Effectiveness of teaching

"The Teaching Trick"

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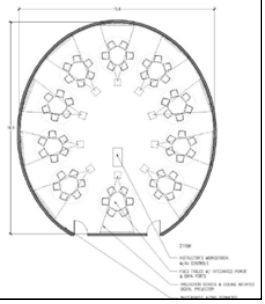
Kristina Edström

- **Engineer & Educational developer**
  - M. Sc. in Engineering, Chalmers
  - Associate Professor in *Engineering Education Development* at KTH Royal Institute of Technology, Stockholm, Sweden
  - 2012-2013 Director of Educational Development at Skolkovo Institute of Science and Technology, Moscow
- **Strategic educational development, national and international**
  - CDIO Initiative for reform of engineering education since 2001
  - Member of the CDIO Council, 2005-2013
  - SEFI Administrative Council, 2010-2013
  - Contributor to Crawley et al (2007) Rethinking Engineering Education: The CDIO Approach, Springer.
- **Faculty development**
  - So far 680 participants have taken the 7.5 ECTS course *Teaching and Learning in Higher Education,* customized for KTH faculty

cdio
CONCEIVE DESIGN IMPLEMENT OPERATE



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.

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

Yeah. We don't have those hours.

We are not sure it would be a good solution either…

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 know-how

Öresund Bridge, George Rotne, 2000.

We want to **improve (maximise) student learning** with a given (or reduced) level of **teaching resources**

$$\eta = \frac{\text{Output}}{\text{Input}}$$

Then we need pedagogical know-how!

Pedagogical competence

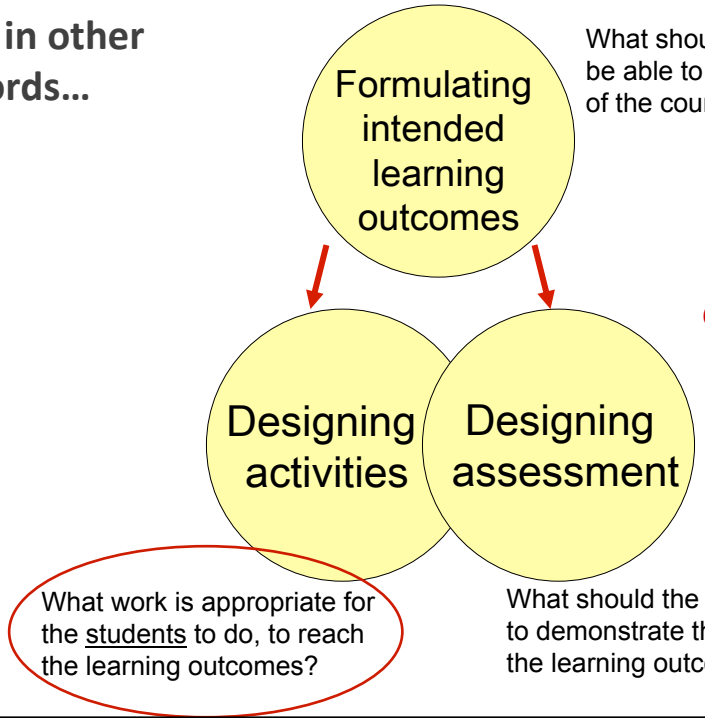
1. setting clear objectives
(intended learning outcomes)
- relevant for the study programs
- defining the threshold level of quality
- deeper working understanding

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

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

Or in other words…



Constructive alignment [Biggs]

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.

Pick one!

1. /* No comments */
2. Master test
3. Inheritance
4. 2+2 > 4
5. Family dinner
6. Invest 0,20 €
7. Seven minutes
8. Fireworks

1. /* No comments */

The teaching trick:

Do less of that which does not contribute

Spend less time on…
”finishing” student work!

Professor S told us:

”**I got 60 reports.** It is a boring task to give feedback and it **takes me two weeks.**

I gave individual comments and asked those who had failed to re-submit.

When the reports came back they were still bad. The students had only corrected the things I specifically commented on. They did not even read the rest!

Next year I did not give individual feedback on failed reports. Instead **I made a list with the most common errors**. Now the students had to **find their own** errors. When I got the reports back they were **generally very good**!”

”**Providing feedback** on students’ work is one of the most **expensive components** in their education!

…but it is often an ineffective investment simply because – **the feedback is often too slow**.

But even timely feedback may not have much impact if students **do not pay attention** to it.”
(i.e. when they do not benefit from using it)

(Gibbs, *Using Assessment strategically*...)

Tax payer’s money down the drain!

Make the distinction between:
- feedback for learning
- justification of grade
  (creates no value, minimize cost)

Remember the purpose

- The purpose **is not**
  that *this particular* report should be good
- The purpose **is**
  that the **student should develop the skills** to write reports
  (so that he/she can write 1000 excellent reports later)

For the same reason:

Keep your hands on your back…

when you are assisting students in the computer lab
– do not ever touch their keyboard!

Every time you tie the shoes for your child, you hinder her own development.

Maria Montessori

2. Master test

The teaching trick:

Do less of that which does not contribute

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

Before:

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!*

What Professor V did:

The assignments were renamed:

- **MASTER TEST 1 & 2 (MÄSTARPROV)**

What happened?

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

3. Inheritance

The teaching trick:

Do less of that which does not contribute

Spend less time…
lecturing to passive students!

Professor B inherited a course

7 weeks course, 90 students

Each week

1. 2 lectures (2 hours each)
2. A tutorial in groups of 30 students with teaching assistants

Problems:

- The teachers perceived the **students** as **lazy** and **passive** during lectures.
- Towards the end of the course, the students had a big heap of raw notes as the only result of 56 hours contact time.
- Students started studying too late.
- Many students had poor results on the exam and poor understanding…

What Professor B did

A material for self studies was handed out
(reference to chapters + problem exercises).

Weekly cycle was introduced**:**

1. Individual work on the problem sheets.
2. **A workshop** with teaching assistants in 3 parallel groups of 30, where the students could ask about difficult things.
3. A **meeting** with 9 students (no teacher). The task is to make a list of things that are still problematic and unclear. The list is sent to the lecturer.
4. One lecture based on the issues the students had listed. This is the only lecture.

Good for learning!

- At first, they are pretty confused...
- System settles during second week!
- Students work continously during the course.
- Students spend much more time actually engaging with the subject.
- Excellent exam results!

Good for the teacher!

- The weekly lectures attracted a full audience and were considered excellent.
- One lecture/week instead of two!
- More preparation time for the single lecture
- The lectures now have a clear purpose - helping students with the problematic parts of the subject ☺

4. 2+2 > 4

The teaching trick:

Do less of that which does not contribute

Spend less teacher time on…
grading exams!

4-hour exam in two steps

First part (2h)

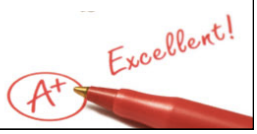
- Students write the exam and hand in
  (During the break exams are photocopied as cheating safeguard)

Second part (2h)

- Hand out exams randomly (and a red pen)
- Joint class discussion to agree on the marking scheme
  (teacher has the last say of course)
- Students mark the exam

Afterwards

- The teacher takes home the bunch for some extra check
  (especially results near boundaries, random checks, feedback to teacher)
- Good marking work is rewarded with an extra point!



Advantages

Good for learning!

- **Repetition is built in**
- **Fast and detailed feedback**
  - Students get to see what they could achieve on their own, and not…
  - They go home with the whole *and correct* answer
- **Exposure creates social pressure to do well**
- **See variation when correcting each others and discussing**
- **Students are active and involved**
  - Criteria for quality are made visible and explicit
  - Transparency and sense of fairness

Good for the teacher!

- **Robust against cheating**
  - It can be the basis for grading
- **Less routine teacher-work**

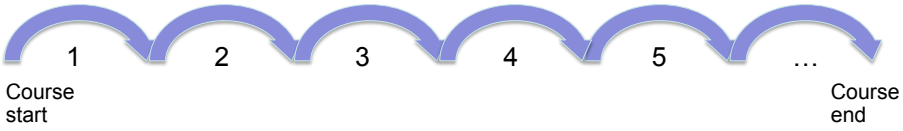
5. Family dinner

The teaching trick:

Do less of that which does not contribute

Spend less time on…
marking coursework!

What Professor K does…



The weekly assignment 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
- Homework

Workshop

- Students work on homework
- 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 (1, 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 lots of own initiatives)

\+ With accepted participation in the feed-back loop +1p

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

At the end of the course, points are converted to final grade!

In some courses there is also an oral exam

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

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.

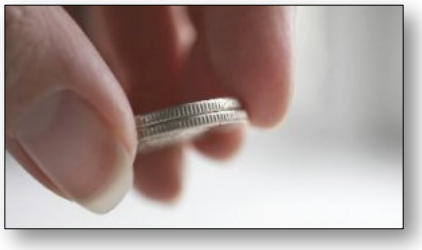
Satisfaction:

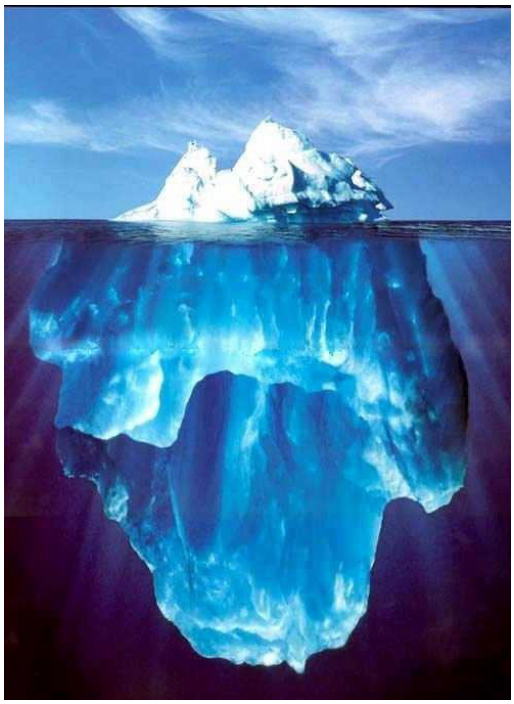
- Students feel that the teacher really cares about their work.
- Clear, fair and transparent grading system.
- Students feel their progression.

Good for the teacher!

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

6. Invest 0.20 €





The Iceberg Principle

Group work with random presenter

Day 1:
All students in the group should be ready to present the whole project

Last minute:
Choose the presenter randomly

Cost: 0,20 €

7. Seven minutes

The teaching trick:

Do less of that which does not contribute

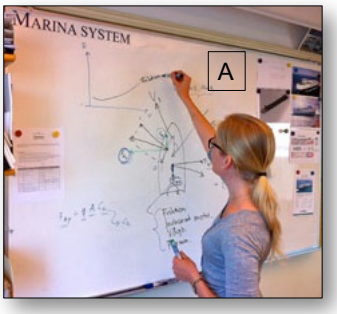
Spend less time on…
designing and correcting exams!

Oral exams are really good for learning

- Can **test deeper understanding** & be individually tailored
- **Influence student preparation** – they know they must show ”real” understanding, in real time (create the right expectation)

Sometimes teachers fear:

- that it is **difficult** for the teacher?
  - Reverse the burden of proof (”the first 7 minuts are yours to show me that you have reached the learning outcomes”)
  - If possible, use simple scale: fail, 1p, 2p
- that it is **expensive** (takes time)?
  - But for a course of up to *N* students it is cheaper!
  - What is *N* for your course?
- that it is **embarrassing** to fail a student?
  - Use the written start
  - Ask how they think it went



Katrin taking an oral exam

Written- vs oral exam, teacher time

Written:

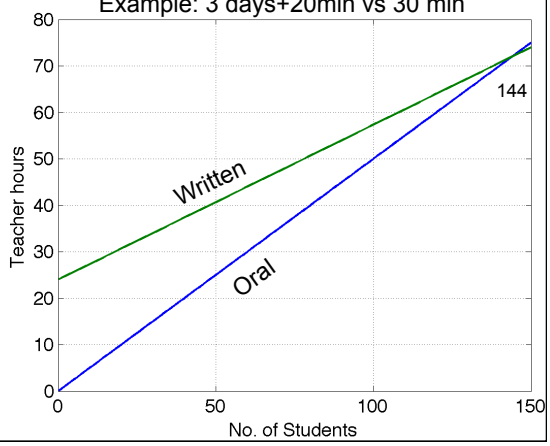
Design and construction of exam and solution-sheet takes ≈**2-4** days.
Correcting one exam takes ≈ **20** minutes

Oral:

The exam takes ≈**30** minutes.

Moreover:
Consider the gain at re-exam!

Example: 3 days+20min vs 30 min




Jakob Kuttenkeuler
den 2 november
Jäddrar, så här skall det se ut på muntlig tentamen i seglingsmekanik när toppstudent briljerar vid tavlan. Bara att njuta av åkturen
Sluta gilla · Kommentera · Dela
Du, Magnus Burman, Helene Rune och 17 andra gillar detta.
Skriv en kommentar...

8. Fireworks

The teaching trick:

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

Spend less time on…
writing feedback

Let us say that ~40 students have submitted a 4-page open-ended final assignment (e.g. essays, designs etc)…

How students prepare

- Form random groups of 4 students and send them each other's assignments.
- Each student reads the other's work and writes ½ page of constructive comments on each.
- Bring 5 copies of the written comments to class – to each group mate +1 to the teacher.

How you prepare

- Print the submissions (single page) and add page numbers.
- Search-read for a strong aspect in each. Mark the passage, draw a "star" in the margin, and write a couple of keywords. (If you can't find a strength, it is probably a fail…)
- Copy the bunch to all students (double-sided, 2 pages per sheet).

Final seminar:

- The groups discuss each person's work with the aim to improve it (4*30 mins).
- Meanwhile, skim their comments (to see they took it seriously + useful input)
- Distribute the bunch. Go through it in plenary and discuss each **"Gold star"** with full enthusiasm and passion (60 mins of fireworks). Bring it on!

Social motivation – Feedback – Exposure – Variation – Summary of the course – Final chord – Positive

The teaching trick

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

Easy part

Do less of that which does not contribute
(especially if 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

- tradition
- it takes effort to change,
- there are risks – you are afraid to get complaints
- lack of knowledge
- we really believe everything is the students fault
- investment in old methods (sunk costs)
- so focused on the content - afraid students will miss information
- stress makes it harder to think and have an open mind
- most universities do not reward good teaching (so why should we)
- we focus on what we do and feel that it is the valuable part
- we want to keep the quality of the course
- change is hard – for teachers and students
- we think students expect us to teach in the traditional ways
- we try to fix everything at the same time when incremental change would be better and we would learn more
- we feel alone in doing new things
- just-in-time-teaching

What reasons can there be…?

- Student expectations (or what we think they want…)
- Colleagues expectations (or what we think they think…)
- We like to feel clever (lecture, have answers to everything, finish student work so it looks good…)
- Tradition, unreflected routines
- Lack of knowledge and fantasy in course design…

Remember that we are here to improve education

Now that it is allowed to be lazy and smart…

Discuss time-saving ideas!

- Something you already do?
- Something you could do?