The Teaching Trick

How to improve student learning without spending more time teaching

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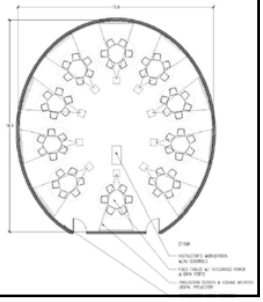
Engineer & Educational developer

- M. Sc. in Engineering, Chalmers
- Associate Professor in *Engineering Education Development* at KTH Royal Institute of Technology, Stockholm, Sweden
- 700 participants in the course *Teaching and Learning in Higher Education*, 7.5 ECTS, customized for KTH faculty, 2004-2012
- Director of Educational Development at Skolkovo Institute of Science and Technology, Moscow, 2012-2013

Strategic educational development, national and international

- CDIO Initiative for reform of engineering education since 2001
- SEFI Administrative Council, 2010-2013
- Editor-in-Chief of the *European Journal of Engineering Education* from 2018

cdio
CONCEIVE DESIGN IMPLEMENT OPERATE



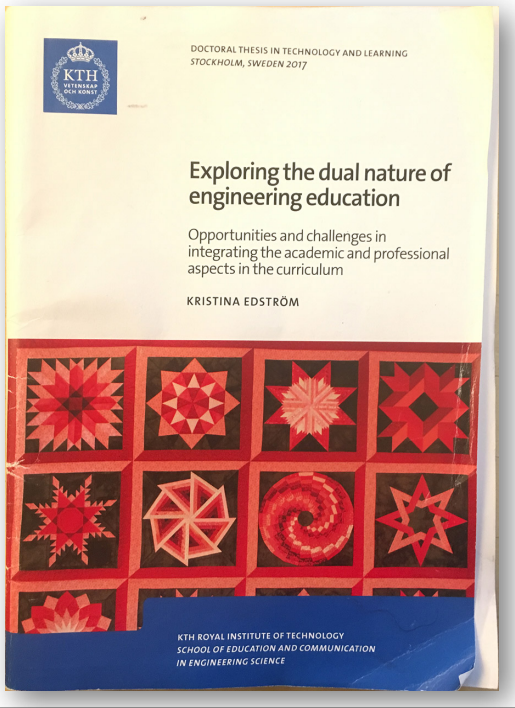
Research

- PhD defense December 13, 2017

Some publications

- Crawley, E.F., Malmqvist, J., Östlund, S., Brodeur, D.R., and Edström, K. (2014) *Rethinking Engineering Education: The CDIO Approach*, 2nd ed., Springer Verlag.
- Edström, K., & Kolmos, A. (2014). PBL and CDIO: complementary models for engineering education development. *European Journal of Engineering Education*, 39(5), 539-555.
- Edström, K. (2008) Doing course evaluation as if learning matters most, *Higher Education Research & Development*, 27:2, 95 – 106.
- Edström, K. (2017). The role of CDIO in engineering education research: Combining usefulness and scholarliness. *European Journal of Engineering Education*, in press.
- Edström,K. (2018, forthcoming). Academic and professional values in engineering education: Engaging with the past to explore a persistent tension. *Engineering Studies*.

PhD defense December 13



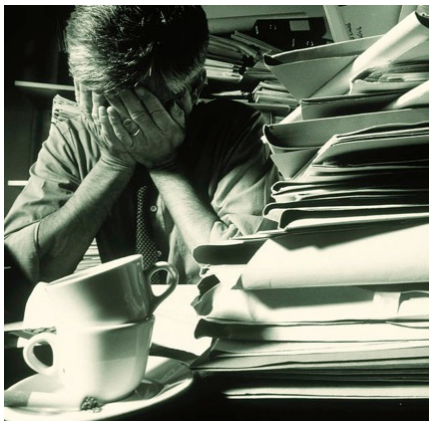
Jakob Kuttenkeuler

- Professor in Naval architecture.
- PhD in Aerospace engineering.
- 10 years as director of two MSc programs and one PhD program.
- Research on design process of high speed craft optimization for sustainability, Routing etc.
- Teaches Hydrodynamics, Ship dynamics, Maneouvering, Propeller design, Sailing mechanics etc.
- Awarded the KTH prize for outstanding educational achievements.
- Engaged in CDIO since start.

Cost-neutral interventions

To persuade the grumpy professor to listen

To relieve those dedicated to teaching



Anyone can improve a course (at least some little bit) by working 100 hours more…

Yeah. We don't have those hours.

And "more of the same" is often not the best strategy…

What if we were building a bridge…

Maidenhead Railroad Bridge, England, I. K. Brunel, 1838.

What is it that we have today that keeps us from replicating the old bridge?

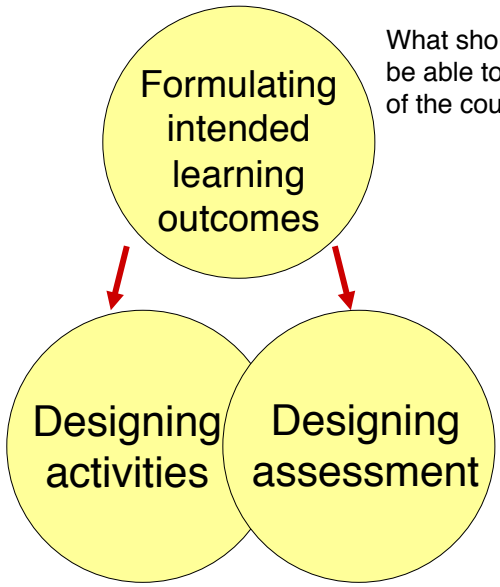
Technical competence

Öresund Bridge, George Rotne, 2000.

Pedagogical competence

1. **setting clear objectives**
   (intended learning outcomes)
   - relevant for the study programs
   - defining the threshold level of quality
   - deeper working understanding
2. **uphold the threshold level of quality**
   - only pass the students who reach the goals
3. **create a course which generates appropriate learning activity**
   - so students actually reach the goals
   - good throughput - with good quality

Or in other words…



What should the students be able to do as a result of the course?

Constructive alignment [Biggs]

What work is appropriate for the students to do, to reach the learning outcomes?

How should the students demonstrate that they fulfil the learning outcomes?

Pedagogical competence

1. **setting clear objectives**
   (intended learning outcomes)
   - relevant for the study programs
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   - deeper working understanding
2. **uphold the threshold level of quality**
   - only pass the students who reach the goals
3. **create a course which generates appropriate learning activity**
   - so students actually reach the goals
   - good throughput - with good quality
4. **and doing this while using teacher time effectively**
   - generate appropriate study for the students
   - spend your time where it has effect on learning
   - create a sustainable workload for yourself
   - and sustainability for your institution and country

The acts of teachers need to be judged in the light of their impact on student learning.

Boud & Molloy, 2013

The teaching trick

Do more of that which contributes to learning ***Pretty easy***

But since we don't have 100 hours more:

Do less of that which does not contribute ***Pretty hard***

Which one is easier and which one is harder?

Examples are illustrations of principles

A specific **example** will **illustrate** **generic principles** to **inspire** **applications** - of many different kinds.

Family dinner .
/* no comments */ .
Invest 0,20 € .
Pick me! .
Seven minutes .
Stroke of Genius .
Master test .
Fireworks .
Ultimate Frisbee .

We do the rest in a workshop tomorrow!

Family dinner

The teaching trick:

Do less of that which does not contribute

Spend less time on…
marking coursework!

What Professor K does…

The weekly challenge cycle drives the course

The weekly cycle

7 Monday

Feedback session

i. Students papers are exchanged randomly, and they write feedback with a red pen.
ii. Students receive & read their feedback immediately.
iii. Advanced and lively discussions!

Afterwards, teacher collects reports (or copies) for grading.

- Feedback session
- Introduce new content
- Challenge

Workshop

- Students work on their challenge
- Support and discussions if needed

1. Read theory and Implement the method
(straight-forward implementation)
2. Test and verify implementation
(normal use and extreme cases)
3. Investigate creatively
(test variants, how would it work if…, play around, think for yourself)
4. Write short report (Limited: 2 or 3 pages)
(describe methodology, limitations etc and own initiatives)

Here comes the trick: Easy marking ☺

Grading scale

- Fail = 0p (Seldom happens)
- Pass = 1p (Typical grade)
- Brilliant = 2p (Requires substantial own initiatives)

\+ Writing feed-back =1p (Needs to be of good quality)

Easy to see the difference between 0, 1 or 2 points, in fact it only takes about 1-3 minutes per paper…

Points	Grade
25-28	A
21-24	B
17-20	C
14-16	D
11-13	E
0-10	Fx

At the end of the course, points are converted to final grade (no exam)

\+ In some courses there is also an oral exam, 0 p, 10 p, 20 p

What about larger classes?

- **Thursday workshops**
  - Might need some more assistants (PhD students).
- **Feedback sessions**
  - Peer feedback works just as well.
  - The group discussions risk to be a little less “personal”.
- **Marking**
  - E.g. A few PhD students need to turn up in your office in time for marking.
  - Discuss the in-between cases.

The principle is to separate the processes

– then both can be made cost-effective

Feedback for learning

- made into a group learning activity
- intense involvement
- learn to discuss the subject
- immediate feedback
- expose variation
- social motivation

Assessment for grading

- by the teacher
- minimalistic
- sufficiently fair

Good for learning!

Continuous studies

- Distributes student effort during the course.

The formative feedback session *as a whole* (giving feedback, getting feedback and discussions) **generates learning**:

- Repetition – Variation – Fast feedback.
- Deep & interesting discussions (instead of discussions on definitions).
- Social motivation – expose your understanding to others and see theirs.

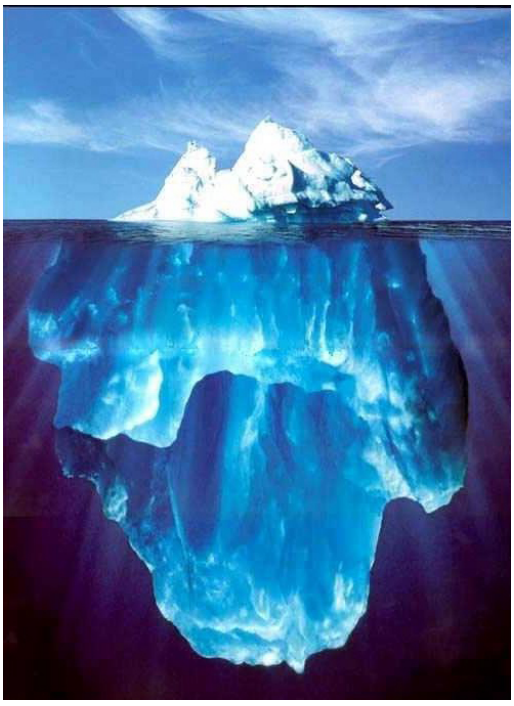
Satisfaction:

- Students feel that the teacher really cares about their work.
- Clear, fair and transparent grading system.
- Students feel their progression.

Good for the teacher!

- ≈1-3 minutes per paper.
- Final grading is no extra work ☺

Invest 0,20 €



The Iceberg Principle

Group work with random presenter

Tell them on day one:
All students in the group should be ready to present the whole project and take questions on all parts

Last minute:
Choose the presenter randomly

Students choose

- It is possible to hide behind strong students
- There is little incentive to learn about each others work
- Only the best presenter will practice presenting
- Towards the end it is mainly the presenter who is working

Random choice

- Everyone knows you cannot hide
- Everyone must learn about all parts
  - what questions can we expect to get on X?
  - why did we choose to Y?
- Everyone will practice presenting

What is the cost?

About 0.2 €

The real cost is explaining the setup for the students

Some students will say:

- *It is unfair!*

You explain:

- *It is. But, you see, the previous setup was unfair too. But now the learning will be much better for all!*

Seven minutes

The teaching trick:

Do less of that which does not contribute

Spend less time on…
designing and correcting exams!

Oral exams are really good for learning

- **Influence student preparation** – they know they have to show ”real” understanding, in real time (create the right expectation)
- Better **test of understanding** & can be individually tailored

Some teachers are nervous about…

...having to invent the necessary questions

- The trick: Reverse the burden of proof (”*the first 7 minutes are yours, to show me that you have reached the learning outcomes*”)
- Follow-up questions will pop up without effort ☺

…grading

- Use a simple scale: Fail / 10p / 20p

...having to fail students

- Ask kindly how they think it went
- Audio recording

…the time it takes

- But it is cheaper for a course of up to *N* students
- What is *N* for your course? Let’s do the math!

Katrin taking an oral exam

Written vs. oral exam, teacher time

Written:

Constructing one exam and solution-sheet takes ≈ 10-16 hours.

Correcting them takes ≈ 20 minutes per student.

Oral:

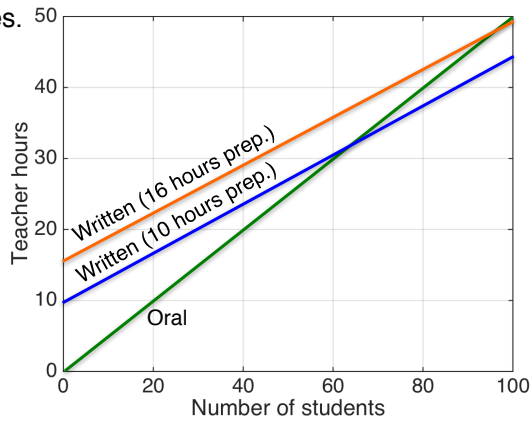
The exam takes ≈ 30 minutes.

No preparation for oral re-exam ☺

Let’s see if we get it

- 16 hours to prepare exam
- 80% passing rate
- One re-exam

Break-even is at 160 students



We have 400 students in Introductory Physics…

…but we also have more than 10 professors who know the subject!

Master test

The teaching trick:

Do less of that which does not contribute

Spend less time (energy) on…
listening to students complaints!

Professor V has a course:

There were two individual assignments in the course:

- **Homework 1 & 2**

The tasks were complex and theoretical…

Students complained bitterly and endlessly:

- *The assignments come too EARLY before we know how to do this!*
- *They are far too DIFFICULT and take TOO MUCH TIME!*

The assignments were renamed:

- **MASTER TEST 1 & 2 (MÄSTARPROV)**

What happened?

- Complaints just stopped
- Students take the assignments very seriously – and are very proud!

…other interesting words…

Accident investigation
Weekly challenge
Show
Master test
Demonstration
Gymkhana
Show & Tell
Fair
Keynote
TED talk
Potluck
Conference
Deadline
Inspection
Q&A session

Evaluation
Summit
Negotiation
All hands on deck
Campaign
Consultancy
Pitch
Elevator pitch
Pecha kucha
Speed dating
Match
Audition
Ceremony
Installation
Inauguration
Boot camp

Time out
Grand challenge
Dress rehearsal
Opening
Court hearing
Stop-press
Workout
Personal training
Vernissage
Hearing
Review
Test pilot
Advisory group
Working party
Quest

Certificate
Jam session
Dissection
Hackathon
Talk show
Level up
Expert panel
Investigation
Workshop
Emergency room
Launch
Countdown
Pit stop
Meeting

The trick question

Do more of that which contributes to learning
(especially when it is cheap)

Easy part

Do less of that which does not contribute
(especially when it is expensive)

Hard part

Doing additional things *on top of the old* is not sustainable…

So why do we often keep doing things that are less effective for learning?

Discuss 5 minutes with your neighbours

So why do we often keep doing things that are less effective for learning?

What reasons can there be…?

Convenience and minimising risk

- When I use traditional methods, there is no need to think, to make decisions, to explain, to defend, to persuade, to take responsibility…
- "When the old model doesn't work, we blame the students, but if I try something new, then everything will be my fault".

Lack of alternatives

- We never tried teaching in different ways and have nothing to compare with.
- We have not reflected on our routines and traditions.

Low capacity for course development

- It is true – we actually never thought of this because we truly believed that it would always take more time.
- We use all our time for running courses in an expensive fashion and have no time left for development
- Lack of knowledge and fantasy in course design.

Expectations

- Student expectations (or what we think they want).
- Colleagues expectations (or what we think they think).

Lack of learning perspective

- We teach in ways that make us feel (or look) good ourselves, without thinking so much about learning.
- We see teaching as a performance rather than a way to make learning happen.

Remember that we are here to improve education

The tricks are not just "oil in the machinery"

More importantly they imply

QUALITY TIME WITH YOUR STUDENTS

- more meaningful and fun, because it is value adding!

How to talk with students about this

NEVER SAY:
this is "alternative" – I learnt a trick – I'm saving my time 😱

Show that this truly belongs in the education

Several tricks address competences relevant for most educational programs. Make this explicit in the learning objectives!

After the course you should be able to (for instance)

- evaluate your own work and the work by others…
- critically analyse and give feedback on…
- critically assess alternative solutions…
- orally present and discuss your conclusions and the underpinning knowledge…
- argue and contribute in discussions about…

Student: *Why do I need to read their report?*
Teacher: *Look at the course learning outcomes. This is how you practice to…*critically review and give feedback on technical solutions! You will need that in working life.

My (not so) hidden agenda

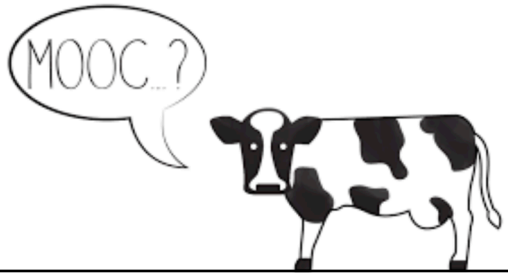
Enabling educational development by addressing implementation

Furthering a learning perspective by gift-wrapping it

It is also about a more stimulating role for teachers

Value-adding processes are often more stimulating
The least value-adding processes are often boring routine tasks

Also note that the most value-adding processes are the last to be replaced…



What was our message?

Students can learn better without more work from the teacher.

What do people remember?

The teacher can save time.

And we only live once…