NTNU

Kunnskap for en bedre verden

A mild form of flipped classroom in large courses for engineering students

Frode Rønning

Department of Mathematical Sciences

Norwegian University of Science and Technology

Trondheim - Norway

Engineering education at NTNU

- NTNU is the main institution for educating engineers in Norway
  - Approx. 1700 students admitted each year to 5 year integrated (Master of Technology, MA) programmes
  - Approx. 1000 students admitted each year to 3 year (Bachelor of Technology, BA) programmes
- All MA students have a common Calculus course in the first semester (7.5 ECTS)
- The talk will deal with some changes made to this course, and some other courses, in recent years

New components introduced

- Digital learning resources
  - Thematic pages on the web
  - Video material on the web
    - Video captured lectures
    - Short thematic videos
- Digital assessment
  - Maple T.A.
- Student support centre
- Two types of lectures

What to do with the lectures?

Traditional pattern:

- 2 x 45 minutes, two times a week
- Linear structure
  - Day 2 starts where Day 1 ends
- Little interaction
- Little (visible) activity

Lectures have got a bad reputation

Hjem

Ytring:

Om krittnisser og innovative læringsprosesser

Kanskje kommer norske krittnisser til å sitte i auditoriene sine og vente på sine studenter i en ikke så fjern fremtid, fordi studentene heller foretrekker glimrende digitale studietilbud i stedet for arkaiske, til dels utdatert utdanninger på norske campuser, skriver Arne Krokan i denne kronikken.

Forelesning er en utdatert undervisningsform, mener Arne Krokan. Foto: Skjalg Bøhmer Vold

Foreslår å forby forelesninger

Professor Arne Krokan mener man burde forby forelesninger og tvinge lærere til å erstatte dem med en undervisningsform som er mer aktiv. — Tøv, svarer Kunnskapsdepartementet.

Students' use and perception of lectures

To what degree do you make use of?

Survey 2013 *n*=662	High degree	Rather high degree	Some degree	Low degree/never
Lectures live	70 %	13 %	8 %	6 %
Video-taped lectures	21 %	25 %	35 %	17 %

Rate these statements

Survey 2013 *n*=662	Completely agree	Partly agree	Partly disagree	Completely disagree
I learn a lot by going to lectures	55 %	35 %	7 %	2 %

Students' perception of lectures

- Surveys indicate that students see lectures as valuable
- Statements about lectures (made in interviews):
  - In mathematics it is important to have things *explained* to you
  - It is difficult to learn mathematics from the book
  - In the lecture you can follow the reasoning as it develops on the board

But still, should something be done?

- Lectures are perceived as important but
  - how can students be more involved during lectures?
  - how to avoid that lectures are more than one way communication?
- Ideas inspired by *flipped classroom* principles
- Requires some preparation by the students
  - but not many prepares for lectures
- Doing fundamental changes to the traditional lecture pattern seemed like a risky enterprise

New lecture pattern

- Survey lectures (2 x 45 min.)
  - Overview over the important topics of the week
  - Video-taped
  - Very large groups
- Interactive lectures (2 x 45 min.)
  - Based on tasks, published in advance, to get deeper into the topics
  - Possibilities for interaction, student-student and student-teacher
  - Smaller (but still large) groups

Calculus 1, Autumn 2018

Klokkeslett	Mandag	Tirsdag	Onsdag	Torsdag	Fredag
08.15 – 10.00	OF: F1 (O1)	OF: F1 (O3)	IF: S5 (G1) R2 (G2)	IF: S5 (G7) R2 (G8)	
10.15 – 12.00	OF: F1 (O2)	(O4)	IF: S5 (G3 R2 (G4)	R2 (G10)	P: F1 (Alle)
12.15 – 14.00	M: S7 S8 (stille)	M: S7 S8 (stille)	IF: S5 (G5) R2 (G6) M: S7 S8 (stille)	IF: S5 (G11) R2 (G12) M: S7 S8 (stille)	P: F1 (Alle) M: S7 S8 (stille)
14.15 – 16.00	M: S7 S8 (stille)	M: S7 S8 (stille)	M: S7 S8 (stille)	M: R2 [1] S8 (stille)	M: S7 S8 (stille)
16.15 – 18.00	M: S7 S8 (stille)	M: S7 S8 (stille)	M: R2 S8 (stille)	M: R2 [1] S8 (stille)	

Survey, 4x

Interactive, 12x

1700 students in total

Interactive lecture

with possibilities for group discussions

Task from Interactive lecture

Analysens fundamentalteorem sier at dersom f' er kontinuerlig, så er

$$f(x) - f(a) = \int_a^x f'(t)\,dt.$$

a) La $u = f'(t)$ og $v = x - t$, bruk delvis integrasjon en gang på

$$\int_a^x f'(t)\,dt,$$

$$f(x) - f(a) = f'(a)(x-a) + \int_a^x f''(t)(x-t)\,dt$$

og sett resultatet inn i analysens fundamentalteorem. Hva får du da?

b) Gjenta prosessen, men nå med $u = f''(t)$, og $v = (x-t)^2/2$. Hva får du da?

c) Har du gjort **b)** riktig, sitter du igjen med leddet

$$\frac{1}{2}\int_a^x f'''(t)(x-t)^2\,dt$$

på slutten. Hva er dette for noe?

$$f(x) - f(a) = f'(a)(x-a) + \frac{f''(a)}{2}(x-a)^2 + \frac{1}{2}\int_a^x f'''(t)(x-t)^2\,dt$$

Experiences

To what degree do you make use of?

Survey 2013 *n*=662	High degree	Rather high degree	Some degree	Low degree/never
Lectures live	70 %	13 %	8 %	6 %
Video-taped lectures	21 %	25 %	35 %	17 %

2016 *n*=791	High degree	Rather high degree	Some degree	Low degree/never
Survey lectures live	72 %	13 %	7 %	7 %
Video-taped survey lectures	7 %	9 %	32 %	49 %
Interactive lectures	81 %	8 %	5 %	4 %

Experiences

- A large portion of students visit interactive lectures regularly (close to 90 % - 2016 survey)
- And they claim that they learn much from this (close to 90 % - 2016 survey)
- BUT:
- Too few prepares by working on the tasks in advance (10-11 % - 2016 survey)
  - Don’t know how to start with the tasks
- Difficult balance between time for student work and teacher led presentation
  - Some students want more lecturing
- Requests for worked solutions and video-recording
- Still too large groups to get real student-teacher interaction