on conceptual understanding broadened to encompass participation and inclusion
  - Need whole curriculum change to deal with ‘time’ issue

Using the typology – scholarly teaching or SOTL?

- Scholarly Teaching
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Returning to:
Questions guiding this talk

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Question 1

- What are the big challenges in engineering education? What education questions should we be researching?

Question 2

- What kind of excellent/scholarly teaching is needed to support high quality student learning?

Question 3

- What knowledge is needed to practice excellent/scholarly teaching? Can education research or SOTL provide this knowledge?