The Teaching Trick

How to improve student learning without spending more time teaching

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1

Kristina Edström

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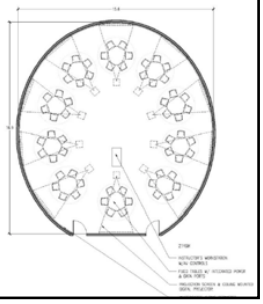
- Associate Professor in *Engineering Education Development* at KTH Royal Institute of Technology, Stockholm, Sweden
- 1000+ participants in courses on Teaching and Learning in Higher Education, customized for KTH faculty
- CDIO Initiative for reform of engineering education since 2001
- Editor-in-Chief of the *European Journal of Engineering Education,* 2018-
- M. Sc. in Engineering (Chalmers) and PhD in Technology and Learning (KTH)
- The KTH prize for outstanding educational achievements, 2004

cdio
CONCEIVE DESIGN IMPLEMENT OPERATE



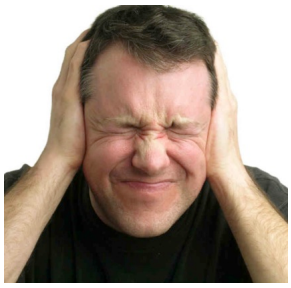
Some publications

- Crawley, E.F., Hegarty, J., Edström, K., & Garcia Sanchez, C. (2020). *Universities as Engines of Economic Development: Making Knowledge Exchange Work*. Springer, Cham.
- Edström, K. (2020). Integrating the academic and professional values in engineering education – ideals and tensions. In Geschwind, L. Broström, A. & Larsen, K. (Eds.) *Technical Universities - Past, present and future*. Springer Higher Education Dynamics.
- Edström, K. (2020). The role of CDIO in engineering education research: Combining usefulness and scholarliness. *European Journal of Engineering Education, 45*(1), 113–127.
- Edström,K. (2018). Academic and professional values in engineering education: Engaging with the past to explore a persistent tension. *Engineering Studies*, *10*(1), 38–65.
- Crawley, E.F., Malmqvist, J., Östlund, S., Brodeur, D.R., & 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.

2

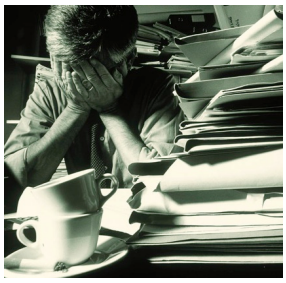
Cost-neutral interventions

To persuade the grumpy professor to listen



Because my best friends found it useful

To support those dedicated to teaching



3

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.

4

Anyone can improve a course by working 100 hours more…

- Yeah. We don't have those hours!
- And "more of the same" is not the best strategy

This is about how to get better learning from existing teaching resources

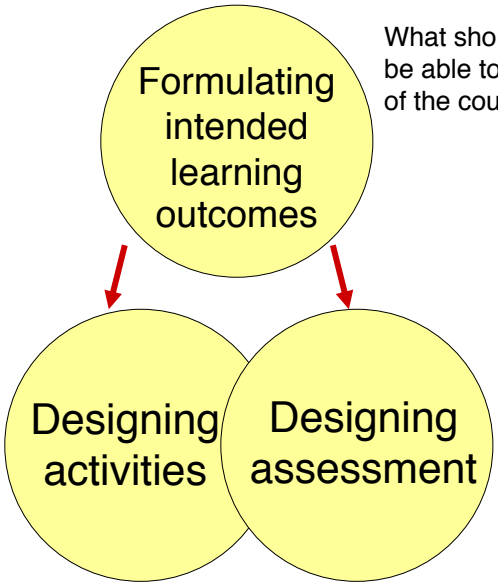
5

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

10

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?

11

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

12

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

Boud & Molloy, 2013

13

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?

14

Examples are illustrations of principles

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

15

- Family dinner
- Seven minutes
- Invest 0,20 €
- # No comments
- Fireworks
- Master test
- Stroke of Genius
- Ultimate Frisbee

16

No comments

17

The teaching trick:

Do less of that which does not contribute

Spend less time on…
”finishing” student work!

18

Providing feedback on students' work is one of the most expensive components in education

Often an **ineffective** investment:

- when the feedback is **too slow**
- when students will **not use** the comments (or even read them)
  - typically in the end of the course
  - when students do not benefit from using it
  - when students focus on the grade rather than learning (e.g. just want to pass)

…this means that our assessment **normally does not support learning**

Gibbs, G. (1999) Using Assessment Strategically to Change the way Students Learn. In Brown, S., Glasner, A. (Eds.) *Assessment Matters: Choosing and Using Diverse Approaches.* McGraw-Hill Education.
Boud, D., & Dochy, F. (2010). Assessment 2020. *Seven Propositions for Assessment Reform in Higher Education. Office of Learning and Teaching, Sydney, Australia.*

20

Tax payer's money down the drain!

Old exams archive

Make the distinction between:

- feedback for learning
- justifying grade (minimize cost)

21

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)

22

To really influence learning:
feedback should be built into a learning activity

1. The students **do something** (report, presentation, etc)
2. Students **get feedback** (formative assessment)
   and there are many ways to do this
3. The students **do it again**
4. Students get **grade** (summative assessment)
   now without feedback

25

How Professor Fosso does it

1. During the course, students **hand in work** (report, code, essay, etc)
   for instance 5 times, according to deadlines
   Important – helps them get started & keep going
2. Teacher gives **plenary feedback** (formative assessment)
   "Top 10 ways to improve your work"
   Tends to be rather stable over the years…
3. Students **hand in their final versions of all assignments**
   Big deadline near end of course
4. Then a **short interview**
   15 minutes on Zoom – students must be ready to explain all the work
5. Students get **grade** (summative assessment)
   Now without feedback

Olav Bjarte Fosso, NTNU

26

Family dinner

27

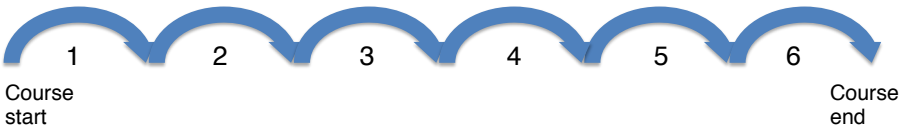
The teaching trick:

Do less of that which does not contribute

Spend less time on…
marking coursework!

28

What Professor K does…



To generate appropriate work for the students, a cycle of weekly reports drives the course

29

The weekly cycle

7 Monday

Feedback session

i. Students papers are exchanged randomly, and they write feedback with a 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)

30

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…

31

At the end of the course, the points contribute to final grade

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

There is also an oral exam, 0 p, 10 p, 20 p

One idea for the oral exam:
- the student brings all their reports
- you select a report randomly
- they should **explain their reasoning and reflect further**
- keep selecting reports until time runs out

They have to prepare discussing all of them ☺
- that is such good studies!

(More about oral exams soon)

32

What about larger classes?

- **Thursday workshops**
  - Bring in some TA's (PhD students).
- **Feedback sessions**
  - Peer feedback works just as well.
  - The group discussions risk to be a little less "personal".
- **Marking**
  - The TA's come to your office for the marking.
  - Discuss borderline cases to establish reliability.

33

The principle is to separate the processes

– then both can be made cost-effective

Formative assessment (to support learning)

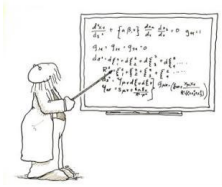
- made into a group learning activity
- intense involvement
- learn to discuss the subject
- immediate feedback
- expose variation
- social motivation

Summative assessment (to grade learning)

- by the teacher
- minimalistic
- sufficiently fair

34

What about the quality of feedback?



"What if the feedback that they give each other is incorrect?"

"It must be better that the teacher gives feedback, after all we are the experts and it is our job."

How do we answer? Write in the chat!

This is our most important answer – from a learning perspective:

It is the quality of learning that decides whether this teaching method is good (not the quality of the feedback per se)

Also:

- Even if teacher feedback is "perfect" (as in correct), it is delayed and limited to what teacher time allows
- Students learn also by *giving* feedback
- (Strategy) Make sure that the discussion generates some general feedback, by asking "What was most difficult, Did you notice the difference between…, Did anyone…

Why it is not so disastrous if poor quality feedback should occur:

- The feedback does not affect the grade, so no student is really hurt
- A student can always ask the teacher about weird feedback ("Look here…")
- Feedback comes from different peers during the course (repeated random selection)
- (Strategy) Provide model solutions or comments, as a safety net

35

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.

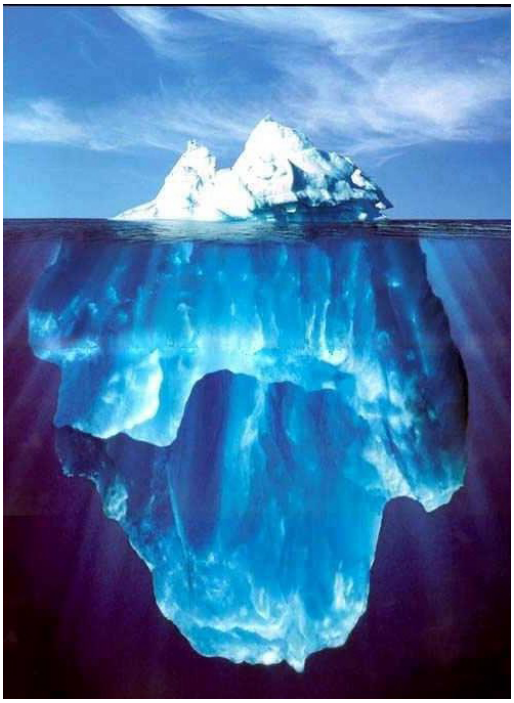
Good for the teacher!

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

36

Invest 0,20 €

37



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

38

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

39

What is the cost?

About 0,20 €

Explain to the students

Teachers report that students tend to accept the setup without protests

But if some students say:

- *It is unfair!*

You explain:

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

40

Seven minutes

41

The teaching trick:

Do less of that which does not contribute

Spend less time on…
designing and correcting exams!

42

Oral exams are really good for learning

- Create the right expectations and influence student preparation
  - Students know they must show ”real” understanding in real-time
- Compared to written exams:
  - Better test of understanding
  - More individually tailored
  - More authentic “work-life” situation

Katrin taking an oral exam

And, as it turned out, they transform better to remote teaching than written exams!

43

Oral exams are really good for learning

BUT

we worry about some things
(write potential worries in the chat)

1. students telling each other what I asked
2. grading
3. having to fail students
4. the time it takes
5. big classes
6. fairness
7. covering the content
8. students who don't like it

Katrin taking an oral exam

44

BUT what about students telling each other what I asked? **(1)**
I have to come up with so many different questions!

The 7 minute trick

– reverse the burden of proof

On the first day of the course, explain:

"*The oral exam will last 25 minutes.* ***The first 7 minutes are yours****, to present something to show me that you have reached the learning outcomes*"

During the course:

- Students will pay attention to the intended learning outcomes – please refer to them
- They will think *"How can I show that I can …"*

When they present:

- Follow-up questions pop up without effort (check their understanding behind, what they leave out)
- Keep the intended learning outcomes in focus

45

BUT what about grading? (2)
How can I possibly determine the grade in 25 minutes?

The Fail-Pass-Brilliant trick
– use a coarse grading scale

- 0, 10 or 20 points
- If the final grade is more fine-grained, the oral exam is weighed with something else (coursework, written reports, projects, etc)

46

BUT what about failing students? (3)
It would be so embarrassing!

Failing productively
– be kind and feed forward

- Ask them kindly: "*How do you think this went?*" (most students will offer a fair self-assessment)
- Ask them to book a new timeslot, and give advice for studying – referring to specific learning outcomes, what chapters to study etc (perhaps write a note)
- Finally smile and say (mean it): "*I am so much looking forward to seeing you again, when you can do this!*"

47

BUT what about the time it takes? (4)
This is only possible in the smallest classes!

Let's just bust that myth

- Oral exams are cheaper for a course of up to *N* students
- What is *N* for your course?
  Let's do the math!

48

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:

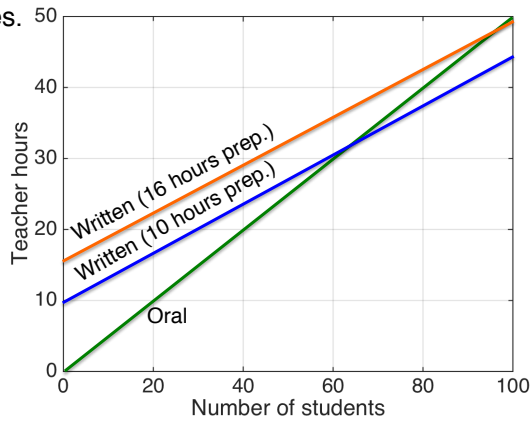
The exam takes ≈ 30 minutes.

But consider also the re-exam!

Let's do the math:

- 16 hours to prepare exam
- 80% passing rate (oral and written)
- One re-exam

Break-even is at ≈160 students



49

BUT what about even bigger courses? **(5)**

"We have 400 students in Introductory Physics…

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

50

BUT what about fairness? **(6)**

How can I be sure that I am not charmed by irrelevant factors?

Focus on the intended learning outcomes

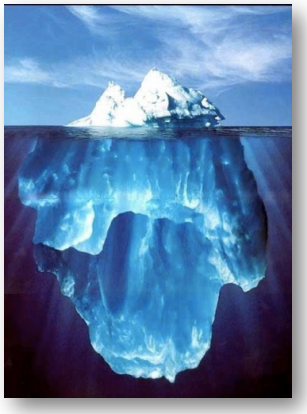
- Really consider the quality thresholds
  - What is required for a Pass?
  - What is required for a Brilliant?
- Keep a page with the intended learning outcomes with you – and focus on them
- Make audio recording
- If more than one teacher in parallel:
  - start with 10 students together to calibrate
  - now and then, do 2 more

51

BUT what about covering the content? (7)
Subjects are different!

The iceberg trick

– leveraging learning



Tricks to encourage breadth and appropriate studies:

- Ask students to prepare a 7-minute presentation for each three parts of the course. But they don't know which one(s) they will actually present ☺
- Randomise from a bank of questions or topics to talk about
- Randomise from students' written work (6 reports, solved examples, etc) which one(s) to discuss – they will have to revise all ☺

52

BUT what about students who don't like it? (8)
They may be nervous…

1) Show that oral communication is a meaningful skill that truly belongs in the course

Make it explicit in the learning objectives

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

- orally present and discuss your conclusions and the underpinning knowledge…
- argue and contribute in discussions about…

Then have these conversations

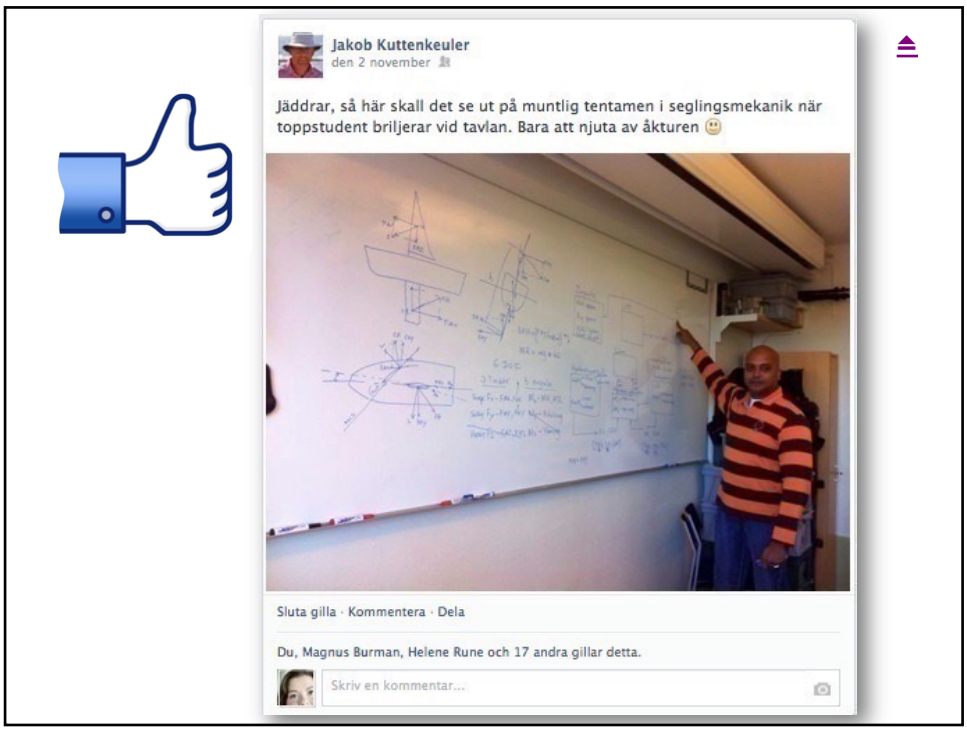
- Why do I need to do an oral exam? It makes me nervous.

- Oh, but look at the course learning outcomes. You should be able to "orally present and discuss your conclusions and the underpinning knowledge". You will do a lot of that in working life – but writing exams, not so much ☺

2) Let students practice

This is the course with 6 feedback sessions…

53



54

Master test

55

The teaching trick:

Do less of that which does not contribute

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

56

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 are far too DIFFICULT*
- *They take TOO MUCH TIME!*

The intervention

The assignments were renamed:

MASTER TEST 1 & 2
(MÄSTARPROV)

What happened?

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

57

…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

58

Fireworks

59

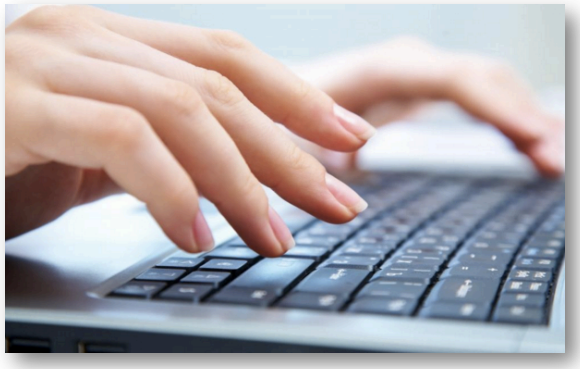
The teaching trick:

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

Spend less time on…
writing feedback

60

~ 40 students write an open-ended assignment of 4 pages
(e.g. essay, design, reflection…)



- The assignment is personal and important (a credo).
- It would take several days to write good feedback!
- Instead a final seminar
  - Intensive learning activity
  - Plenty of peer feedback and some from the teacher
  - Minimal summative assessment, sufficiently fair (pass/fail grade)

61

- The teacher skims essays and makes quick decision:
  - **Accepted** to join the seminar
  - **Pending acceptance**, allowed to join but must submit improved version after the seminar (and they must tell the group and ask for guidance)
  - **Reject**, cannot join and must redo assignment the next time the course is given
- Divides the students in groups of 4
  (Usually one excellent essay, two medium good, and one needing improvement)
- Sends mail with instructions
  - **Download** your colleagues' work (from the digital platform).
  - **Write ½ page constructive comments** to each colleague, *strong aspects and how the work can be improved*.
  - **Bring** prints of comments to the seminar
    (4 for the group + 1 to the teacher).
- This takes maximum 2 hours…

62

Teacher prepares feedback before the seminar

- Merges all essays into one big pdf.
- Searches for **a strong aspect** in each text, making sure to cover the things that are important in the course.
- Marks the passage with a "star" in the margin with some keywords.
- This takes just as long time as a hockey game ☺

63

At the seminar – group feedback

- Discuss each essay with the aim to improve it (4*30 minutes).
- Meanwhile, the teacher reads the written comments (to see that they were taken seriously + as input)
- Their feedback is quite useful
  - Students are really good at pointing out deficiencies
  - Getting three different comments on your essay is great

64

End with fireworks

1 hour in plenary:

- Display the pdf and discuss each ”Gold Star” full of enthusiasm and passion (fireworks). Bring it on!
- End by recommending 3 – 4 essays to read before writing version 2.0 (for most students it is voluntary).
- Publish the pdf in the digital platform as an invitation to browse.

65

Experiences

- An excellent way to summarise the most important points in the course through the students' own work
- Creates a positive final chord, a feeling that we have really achieved something together
- Social motivation (teachers and friends)
- Rich feedback
  - It is a good learning activity to comment on the others
  - Peers are excellent to spot deficiencies
  - The teacher adds the positive things for which the students lack frames of references
- Exposes quality and variation (considerately but clearly)
- Handles poor work fairly but discreetly
- Course evaluations are written immediately after the seminar, in a rush of excitement ☺

66

Stroke of genius

71

The teaching trick:

Do less of that which does not contribute

Spend less time on…
ineffective group supervision!

72

Professor E's students do a project

- Big first-year course, 140 students in groups of 5
- A handful of teaching assistants as supervisors

HOW THE COURSE USED TO WORK

START	MIDDLE	END
Student groups hand in	▪ draft reports	▪ final reports, make oral presentations
	▪ **Supervisors give feedback and grade**	▪ **Peer groups are opponents** ▪ **Supervisors give feedback and grade**

73

Problems

- Lots of teacher time for
  - reading and commenting on reports – twice!
  - students who repeatedly ask: ”Are we on the right way?”
- Groups that
  - pause the work, waiting for feedback on drafts (2 weeks)
  - fix only what supervisors commented on, with little reflection
  - divide the work focusing mostly on ”their own” part

Classical problems! What can be done?

74

NEW MODEL with 2 peer reviews

Student groups hand in
- draft reports
- final reports, make oral presentations

START | MIDDLE | END

MIDDLE:
- **Peers comment**
- **Supervisors meet groups**
- **Supervisors approve revised drafts (without feedback)**

END:
- **Peers comment again**
- **Supervisors grade revised reports (without feedback)**

Supervisors very sceptic in advance:
- they would get even more work, reading the reviews
- peer feedback would be of low quality (“*a blind leading a blind*”)

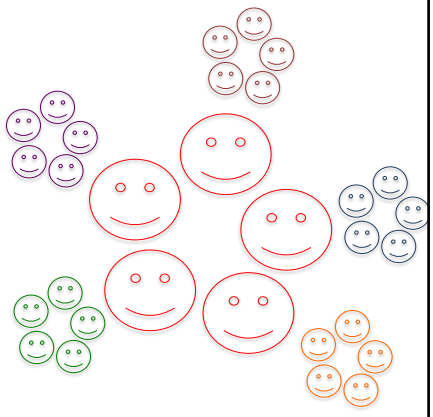
75

HERE COMES THE TRICK: Professor E's stroke of genius

Peer review was made individual

Instead of "groups reviewing groups" it is **individuals reviewing groups**

- Thus, each group received **five different sets of comments**
- Also, the group had **access to five other reports** that they had read and analysed



76

Template for reviews

Examples of questions:

- What are the strongest aspects of the work?
- What are the most important areas for improvement?
- Other comments?

- The questions or issues that I want to discuss with this group are (DESCRIBE):
- The issue is relevant because (RATIONALE):

- After having read and analysed this work, what is the most important reflection, for yourself – for your group project – for your future professional role?

77

Mid-course review on drafts

- *"BUT THEY SAID DIFFERENT THINGS, AND WE DON'T AGREE IN THE GROUP EITHER…"*
- *"ON THE ONE HAND… BUT ON THE OTHER…"*

Compulsory meeting with the supervisor:

- Discuss the comments you have received, your thoughts about the **different views**, what **reflections you made when making your reviews** and how you want to **proceed** with your own work.
- After this meeting they can **revise their draft** before **handing in for approval** by the supervisor (no further feedback).

78

Second review
(of final draft and oral presentation)

- Students deliver their written comments the day before the presentation. Many groups quickly revised their work and prepared to answer the questions.
- After the seminar, groups are allowed to revise their reports before submitting for grades (without feedback).

Note:

- Students reviewed the same group's work both times. This was mainly meant to save them some time. But it also opened up for comments about the progression of the work, and on how the group had handled the earlier comments.

79

RESULTS

Better learning:

- Work of higher quality:
  - more “finished” and worked out in detail
  - aligned with the instructions
  - better justifications for decisions
- Student feedback much faster than supervisors could have achieved.
- Students thought that reviewing took much time, but was rewarding.

More effective teaching:

- Supervisors’ time is used to discuss face-to-face with students and guide them in interpreting and using the comments.
- Fewer students came to check ”if they were on the right way”.

Supervisors:

- They all saw the improvements in student learning
- Still, some thought it felt ”unprofessional” not to give written and detailed comments

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

80

Ultimate frisbee

81

Dear Professor,

I coach the women's ultimate frisbee teams and based on your workshop I changed our program for the practice weekend.

Normally, since a game only involves 14 players, we would rotate and the others would do some drill on the side.

Now, instead, I had a non-playing team standing on the sidelines and assigned each of them a player. Then I stopped the game periodically and had the sideline players give individual feedback to their assigned player.

It went over remarkably well. A number of the ladies had very positive feedback, and said they had numerous strategy talks that they found incredibly helpful. It was also great for me, since I can't possibly watch every player all the time. It was incredibly time efficient!

So in conclusion, thanks again for the workshop. I thoroughly enjoyed it, and I thought you might like hearing about an application in a completely different "field"!

Best regards,
Professor D

82

Why do teachers often keep doing things that are less effective for learning?

84

How to talk with students about this

NEVER EVER 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.

88

The tricks are not just “oil in the machinery”

It is about

QUALITY TIME WITH YOUR STUDENTS

- more value adding, meaningful and fun!

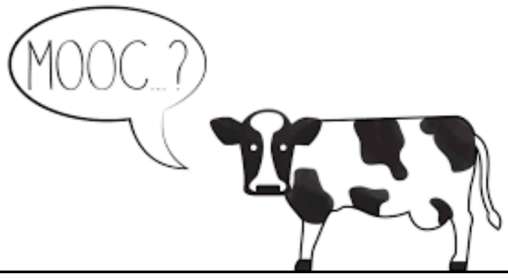
89

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

90

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



91

And we only live once…

92

What do people seem to remember from this talk?

The teacher can save time.

But what was the message?

WE CAN HELP STUDENTS LEARN BETTER (without working more).

93

My (not so) hidden agenda

Enabling educational development by addressing implementation issues

Furthering a learning perspective by gift-wrapping it

Challenge the image of educational development as self-sacrifice

94