DNV·GL

VOLKER BERTRAM

Teaching Engineering in the 21st century

No shortage of buzzwords

- e-learning
- multimedia labs
- andragogy
- self access center
- mobile learning
- learning facilitator
- competence based learning
- edutainment
- ...

How dare you ?

Volker –

Teachers' Ranger

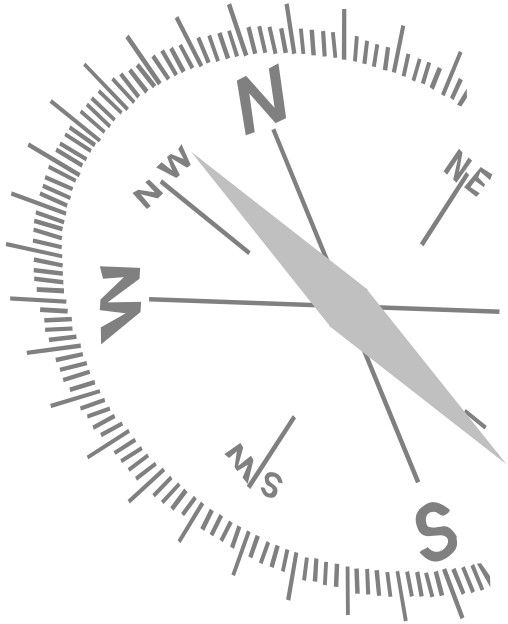
OK, so I am blind, too. But…

- my wife gives me hell (she studied pedagogy)
- I have a Master and a Diplom
- I have taught in Denmark, France, Germany, Italy, Sweden, South Africa
- … and now DNV GL Academy
- participated in ONR workshop on teaching Nav Arch
- was tasked to counsel on "future teaching in engineering" in Chile

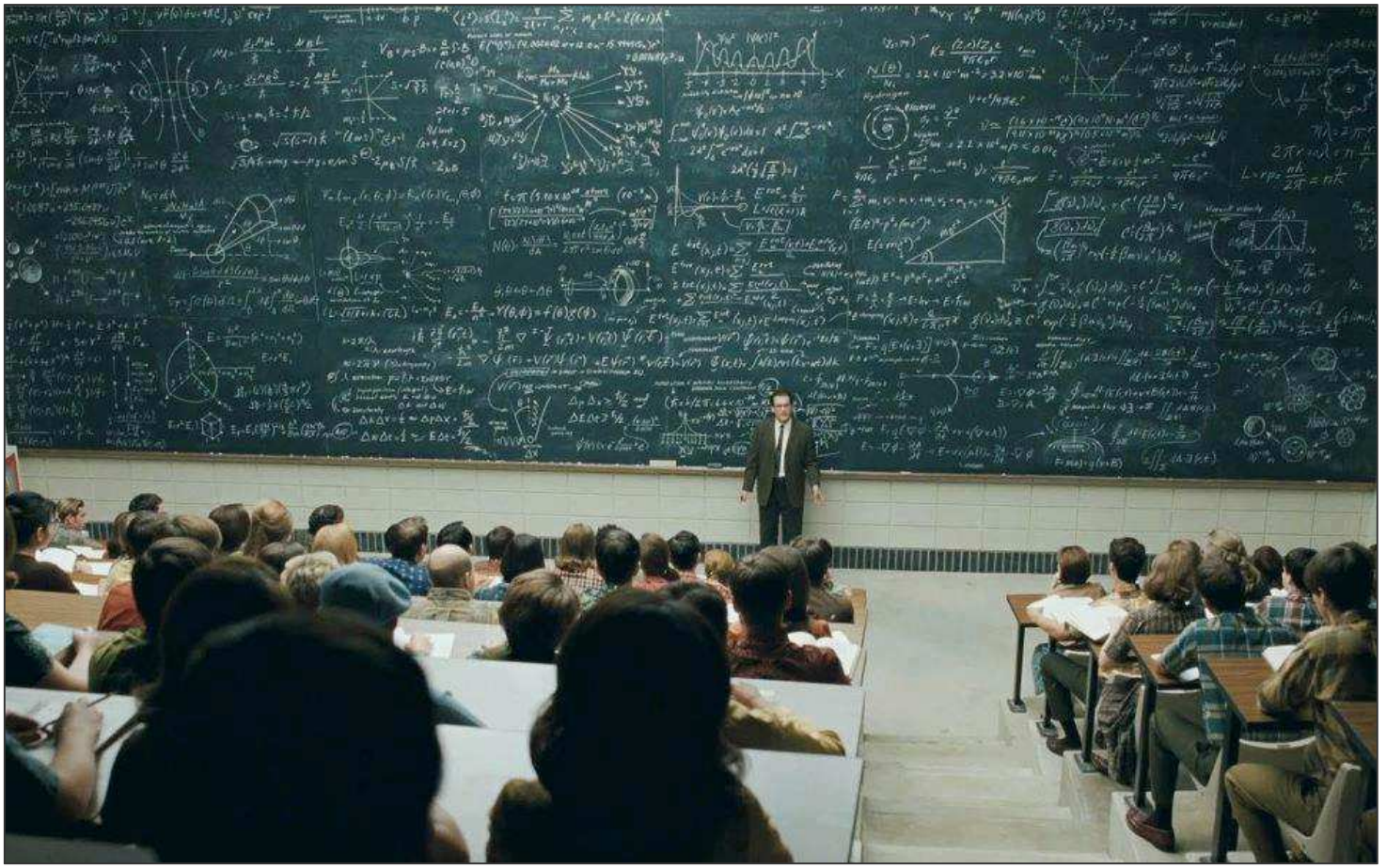
So you can say "**I see**…"

Navigator

- **Setting the theme – On a cynical note**
- Competition & New entrants
- Customer – Industry expectations
- Supply – Our students
- Substitutes – E-Learning & Co.
- Some heretic thoughts



Teaching has changed over time 1/3



Yesterday

Blackboard & teacher

Teaching has changed over time 2/3

Today

PowerPoint & teacher

Teaching has changed over time 3/3

Tomorrow: ???

Self access center

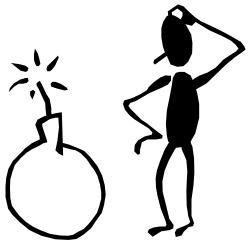
Hey! Where's the teacher gone?!

In theory, this is a great new world

SELF ACCESS CENTERS (SACs):

Self-access learning gives you the opportunity to develop initiative, **responsibility**, self-awareness, confidence and **independence in learning**. It is about making choices and having **flexibility** in learning.

Description from SAC website at Hong Kong University of Science & Tech.



Great !!!

Really ?!

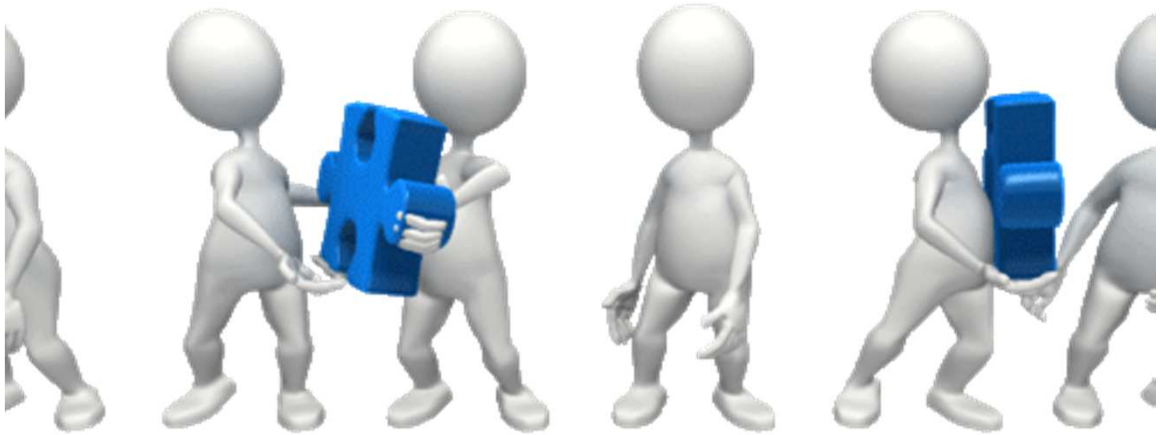
Guess frequent problems with Self Access Centers

In practice, it did (does) not work

- Expensive to set up a good one
- Need to be staffed (no budget, no training, wrong profile)
- Badly organized
- Material gets stolen
- Half the computers don’t work
- Security issues
- Students have no time or are not motivated to use them

Teaching & technology must go hand in hand

As Facebook says: **It is complicated**



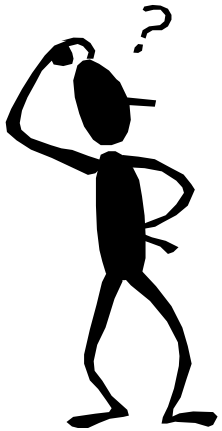
Let‘s have a closer look

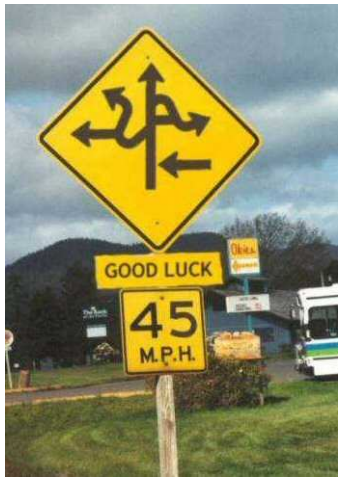
Time for some strategic analysis

For those who don't know to which port they are sailing, no wind is favorable.*

Seneca

Time for strategy



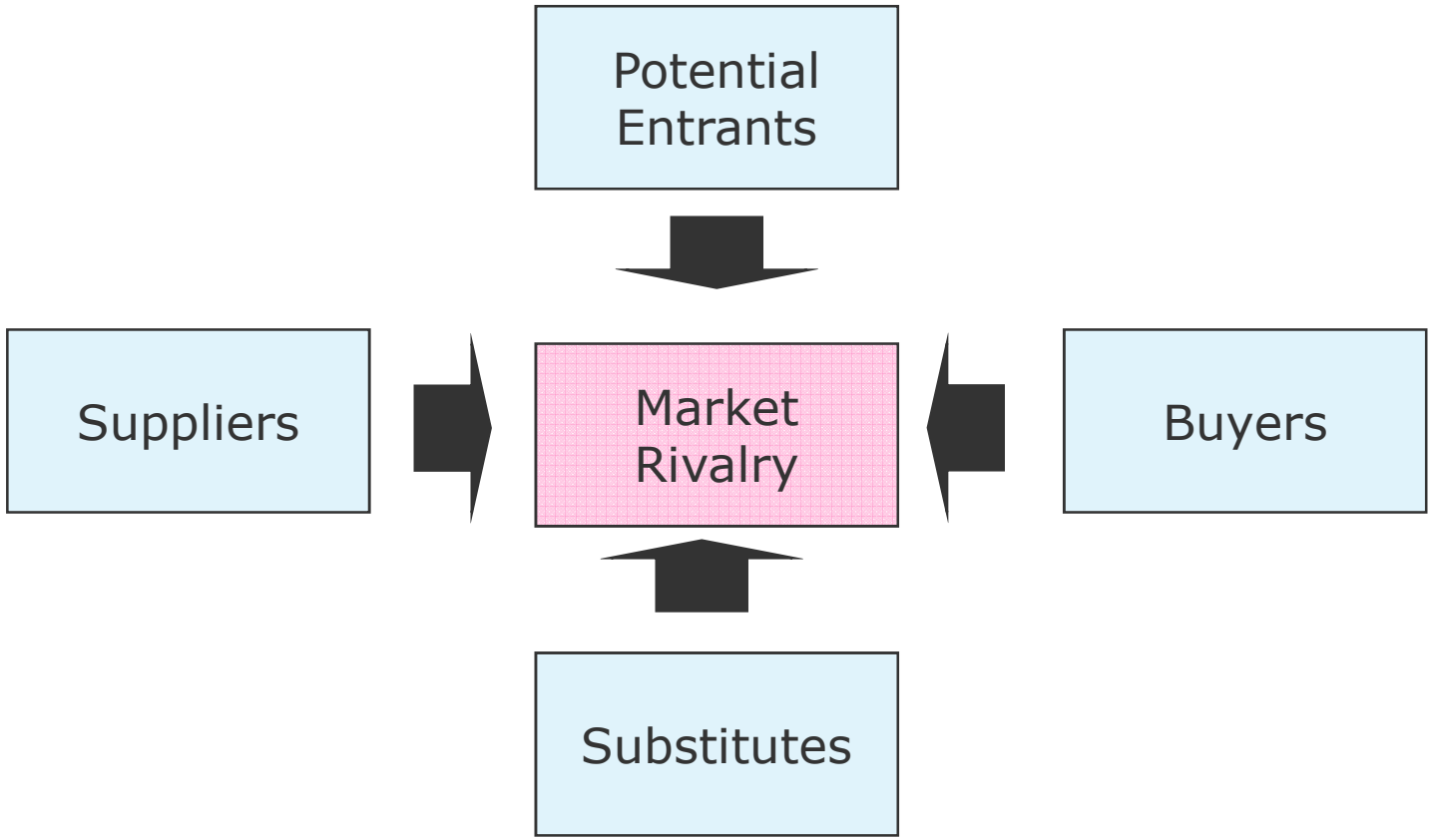


* Ignoranti, quem portum petat, nullus suus ventus est.

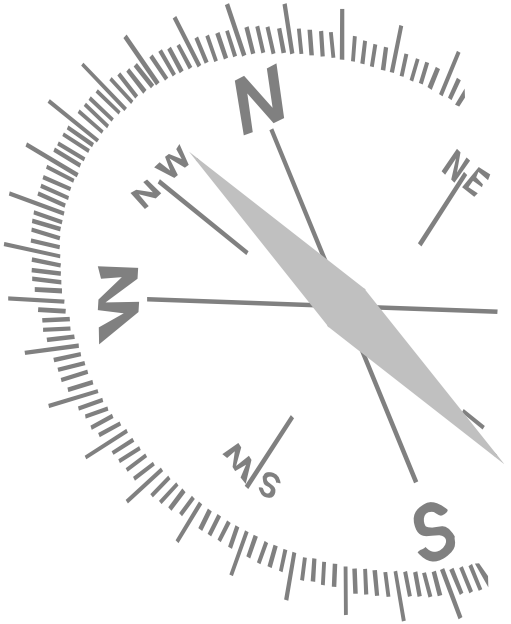
Let’s try the Porter model

- named after Michael E. Porter (Harvard Business school)
- standard model in management strategies
- helps structuring thoughts

Porter model



Navigator



Setting the theme – On a cynical note

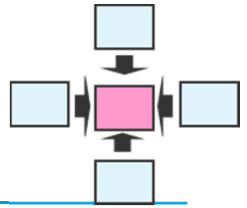
Competition & New entrants

Customer – Industry expectations

Supply – Our students

Substitutes – E-Learning & Co.

Some heretic thoughts



Market (Competitors)

The traditional market for “Dipl.-Ing.” NAOE

- Berlin Dipl.-Ing.
- Duisburg Dipl.-Ing.
- Hamburg Dipl.-Ing.
- Rostock Dipl.-Ing.

Rather constant “market shares” & transparent markets

NAOE = Naval Architecture & Ocean Engineering

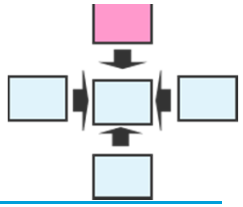
New Entrants

Bologna Accord / Bologna Treaty

- signed in 1999 in Bologna
  to be implemented by 2010

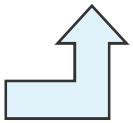
- goal: harmonized university education in Europe
- 3-2-3 system (BSc – MSc – PhD)
- **slow response** in countries with strong "home market" (DE, FR, IT)

“Universities of Applied Science”



New local entrants increase pressure

• Berlin	B.Eng.	M.Eng.	PhD
• Duisburg	B.Eng.	M.Eng.	PhD
• Hamburg	B.Eng.	M.Eng.	PhD
• Rostock	B.Eng.	M.Eng.	PhD
• Bremen	B.Eng.	M.Eng.	
• Kiel	B.Eng.	M.Eng.	



increased competition

EU competitors

The game is now international

• Berlin	B.Eng.	M.Eng.	PhD
• Duisburg	B.Eng.	M.Eng.	PhD
• Hamburg	B.Eng.	M.Eng.	PhD
• Rostock	B.Eng.	M.Eng.	PhD
• Bremen	B.Eng.	M.Eng.	
• Kiel	B.Eng.	M.Eng.	
• 30+ EU Universities	B.Eng.	M.Eng.	PhD

Expected consequences:

local competition for 'bachelor' (in home language)

Problem: produce enough **qualification** for students to enter job market

graduates will require **re-training later** in professional career

international competition for 'master'

Problem: offer it in (imperfect) **English** or face brain-drain

accelerated **consolidation** will kill some smaller players

☹ losers: France, Germany, Italy

☺ winners: UK, USA, Scandinavia

Expected consequences:

PhDs in engineering in shorter time

Problem: **PhD supervisors** do more (work overload?) and/or
quality declines (depth, independent research)

Need for continuous professional development

Problem: demand for **long-distance training**
demand for intensive (block) training (**summer schools**)
demand for **after-hours training**

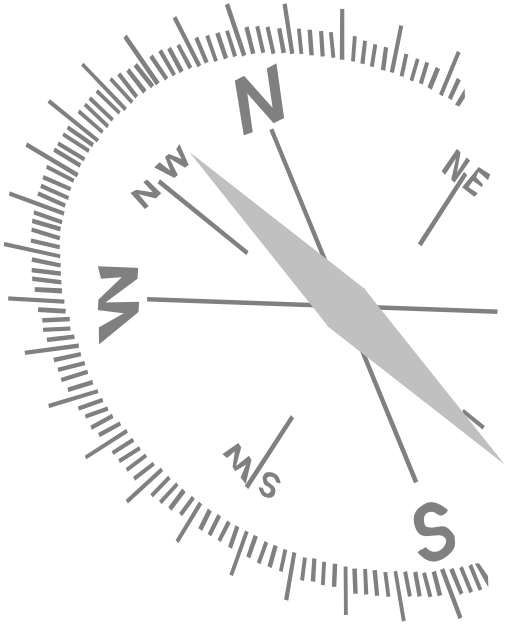
Bologna changes landscape 2/2

Expected consequences:

Retraining need will stimulate continuous professional development

Problem: demand for long-distance training
demand for intensive (block) training (summer schools)
demand for after-hours training

Navigator



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Some heretic thoughts

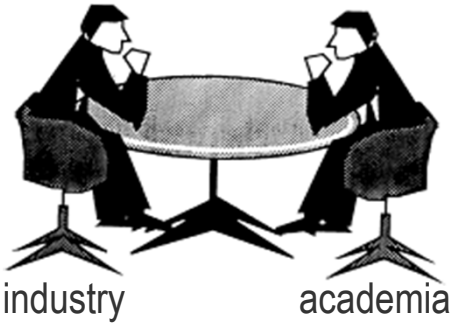
Industry expectations elaborated in workshop

OK, industry needs naval architects (XYZ engineers), but...

"What should a naval architect (XYZ engineer) know?"

ONR Workshop 2004 "Teaching Future Ship Designers"

- all US universities
- some EU universities
- main US industry employers



Do they know what they want?

Customers know what they want,

but **often unable to express** it clearly

Example:

"We want a car door

that shuts well"

Some misleading specifications for engineers

Example:

“We want creative people”

meaning

“We want engineers who

can use first-principle methods.”

Example: Naval architecture 1/2

What should be taught (industry & university discussion)

Good base in naval arch. / engineering principles

strength and structural design
production
hydrostatics / stability
ship design (lines, layout, estimations)
hydrodynamics
marine engineering

Computer literate

CAD proficiency seen as lim gap
level of competence (hours) not specified
tradition: nav arch = exotic mech eng
trend: nav arch = exotic applied computer science

Hands-on experience

as worker
as engineer
at sea / at shipyard

more specialized knowledge, more math at master level

Example: Naval architecture 2/2

What should be taught (industry & university discussion)

soft skills

ability to study independently
creative with feel for viability o ns
enthusiastic
team capability

management skills

project m nt
commun atio
basic leg f mew rks (contracts, work)
motivatio

engineering English

technical
business

What shall we teach?

Teaching content subject to various forces:

- industry expectations
- professors' competences
- suitability of university environment to learn topic
- financial constraints of university

(industry pays? Nice dream)

(students pay? Nice dream)

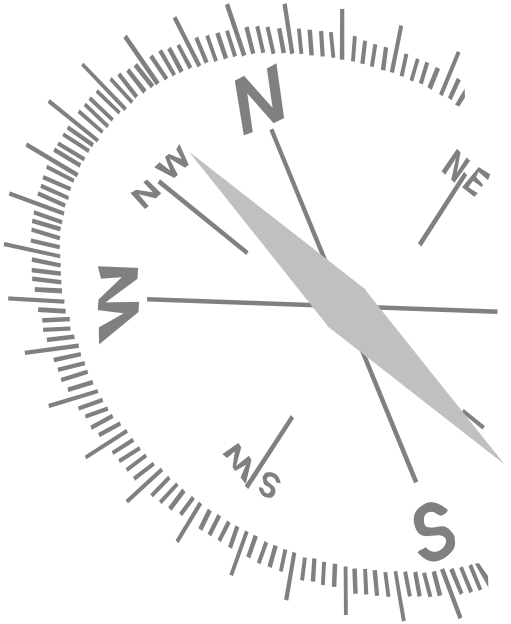
Resulting compromise seen as half-full, half-empty glass

There is learning outside university

When should topics be learnt?

- **in lectures** every year / semester / second year ?
  on occasion ?
  compulsory / elective ?
- **in formal exercises** under supervision
- **in laboratories** (expensive, outdated?)
- **in projects** with occasional contact to supervisor
- **in excursions**
- **during internship**
- **in industry after graduation**

Navigator



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Some heretic thoughts

Suppliers

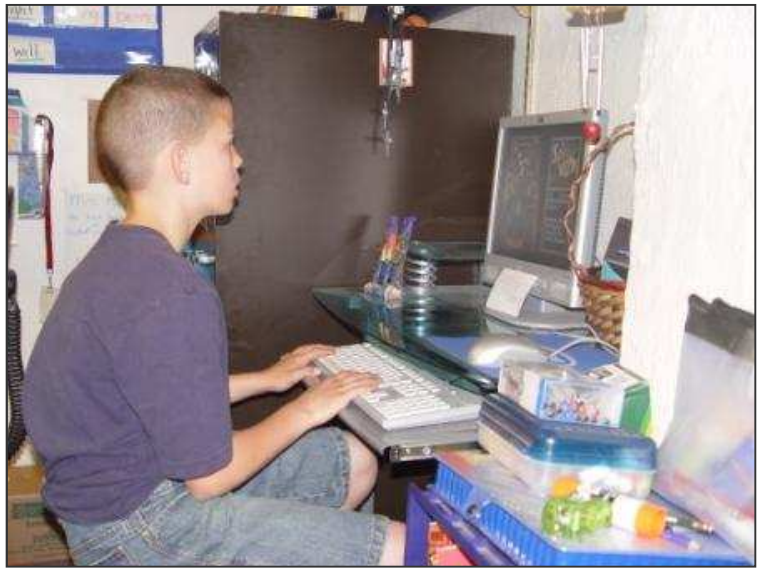
Our raw material: The high-school graduate

What changes have we noticed

in the last 30 years?

We notice changes in students

Today's high-school kids are tomorrow's students



"Digital natives"

"Today's average college grads have spent <5,000 hours of their lives reading, but >10,000 **playing video games**…"

"...it is very likely that our student 's **brains** have physically **changed…**"

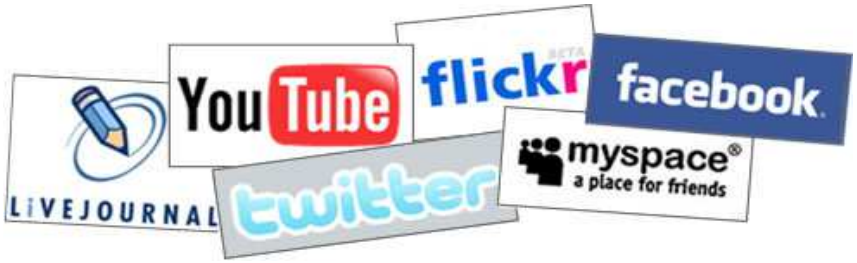
(Prensky 2001)

Next-generation engineers

They won’t even know what this is !

They are “Digital Natives”

They use these every day !



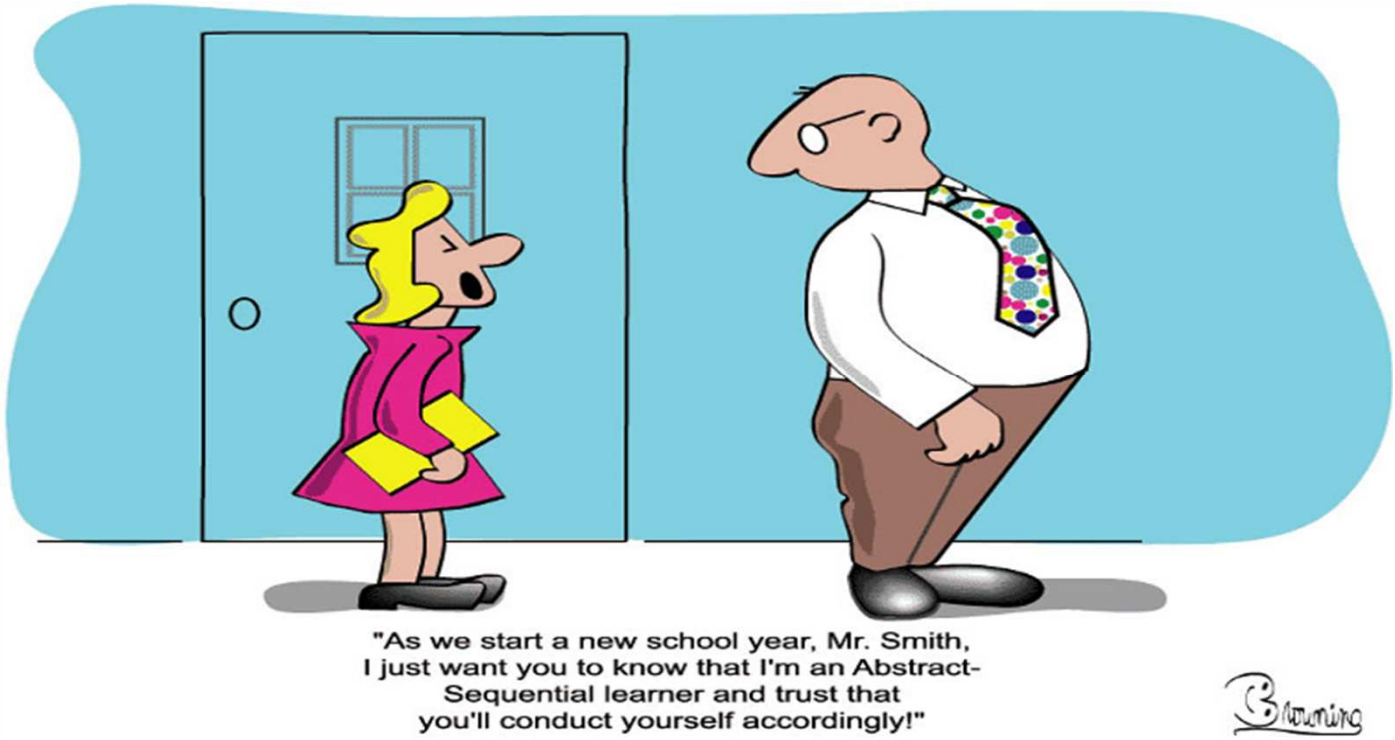
They (Digital natives) are different from us (Digital immigrants)

- used to getting **information fast**
- prefer **graphics** before text
- prefer **random access** (hypertext)
- like to **network**
- thrive on **instant gratification**
- prefer **games** to serious work
- want **"edutainment"**

Source: Prensky (2001)

From “Gods” to service providers?

Students rate us and have demands (on others)



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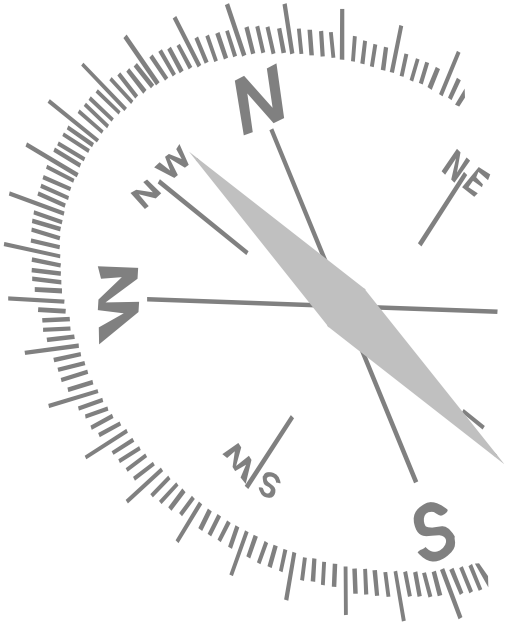

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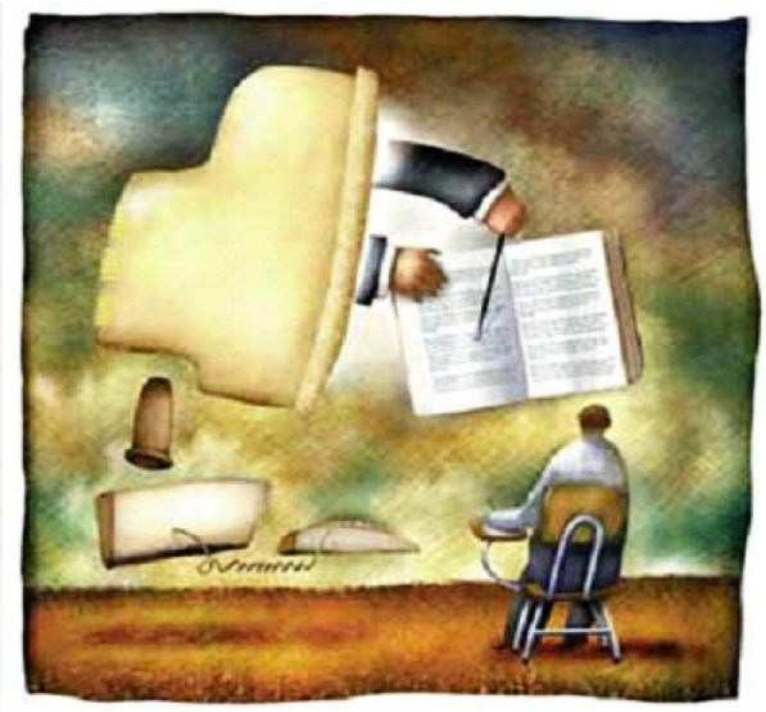
Some heretic thoughts

Substitutes

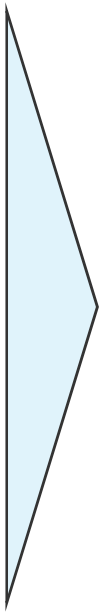
How about distance learning / e-learning ?



Yes, we can – in principle...

Elementary learning techniques are media independent

watching	blackboard	powerpoint / videos
reading	books / lecture notes	internet texts
doing	exercises physics labs projects	exercises virtual labs projects
testing/evaluating	in class homework submission	on-line homework submission



Distance-teaching requires more work

All documents must be electronic

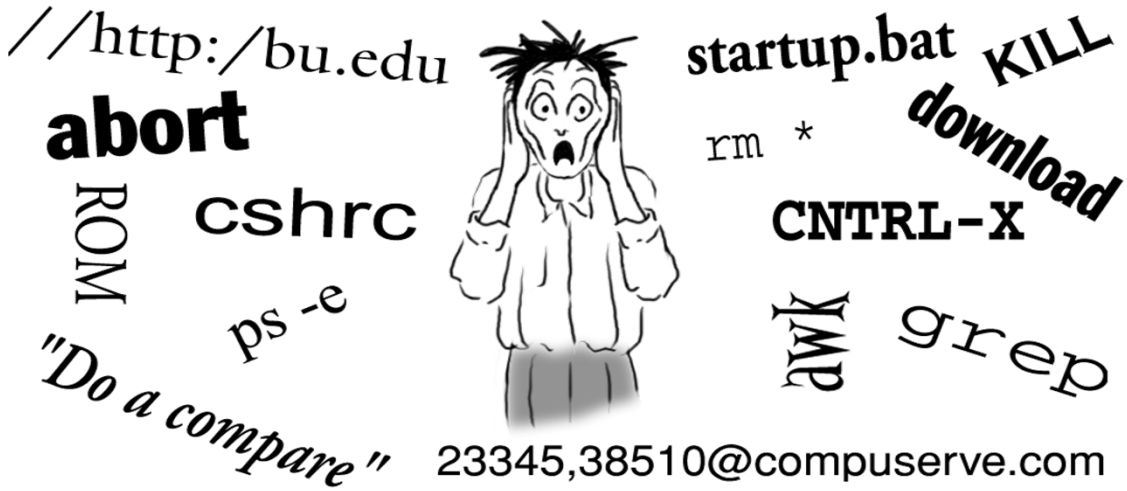
lecture notes	pdf
exercises and solutions	pdf, excel, interactive on-line possibly automatically corrected
lectures	ppt, video, webcam
tests	via internet, perhaps even smartphone
infrastructure	moodle (?)

This all requires work = **time & money**

Not so easy in reality

best teachers often not computer literate,

computer gurus often don't know what needs to be taught



no budget for conversion

to electronic teaching

if you don’t have time & money

for writing a book...

... you definitely don’t have it

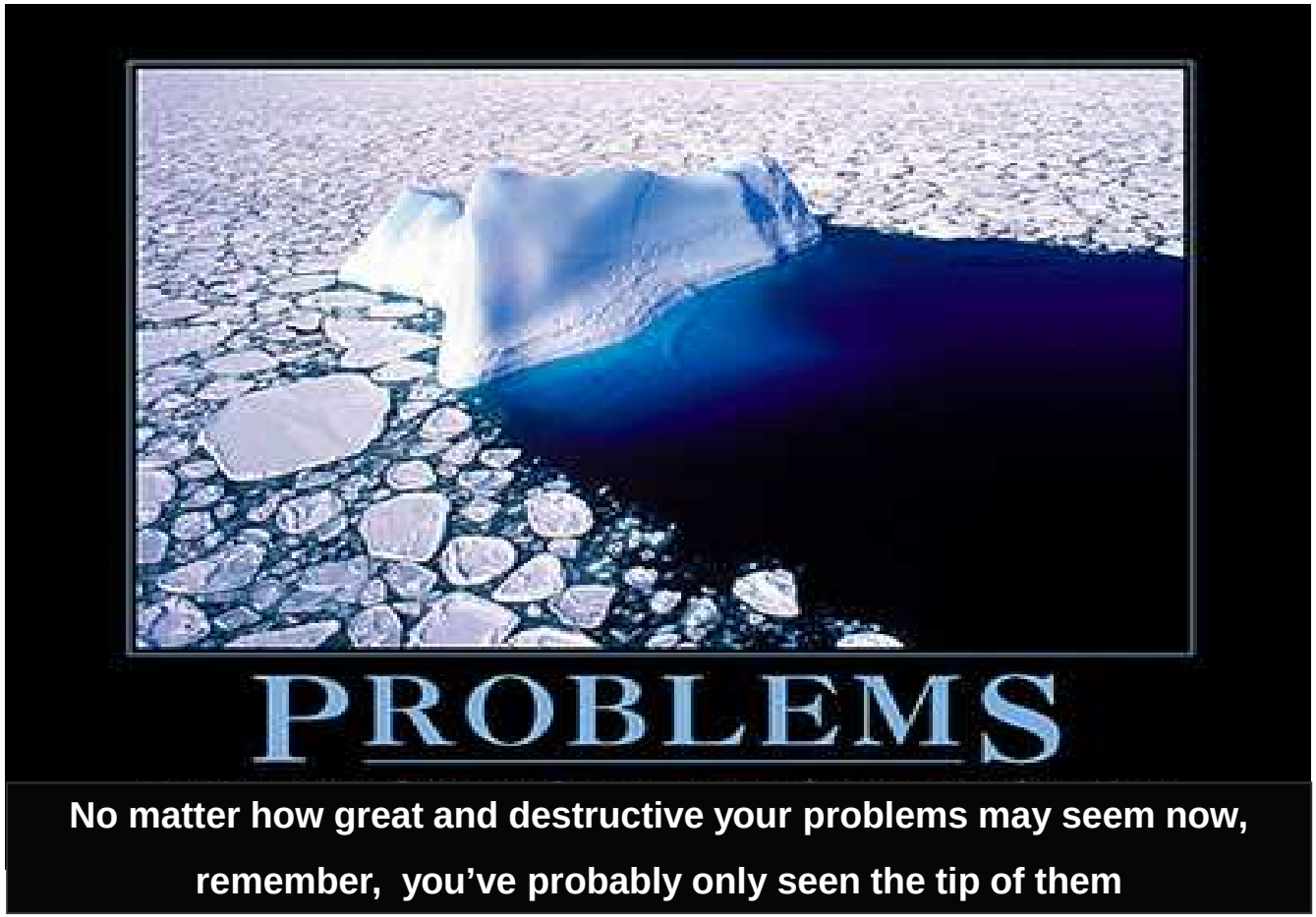
for (decent) e-learning packages

Not so easy in reality 3/4

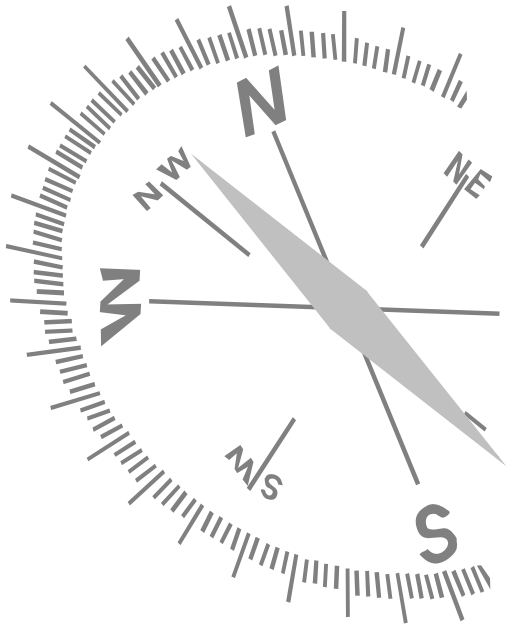
no feedback from students

(see the look in their eyes and you know they are lost)

Not so easy in reality



Navigator



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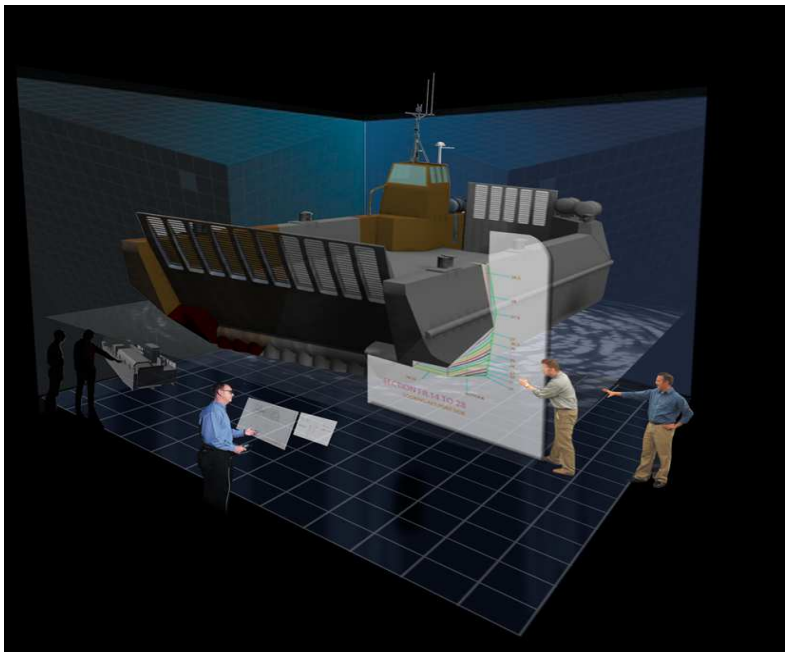
Some heretic thoughts

Some heretic thoughts 1/3

Do we need **classical laboratories** (toys) OR

Are '**virtual labs**' the future?



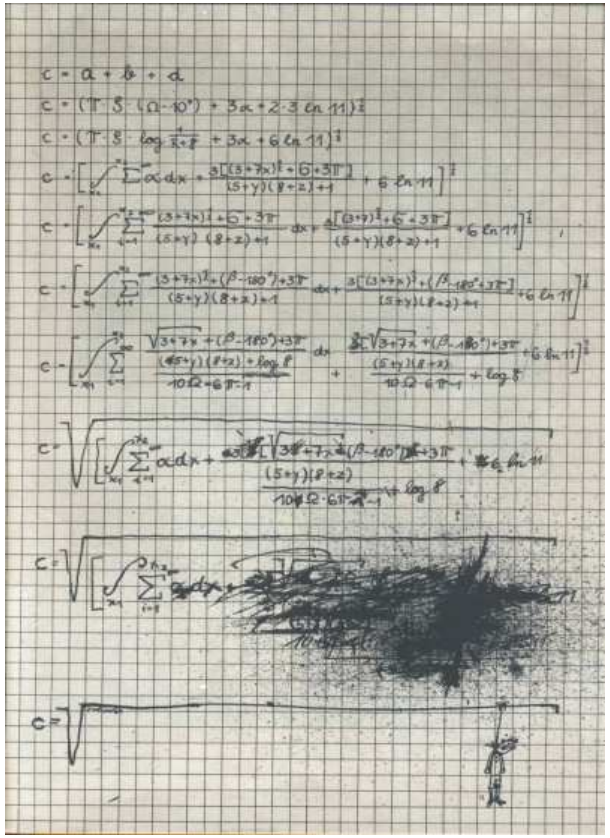
Some heretic thoughts

Do we need

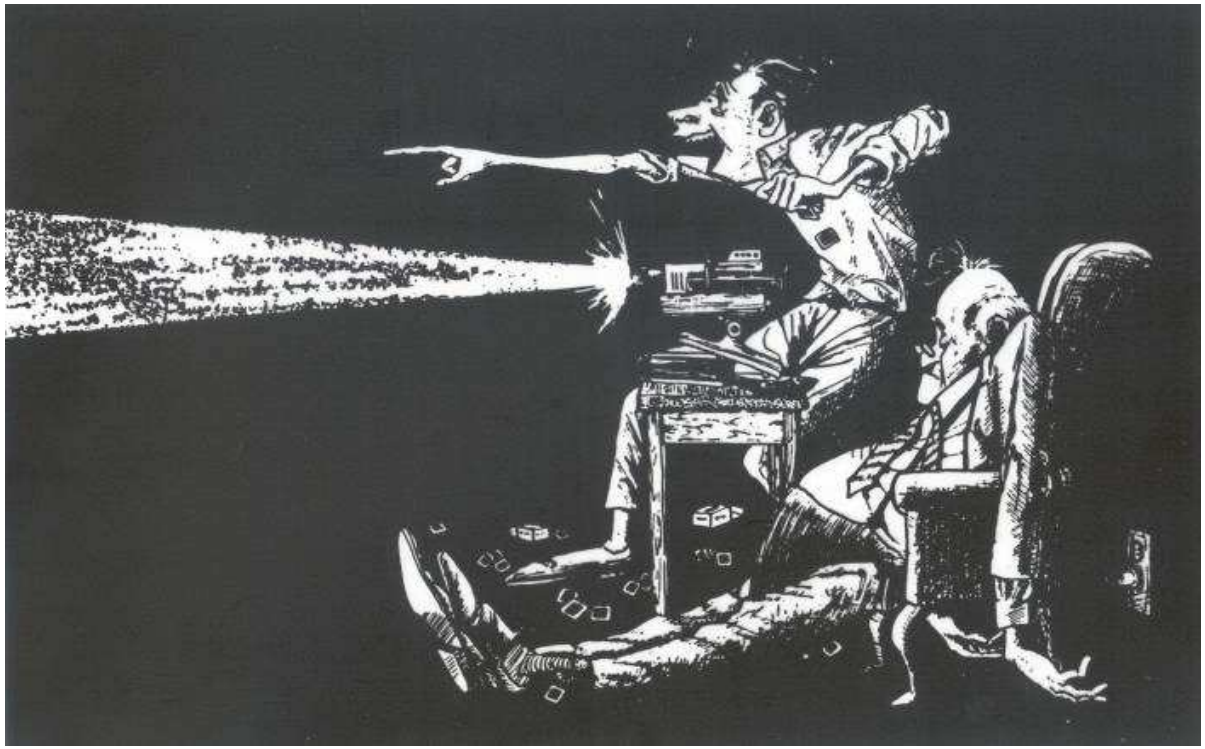
- (lengthy) **mathematical derivations**

  in class?

Why not give derivation in pdf to download and focus on assumptions and resulting limitations?

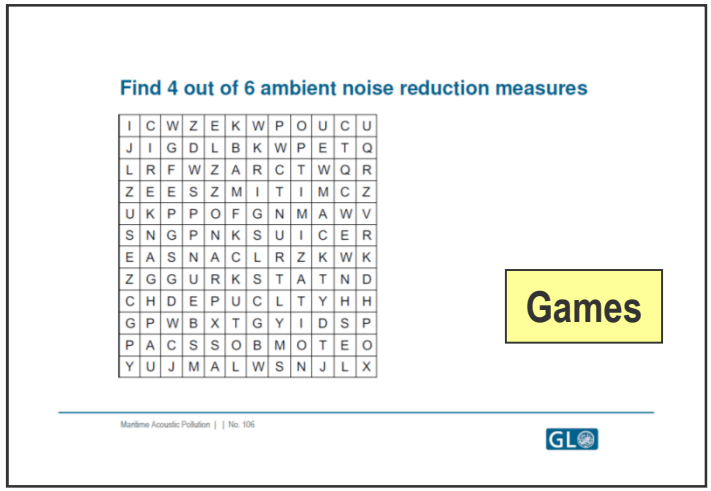


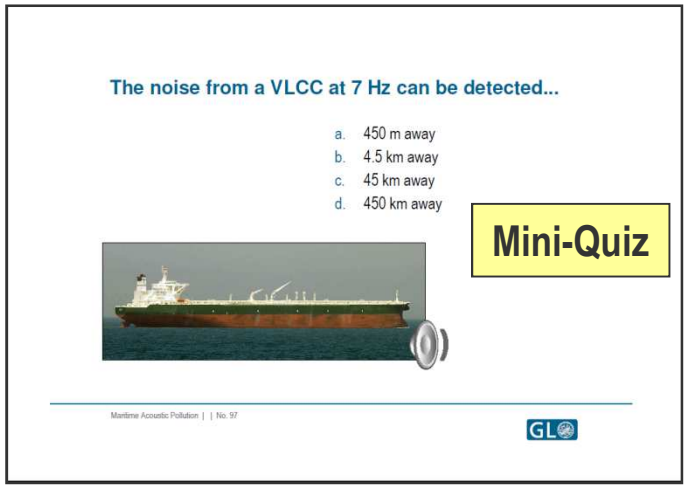
Do we need that much frontal teaching ?



Death by Powerpoint

There are alternatives

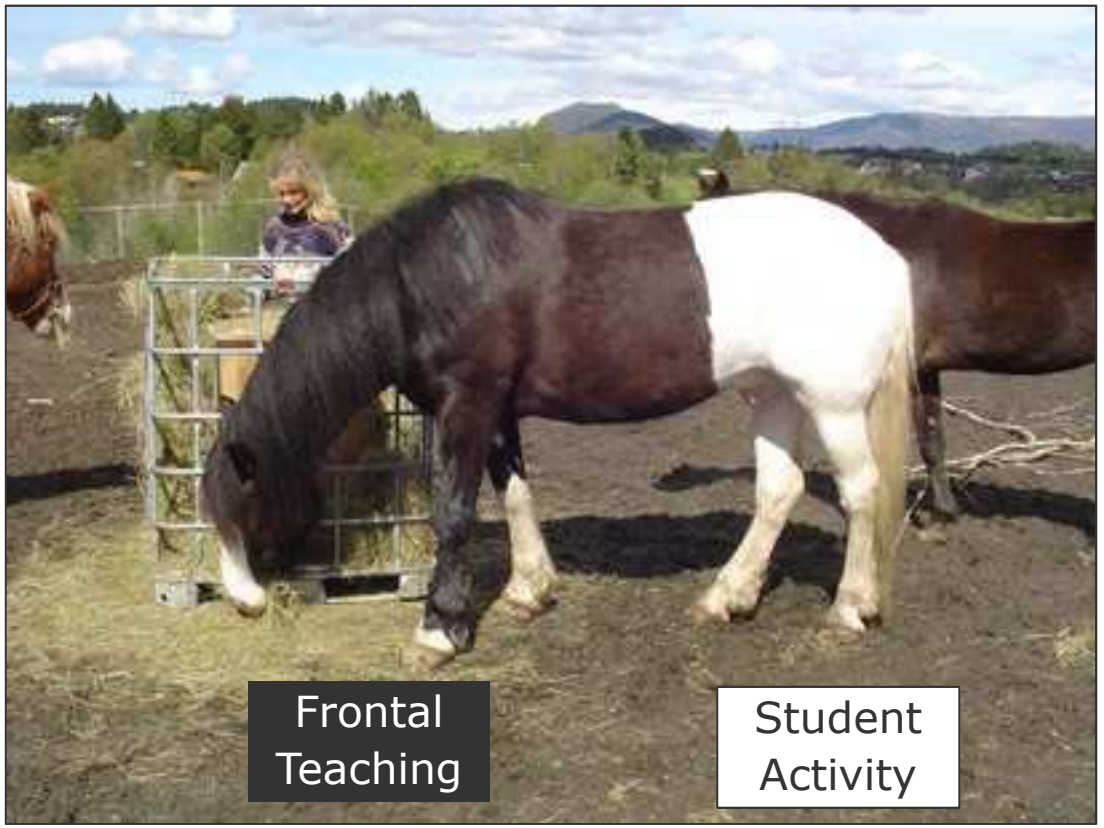




Source: DNV GL Maritime Academy

Do we need to change our timing?

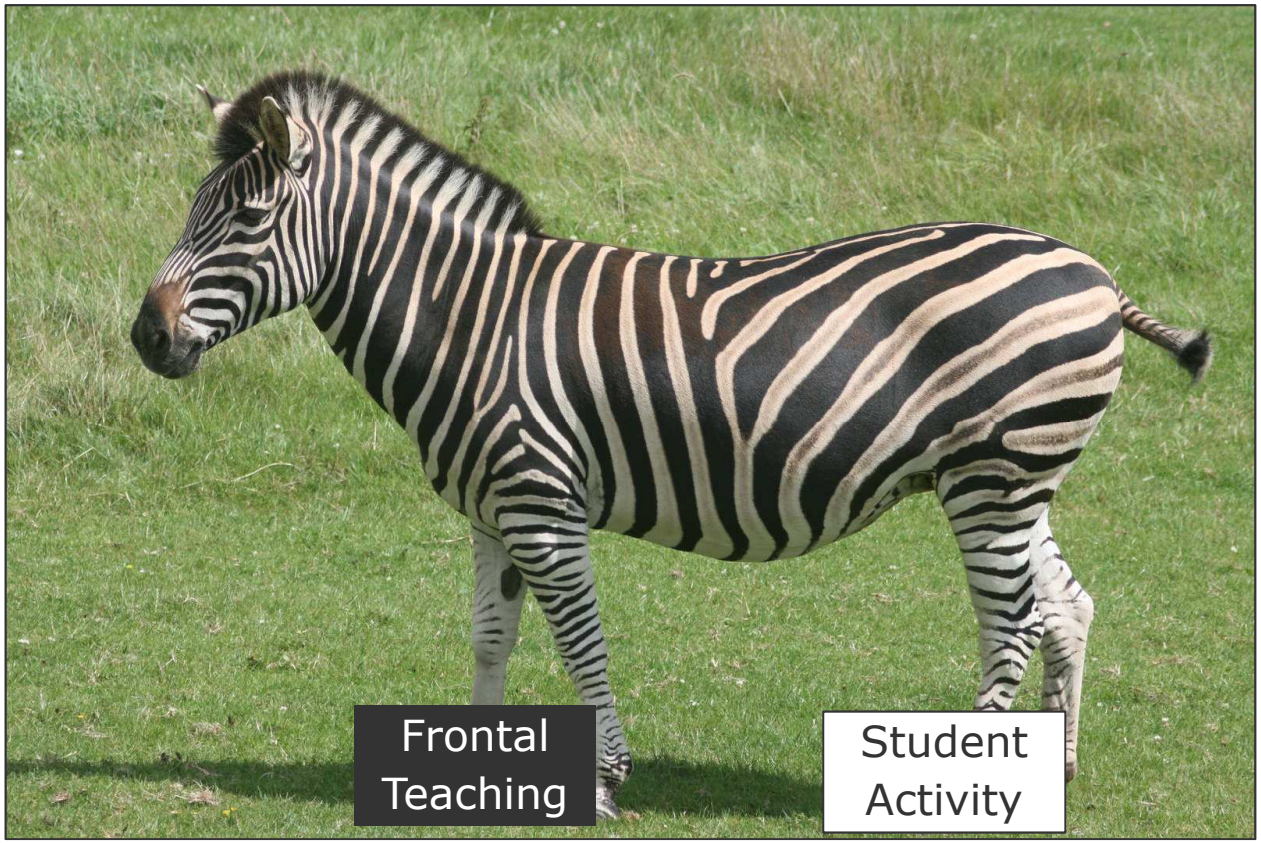
Current organisation:



~1.5h

Do we need to change our timing?

Should be: Max. 15 min and then they have to do something



Example - How my teaching has evolved

Part of teaching energy efficiency of oil tankers

- Version 2001
- Version 2010
- Version 2012
- Version 2015

Aim: To show how energy efficient large ships are

2001

Power-mass ratio

	P[kW]	m [t]	P/m [kW/t]
Porsche	408	1,8	227
Mercedes	150	2,40	63
Tug	2300	520	4
Containership	57100	125000	0,5
VLCC	29500	420000	0,07

2010

Tanker are low-powered

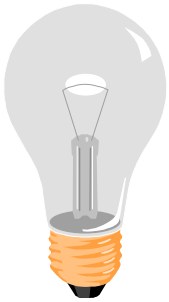
227 kW/t

63 kW/t

4 kW/t

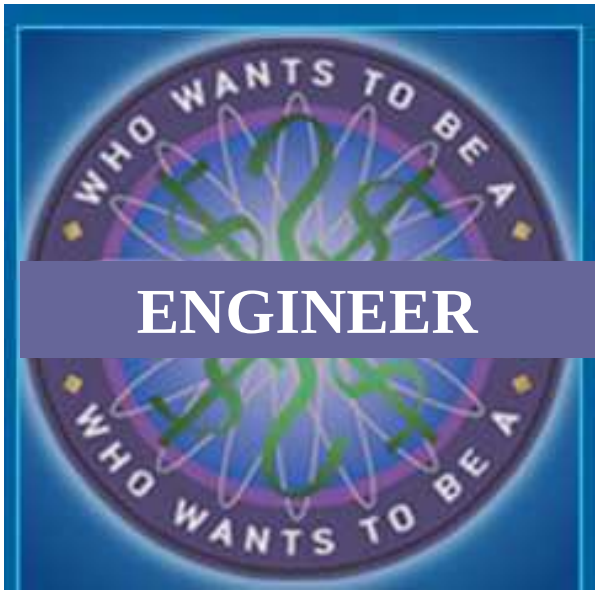
0.5 kW/t

0.07 kW/t



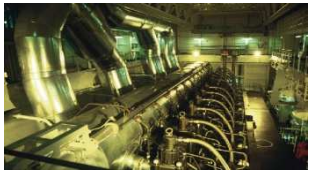
Light bulb powers car

Quiz-Time



Tankers have 0.07 kW/t as power-mass ratio.

What engine power should be installed in a car (e.g. yours) to have the same efficiency?



?

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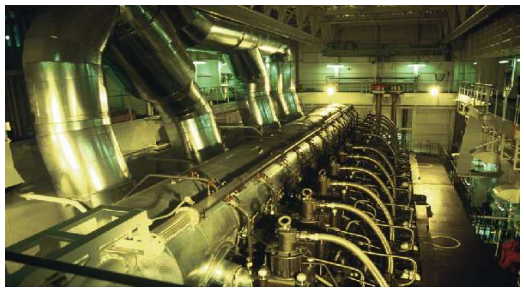
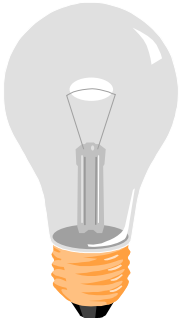
Tankers are extremely efficient





Light bulb
powers a car

2015

What engine power would be needed …

… for a compact car to have the same power-mass ratio as a VLCC ?

a. ~ 100 W (light bulb)
b. ~ 1 kW (coffee maker)
c. ~ 5 kW (water heater)
d. ~ 10 kW (lawn mower)

VLCC = very large crude carrier = supertanker

Conclusion

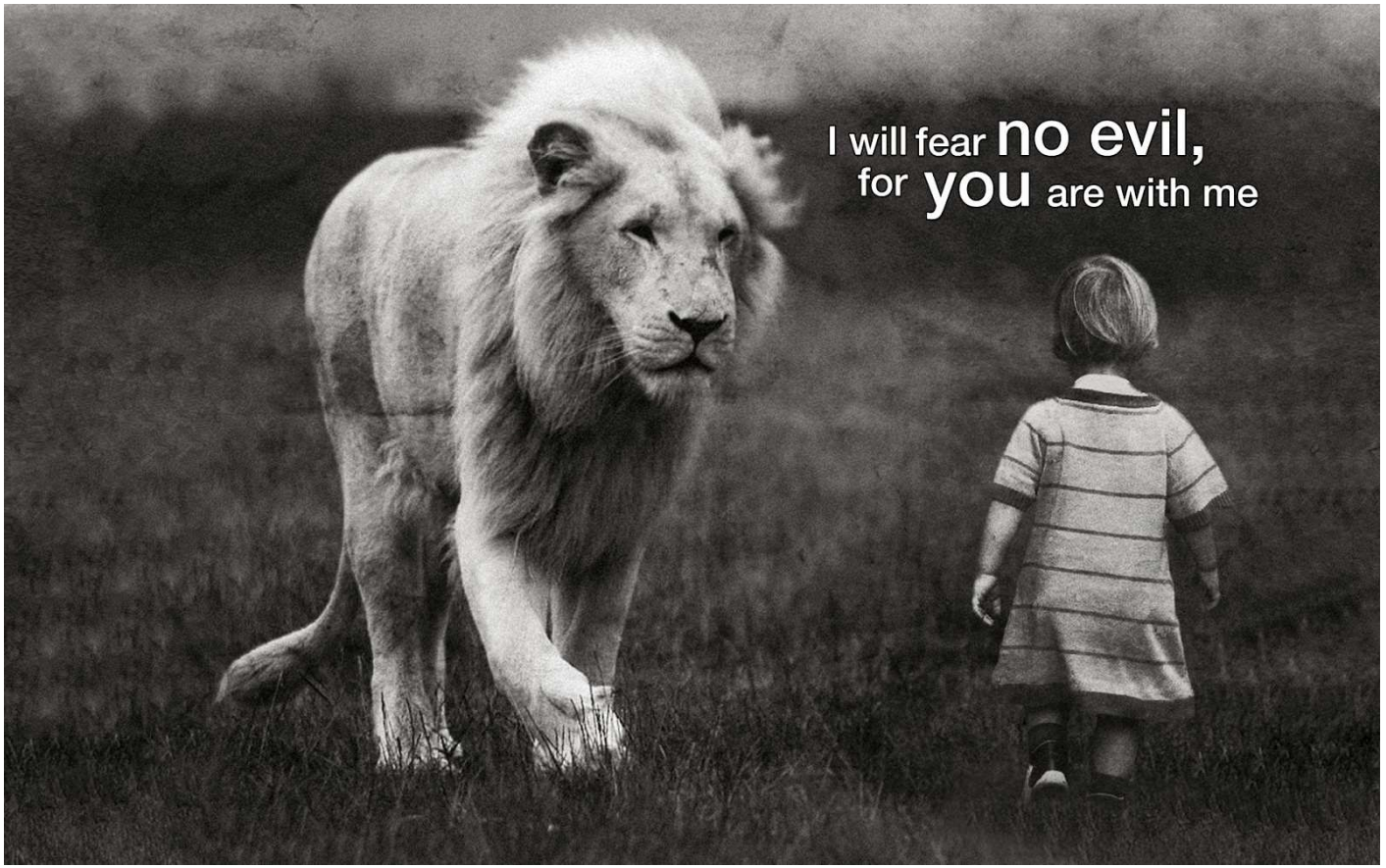
- Increasingly **international competition**

- **Students change** – we need to adapt
  - gamification of teaching
  - pedagogy more important than IT
  - change teaching roster

- **CPD increasingly important**
  - by universities
  - by private suppliers

CDP = continuous professional development

Thank you for letting me live this far…



Let the debate begin…

We are here to help you !

Volker Bertram

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