



Activating Blended Learning Approaches in Two Freshmen Chemistry Courses

**Danny J. Scholten,^a Maikel Wijtmans,^b Stefan J. Dekker,^a
Erik Boon,^c Anna H. Vuuregge,^a J. Chris Vos,^d Marco Siderius,^b
Jacqueline E. van Muijlwijk-Koezen^a**

^a Division of Innovations in Human Health & Life Sciences,

^b Division of Medicinal Chemistry

^c Audiovisual Centre VU

^d Division of Molecular Toxicology

danny.scholten@vu.nl

stefan.dekker@vu.nl

iH2LS.beta@vu.nl

Problems & Aims

- **Problems**
 - **General:** Too much focus on transfer of information
 - Classical lecturing not so effective
 - **Specific:** 1st year bachelor courses
- **Aim: activate & involve students**
 - Increase in motivation, active learning & engagement



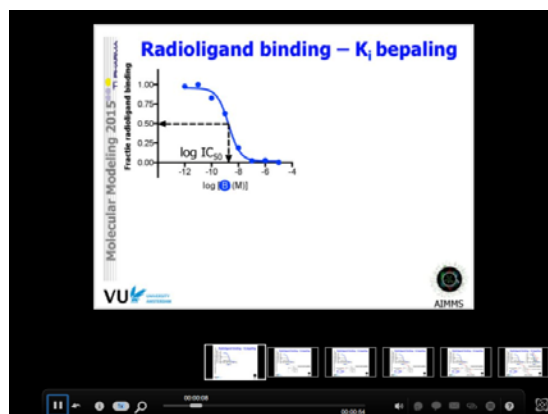
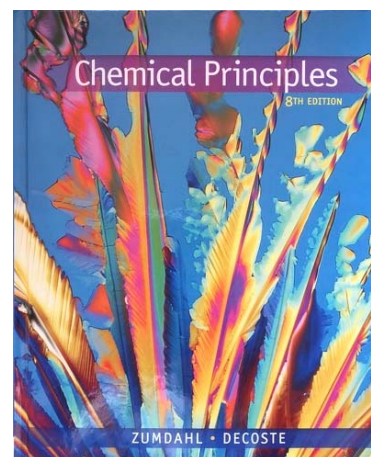
The approach: Blended learning

- A mix of online & offline learning
 - **Less** information transfer = **fewer** lectures
 - **More** information assimilation = **more** student activity
 - Complementary ways to engage with course material



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The courses

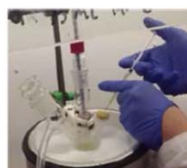
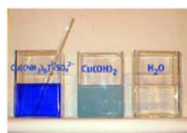
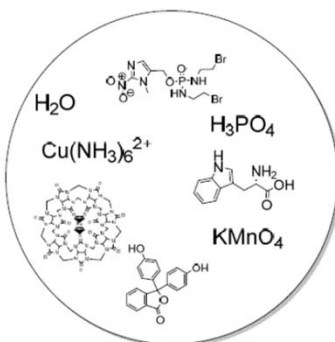
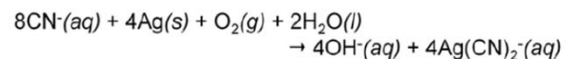
- Molecular Principles (MP)
- Cellular Biochemistry (CB)

MP

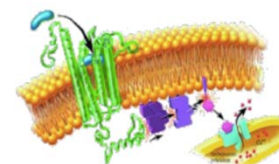
CB



$$\text{pH} = \text{pK}_a + \log \left(\frac{[\text{base}]}{[\text{acid}]} \right)$$



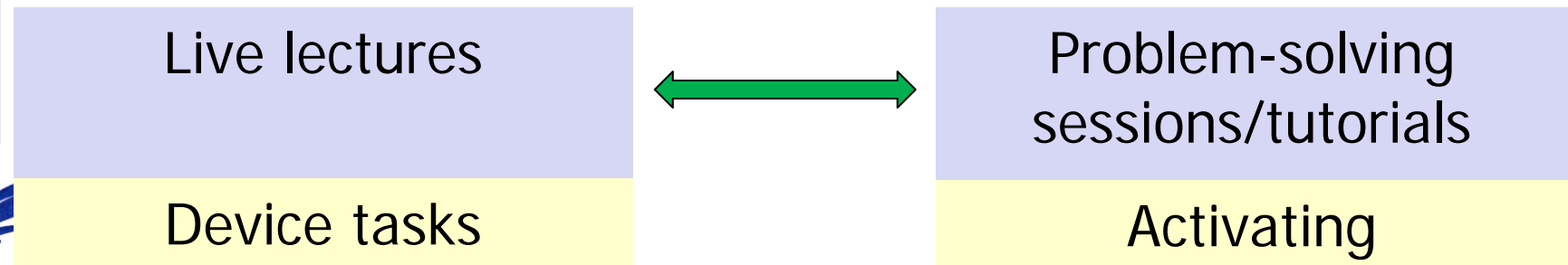
Cellulaire Biochemie 'van Gen tot Geneesmiddel'



MP: Stepwise trajectory

MP

- Sept '13: classical setup + activating components



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MP

- Sept '13: classical setup + activating components
- Sept '14: lectures recorded with phone → slidecasts
- Sept '15: casts edited



Live lectures

Device tasks



Problem-solving
sessions/tutorials

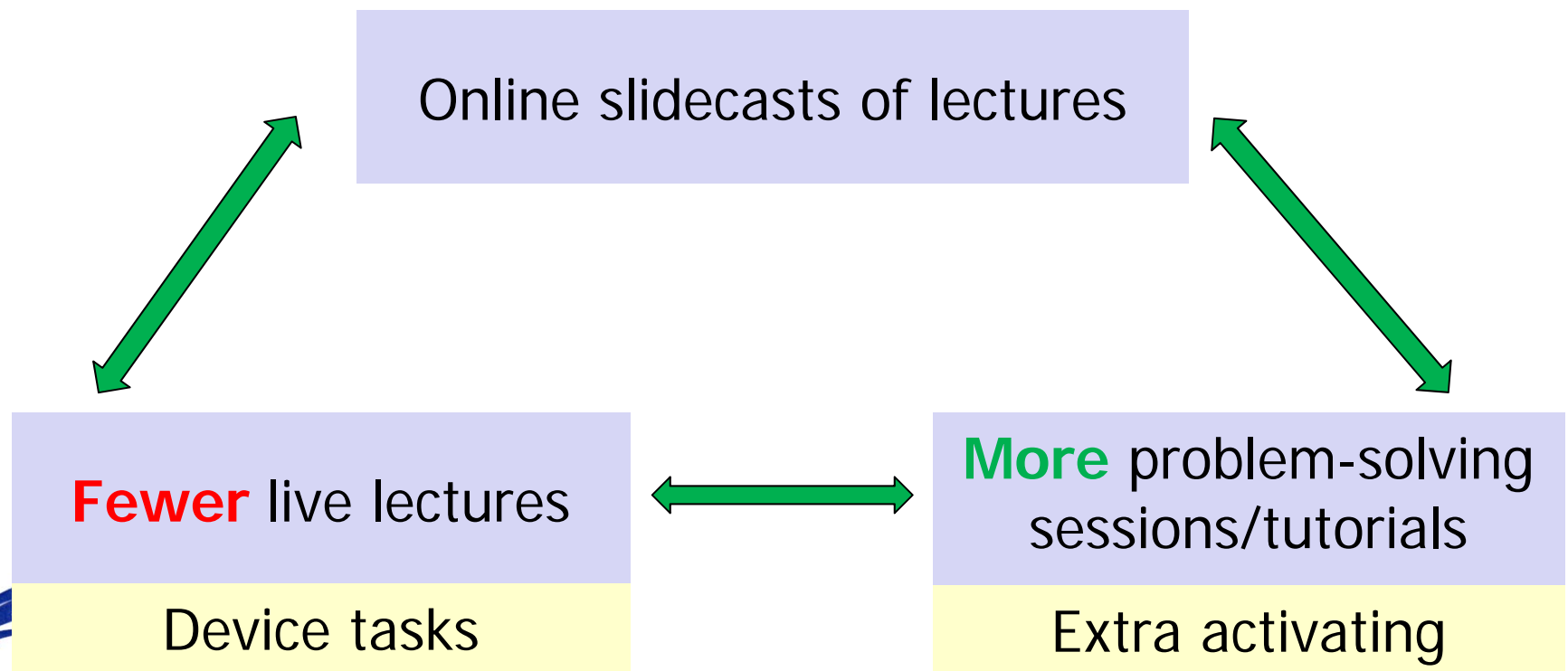
Activating



MP: Stepwise trajectory

MP

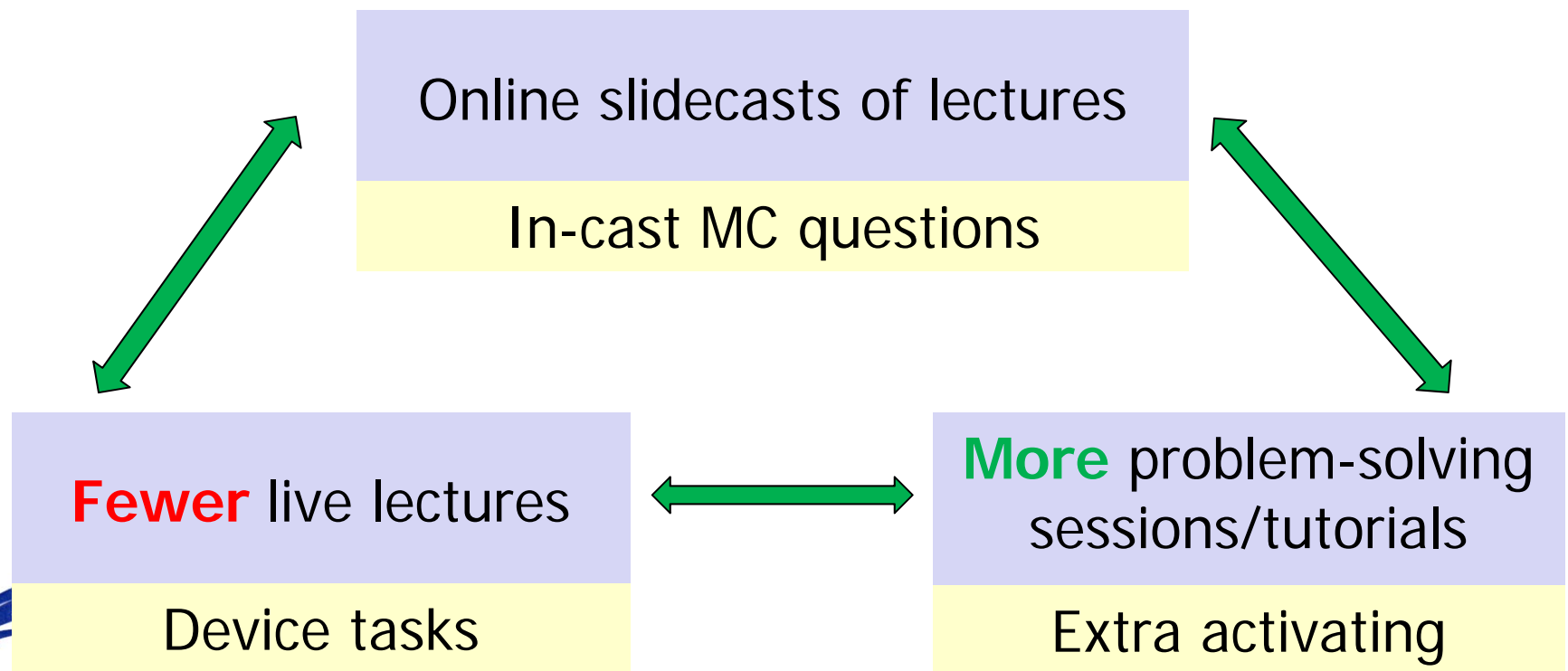
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- Sept '15: casts edited, part online, **students' vote**



MP: Stepwise trajectory

MP

- Sept '13: classical setup + activating components
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- Sept '15: casts edited, part online, **students' vote**
- Sept '16-'18: MC questions in slidecasts



General outcome

- Satisfactory electronic engagement
- Small effect on average grade



Key evaluations students

- Three or four years combined (N=88-123)

"The use of in-cast MC questions is a good way to keep attention"	92% ✓	0% ✗
"The Blended Learning approach stimulates me to be active with the course material"	88% ✓	4% ✗
"The Blended Learning approach has resulted in me better grasping the course material"	80% ✓	2% ✗
"The Blended Learning approach should be used next year again for this course"	92% ✓	2% ✗



Written feedback students

- "What do you consider good about the Blended Learning approach in the MP course....."



Time

8

Tutorials

2

Course
material

1

Questions

7

Self

6

More

3

Good

4

Busy

5

N=99





CB: Addressing problems

CB

- Low scores: perceived as difficult/many “details”
- Online MC questions largely ignored: not graded
- Joy of teachers reduced



Trajectory

- 2016: classical setup, no tutorials/device tasks



Live lectures

Trajectory

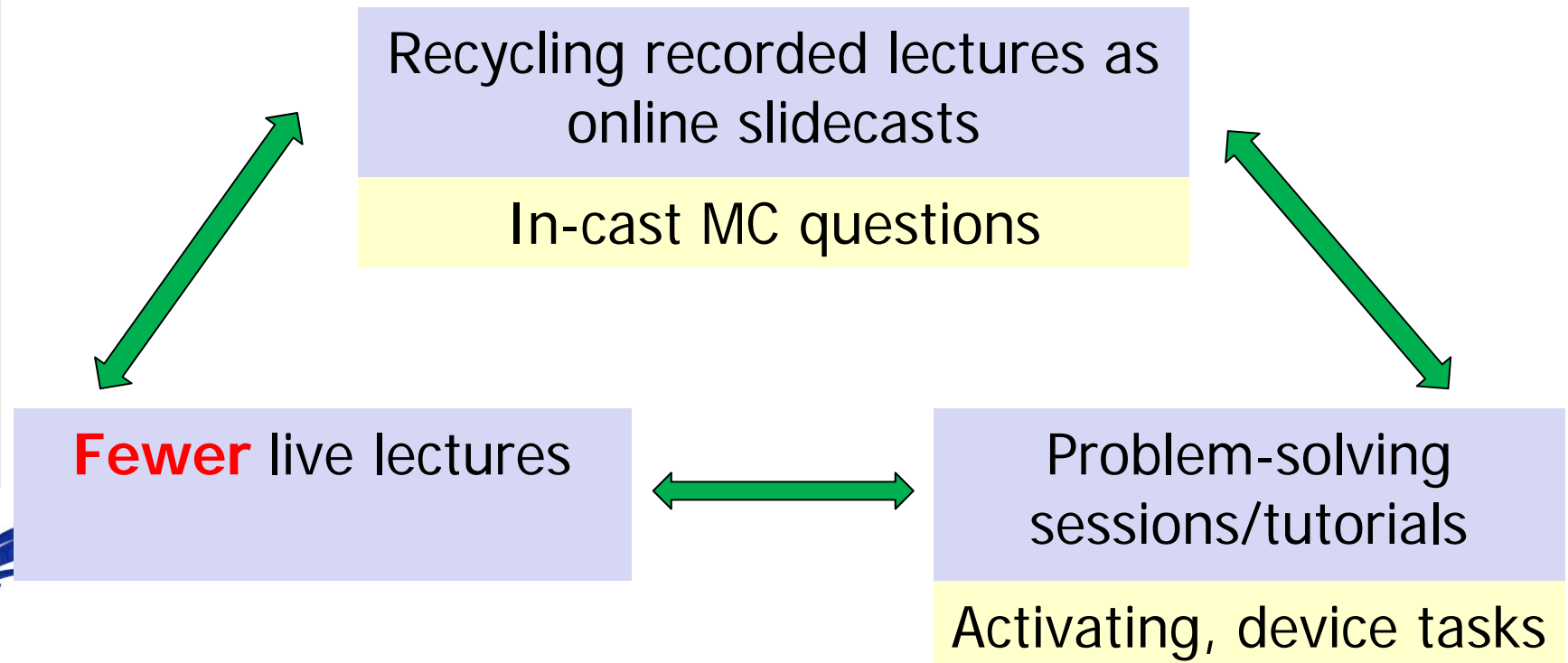
- 2016: classical setup, no tutorials/device tasks
- 2017: implementation blended learning
 - Complete overhaul

Live lectures



Trajectory

- 2016: classical setup, no tutorials/device tasks
- 2017: implementation blended learning
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Electronic engagement

- Cumulative: 2 academic years
 - 2017-2018, 2018-2019
- Slidecast viewing

Cumulative #students	
Cumulative watch time (h)	



Electronic engagement

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Cumulative #students	144
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Electronic engagement

- **Cumulative: 2 academic years**
 - 2017-2018, 2018-2019

- **Slidecast viewing**

Cumulative #students	144
Cumulative watch time (h)	925



- **In-cast MC questions**
 - 79 questions

Cumulative think time (h)	67
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Written feedback students

- "What do you consider good about the Blended Learning approach in the CB course....."

Learning 5

Good 3

Busy 6

Course material 1

Tutorials 2

Slidecasts 4



Key evaluations students

- Two years combined (N=46-48)

Next year again?	2018	2017
In-cast MC questions		
Blended Learning		

Key evaluations students

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Next year again?	2018	2017
In-cast MC questions*	✓ 100% ✗ 0%	✓ 100% ✗ 0%
Blended Learning		

*Students want even more questions



Key evaluations students

- Two years combined (N=46-48)

Next year again?	2018	2017
In-cast MC questions	✓ 100% ✗ 0%	✓ 100% ✗ 0%
Blended Learning	✓ 79 % ✗ 0%	✓ 94% ✗ 0%



Grade effect?

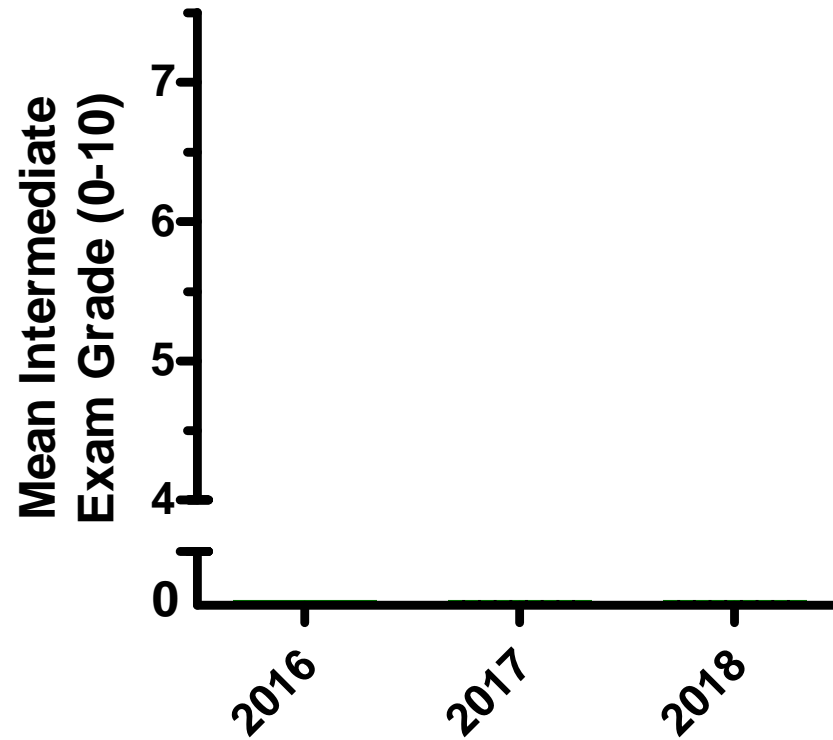
- **Cohort**
 - Only 1st year students
 - Age/gender: cohorts not significantly different
- **Concurrent 'Calculus' course: reference final exam**
 - No intervention
- **Midterm and final exam**
 - Both multiple choice





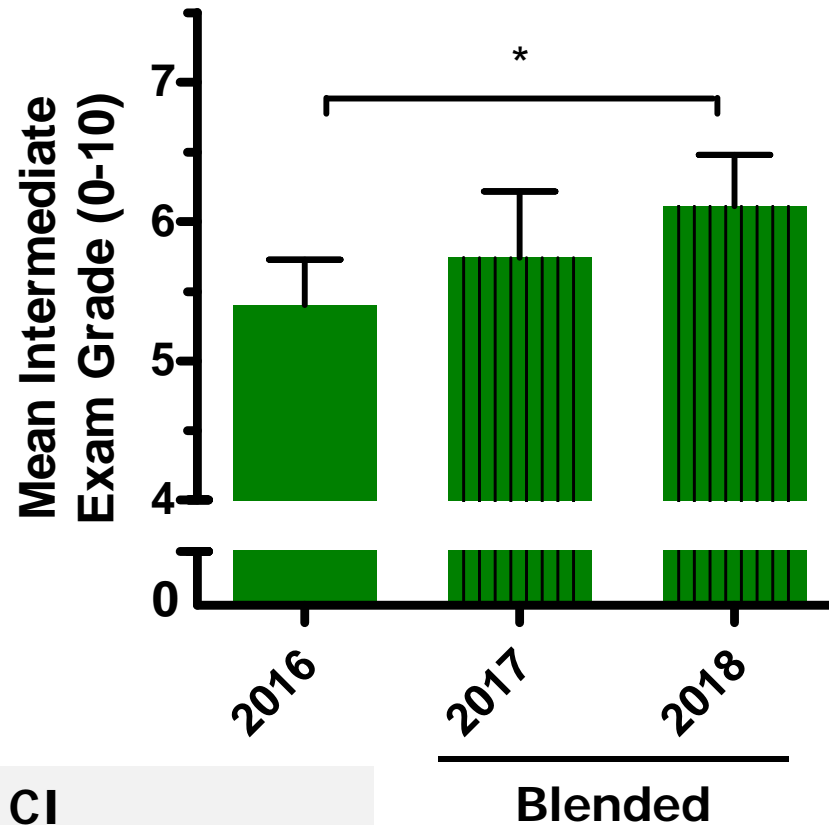
Midterm

CB



Means with 95 % CI

Midterm



Means with 95 % CI

One-way ANOVA: $F(2, 180) = 3.866$ $p = 0.02$

Post-hoc Tukey test
* $P < 0.05$

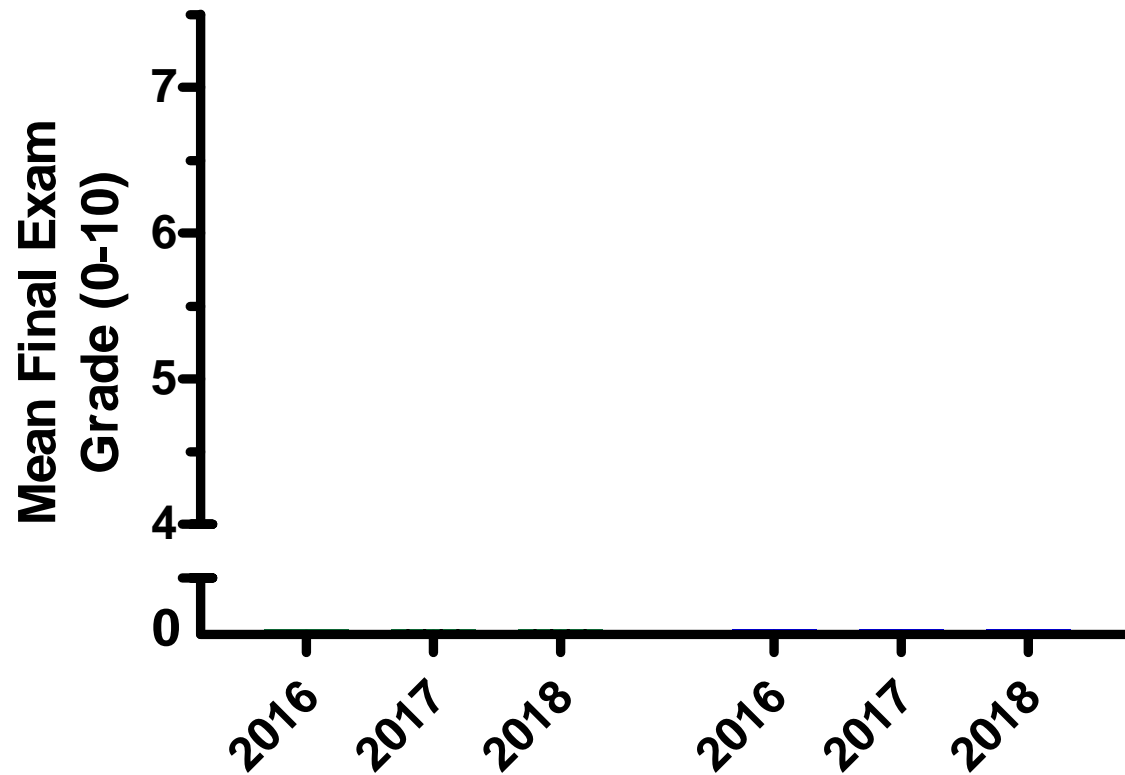
Cohen's d score:
2016 vs 2018: 0.49 (medium effect)





Final exam

CB

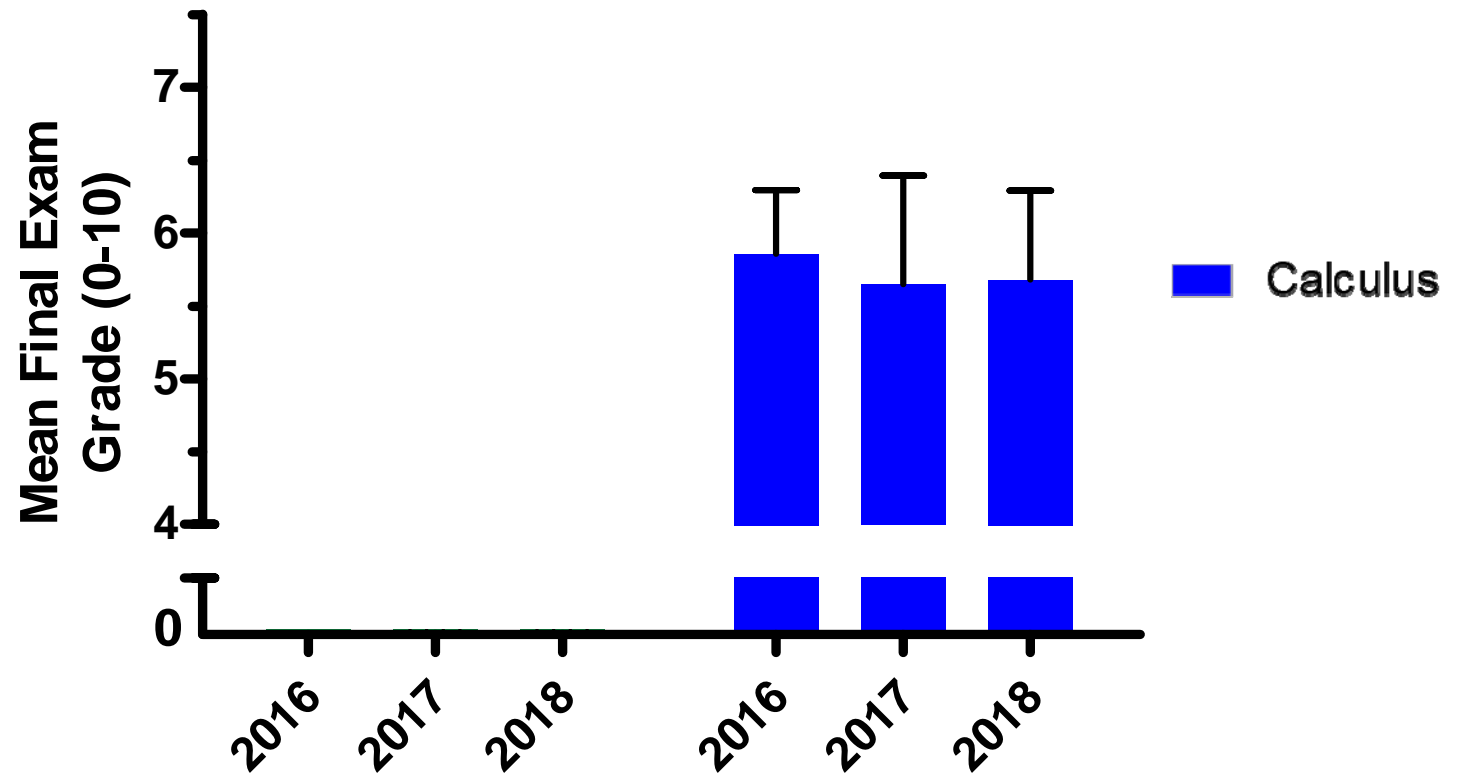


Means with 95 % CI



Final exam

CB

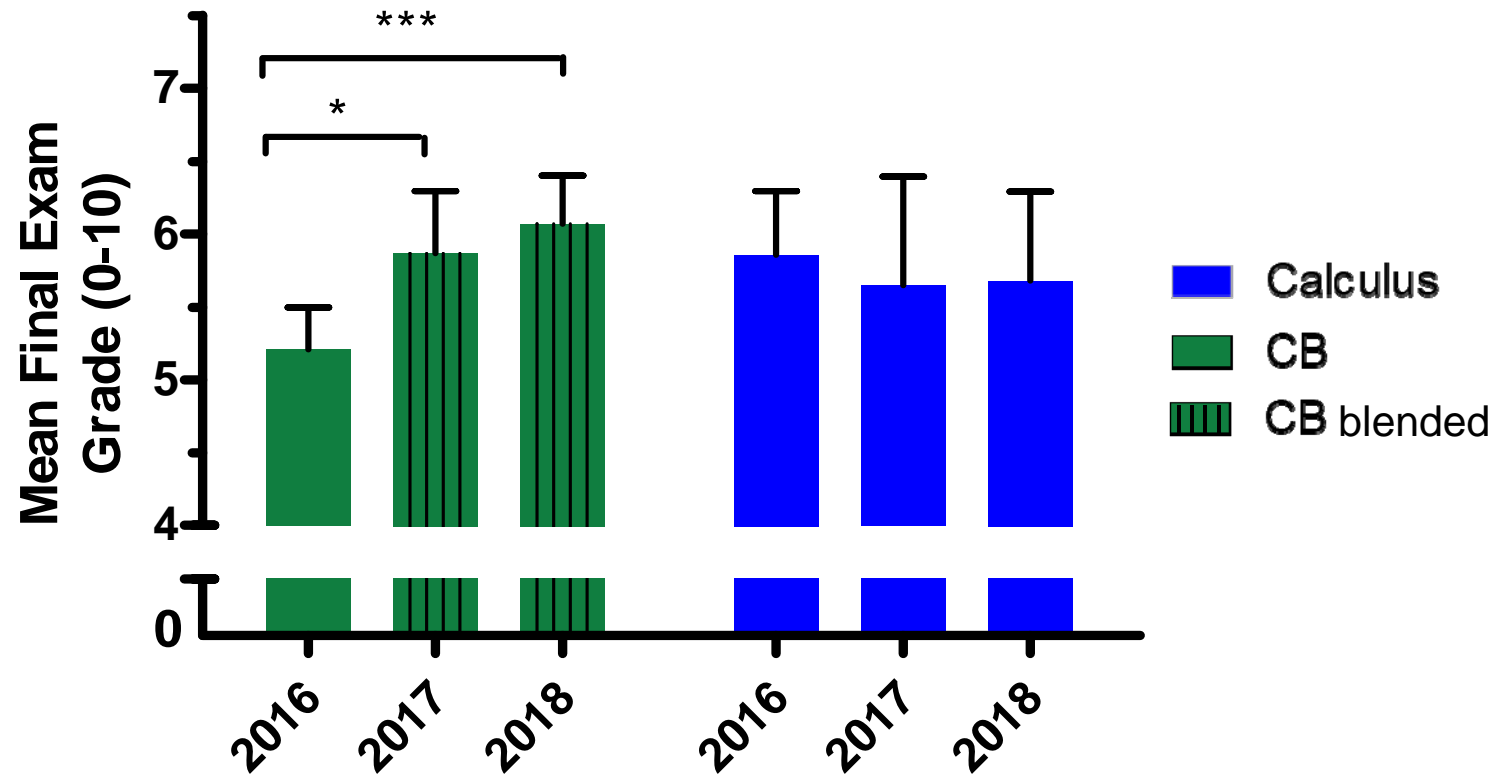


Means with 95 % CI



Final exam

CB



Means with 95 % CI

One-way ANOVA: $F(2, 181) = 7.993, p = 0.0005$

Post-hoc Tukey test

* $P < 0.05$

*** $P < 0.001$

Cohen's d score:

2016 vs 2017: 0.50 (medium effect)

2016 vs 2018: 0.68 (medium/large effect)

Review *meta*-analyses higher education:

Blended: average Cohen's d = 0.33

Longitudinal: novelty vs **persistence**

Evaluations teachers

- MP and CB teachers about Blended Learning:

More enjoyable than classical teaching format

More effective in having students master class material

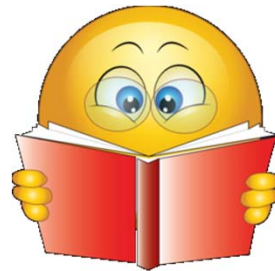
Conclusions

- Recycling carefully designed lectures



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- Blended learning: engage students
 - Total package: activating components in and out of class
 - Implementation in two 1st year-courses (4 and 2 yrs)



Conclusions

- **Recycling carefully designed lectures**
- **Blended learning: engage students**
 - Total package: activating components in and out of class
 - Implementation in two 1st year-courses (4 and 2 yrs)
- **Stepwise incorporation**
 - MP: Setting framework → solid foundation
 - CB: Problem → overhaul → significant grade effects
- **General outcome**
 - Students: highly positive
 - Satisfactory electronic engagement
 - Teachers: more enjoyable, quality time
- **Grade effect**
 - Proportional to changes incorporated?
 - Longitudinal: persistent



The development team



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- Saskia van Es

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