

# Activating Blended Learning Approaches in Two Freshmen Chemistry Courses

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

<sup>a</sup> Division of Innovations in Human Health & Life Sciences,

<sup>b</sup> Division of Medicinal Chemistry

<sup>c</sup> Audiovisual Centre VU

<sup>d</sup> Division of Molecular Toxicology

[danny.scholten@vu.nl](mailto:danny.scholten@vu.nl)

[stefan.dekker@vu.nl](mailto:stefan.dekker@vu.nl)

[iH2LS.beta@vu.nl](mailto:iH2LS.beta@vu.nl)



# Problems & Aims

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



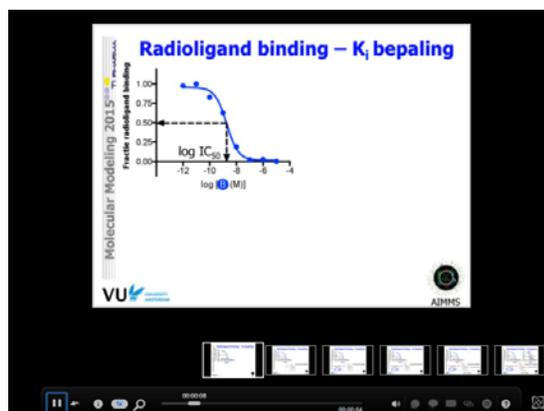
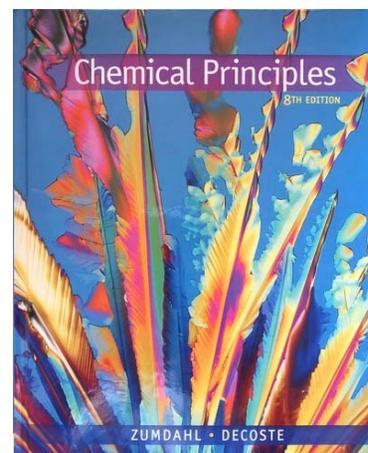
# The approach: Blended learning

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



# 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



# The courses

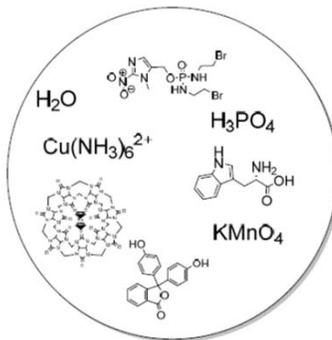
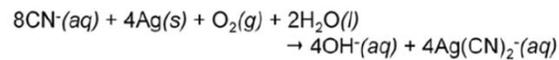
- Molecular Principles (MP)
- Cellular Biochemistry (CB)

MP

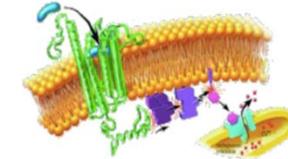
CB



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

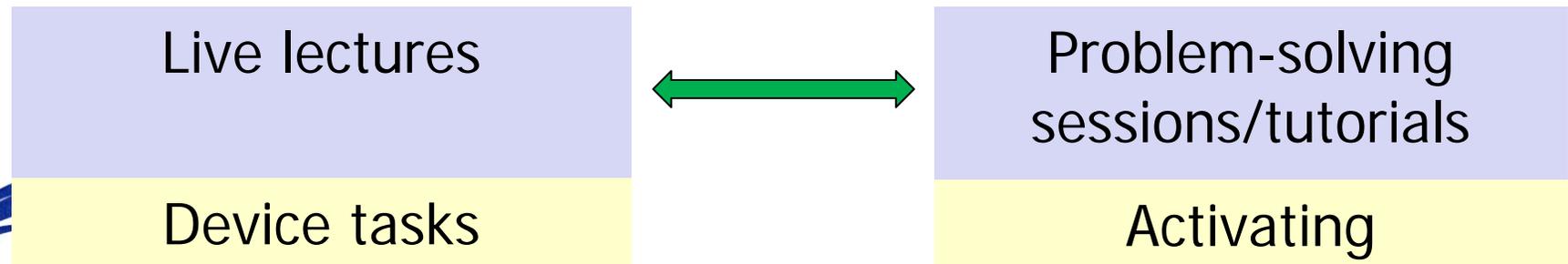


## Cellulaire Biochemie 'van Gen tot Geneesmiddel'



# MP: Stepwise trajectory

- Sept '13: classical setup + activating components



# MP: Stepwise trajectory

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

Presentain 

mediasite®   
by sonicfoundry®

Live lectures

Device tasks



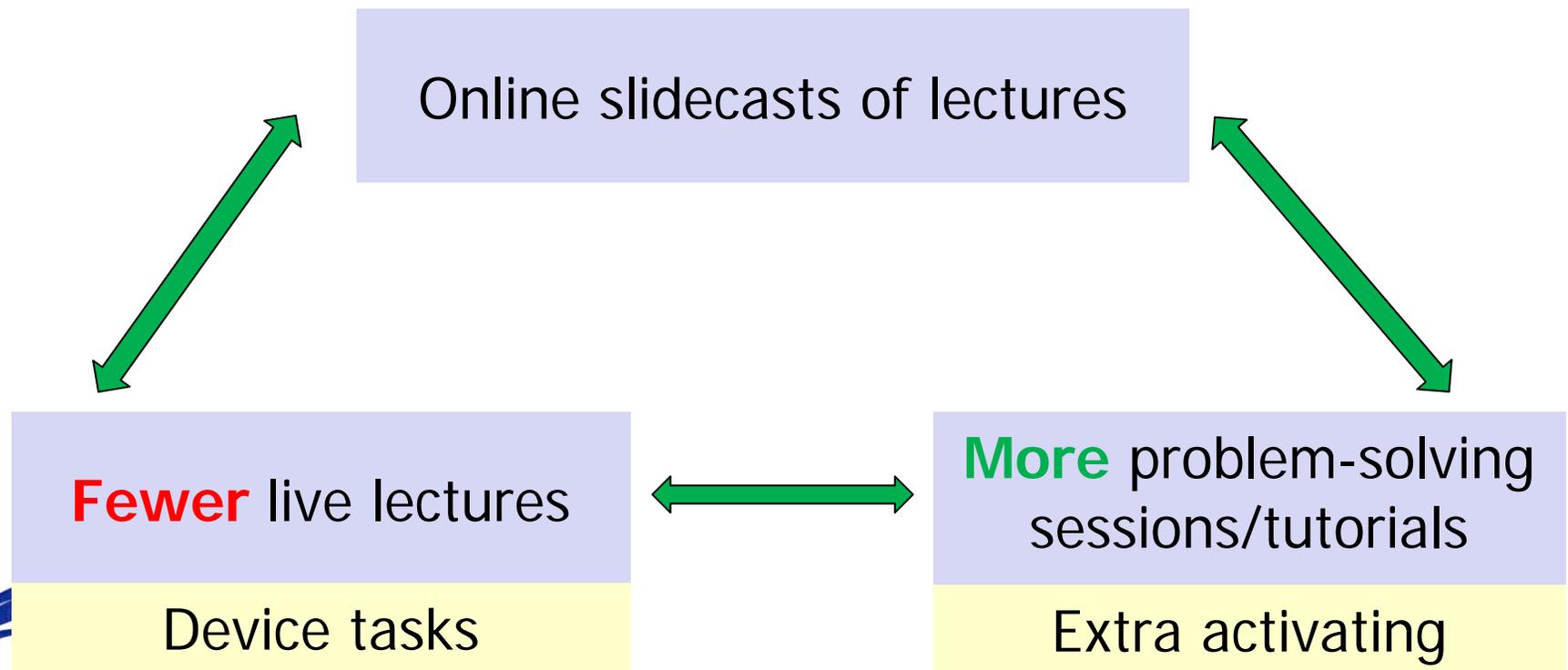
Problem-solving  
sessions/tutorials

Activating



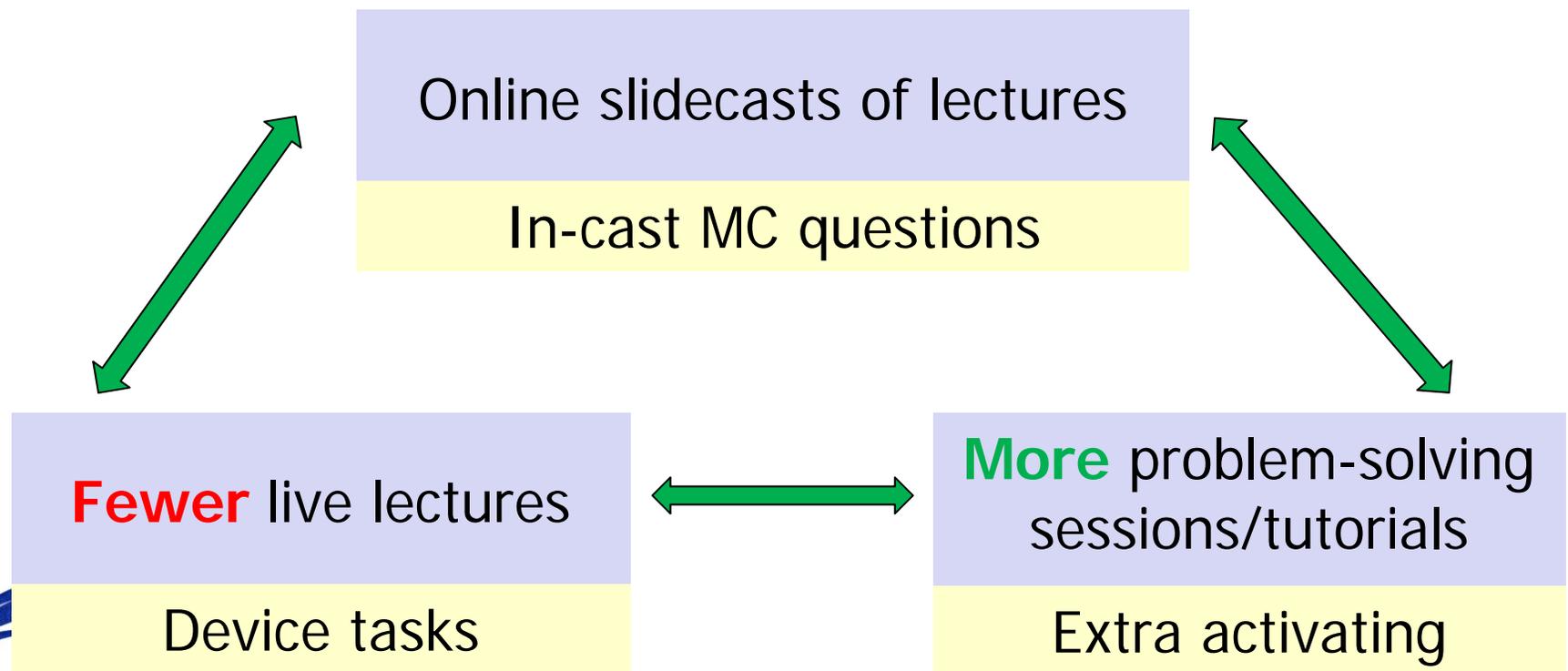
# MP: Stepwise trajectory

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



# MP: Stepwise trajectory

- Sept '13: classical setup + activating components
- Sept '14: lectures recorded with phone → slidecasts
- 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% ✗







# CB: Addressing problems

- 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

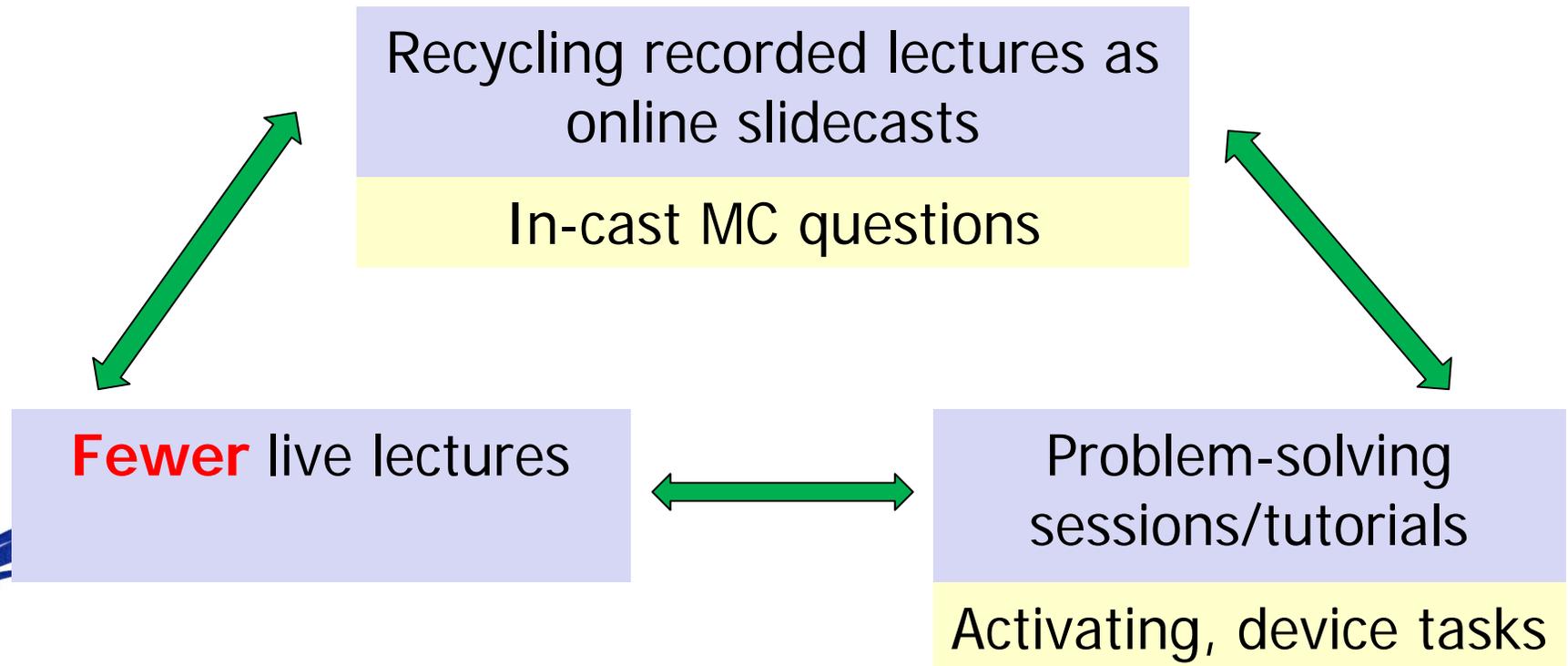
- 2016: classical setup, no tutorials/device tasks
- 2017: implementation blended learning
  - Complete overhaul

Live lectures



# Trajectory

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



# Electronic engagement

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

Cumulative #students

Cumulative watch time (h)



# Electronic engagement

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

Cumulative #students	144
Cumulative watch time (h)	925



# 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
---------------------------	----





# Key evaluations students

- Two years combined (N=46-48)

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



# Key evaluations students

- Two years combined (N=46-48)

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%

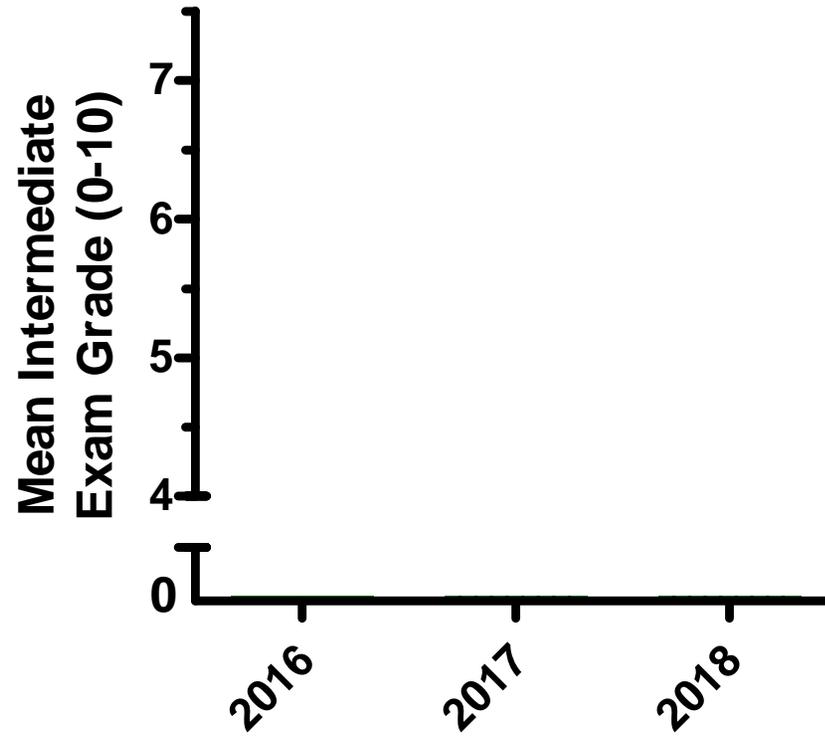


# Grade effect?

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



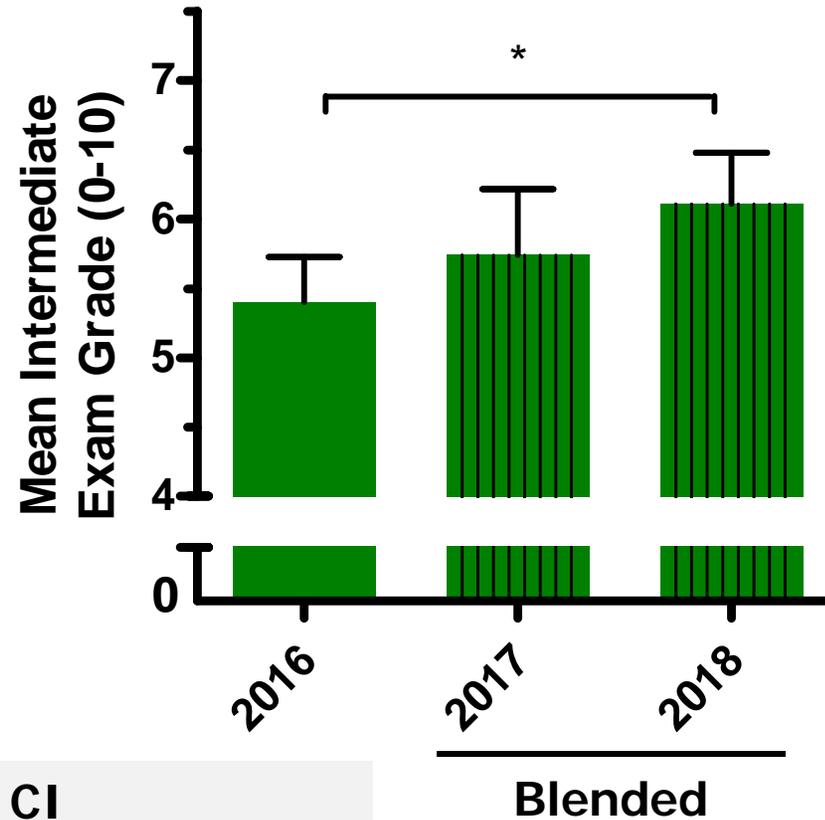
# Midterm



Means with 95 % CI



# Midterm



Means with 95 % CI

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

Post-hoc Tukey test  
\*  $P < 0.05$

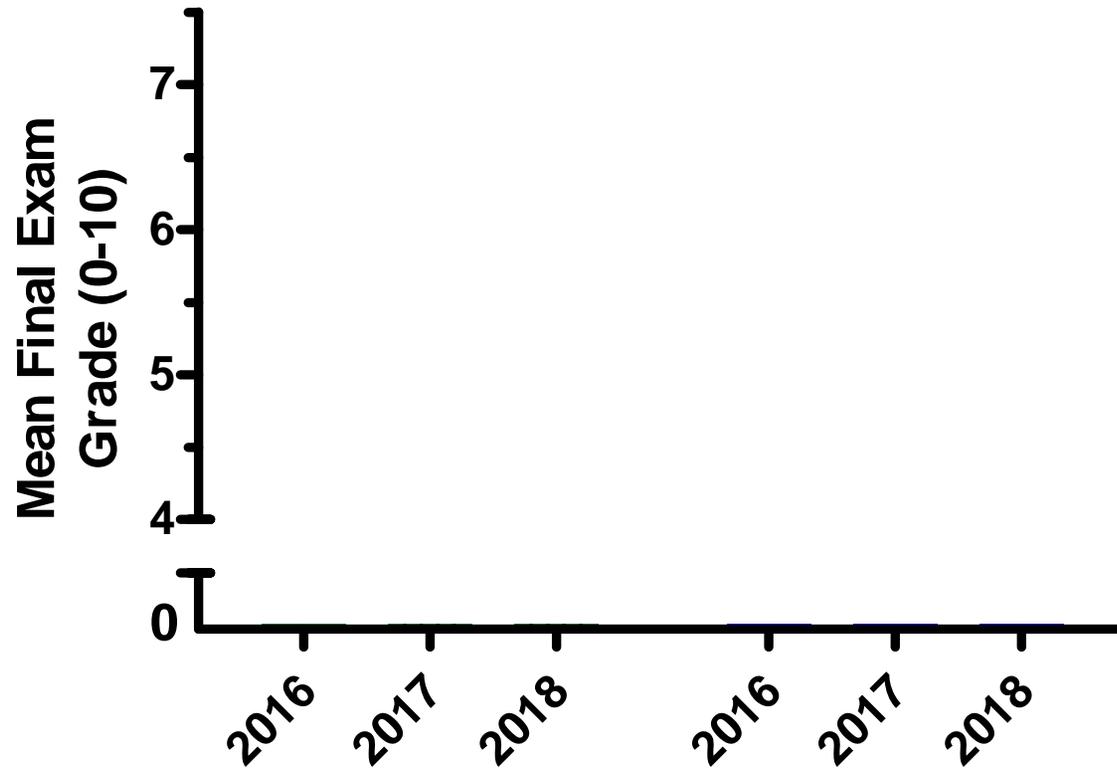
**Cohen's d score:**

2016 vs 2018: 0.49 (medium effect)





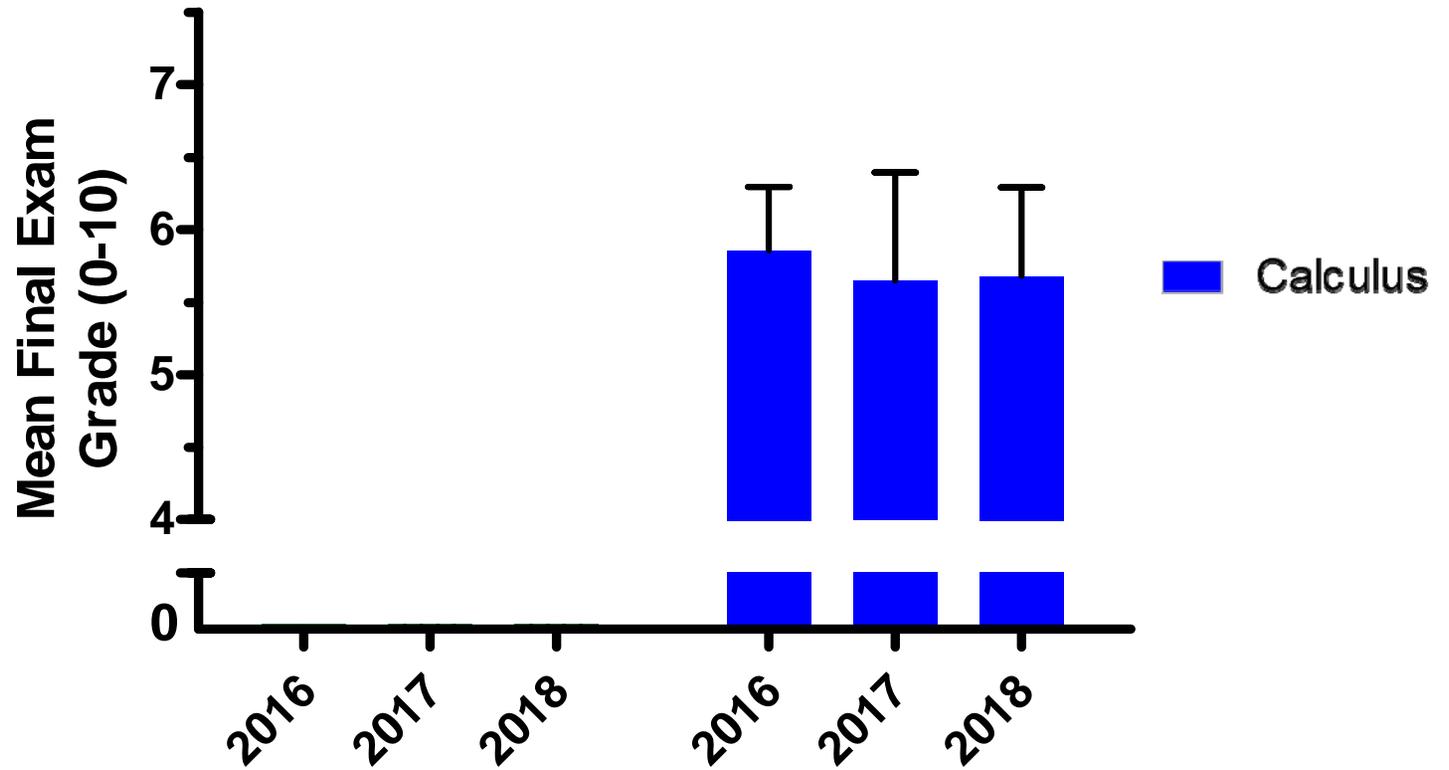
# Final exam



Means with 95 % CI



# Final exam

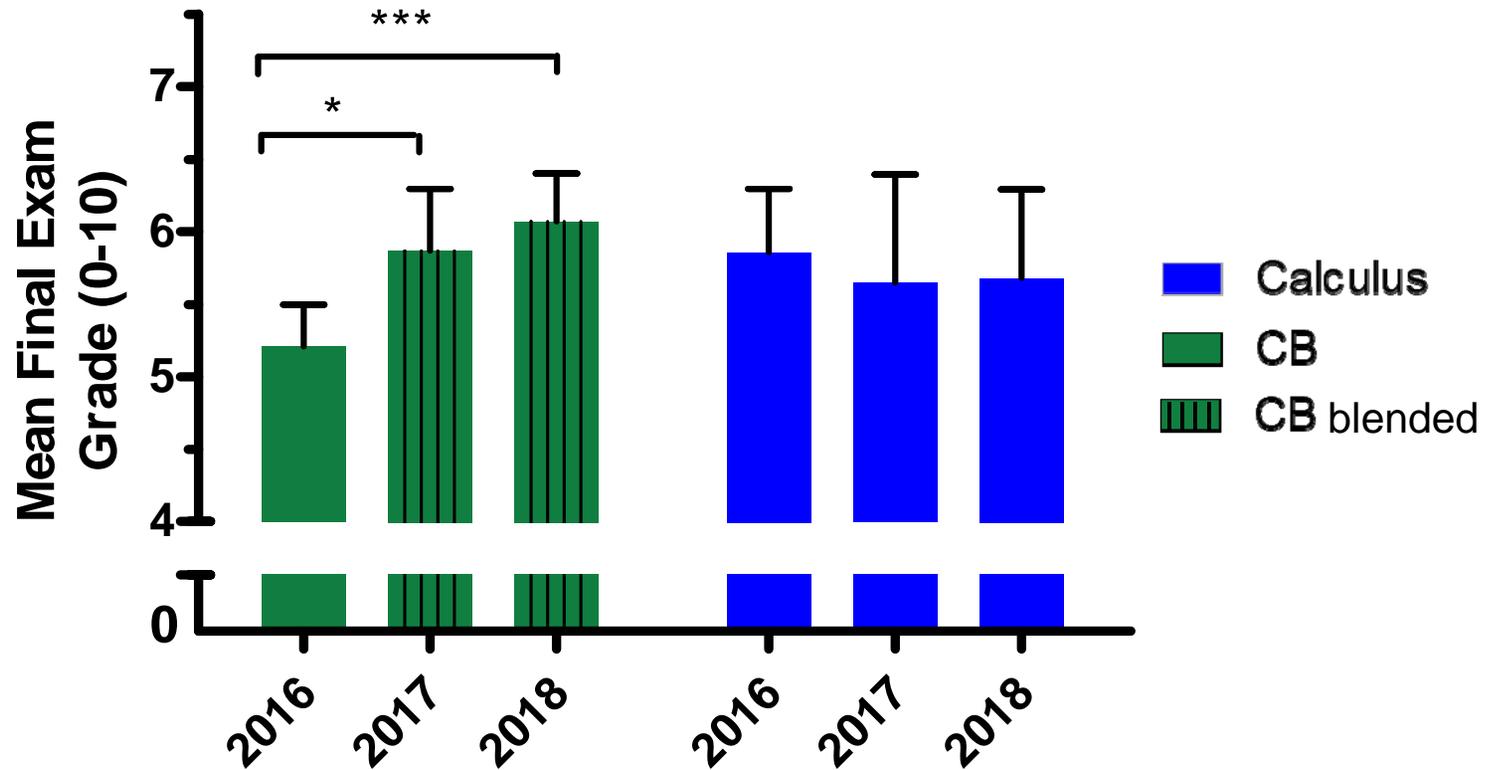


Means with 95 % CI



# 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



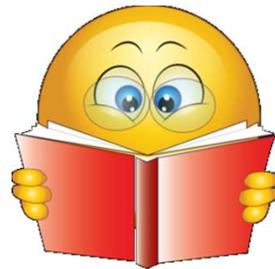
# Conclusions

- Recycling carefully designed lectures



# Conclusions

- **Recycling carefully designed lectures**
- **Blended learning: engage students**
  - Total package: activating components in and out of class
  - Implementation in two 1<sup>st</sup> 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 1<sup>st</sup> 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



# Acknowledgments

## Assistance tutorials

- Maarten Sijm
- Stephanie Thee
- Hans Custers
- Isabelle Koning
- Steven Eleonora
- Ferry Pronk
- Okke Merton
- Umit Gögcebulak

## Technical assistance/advice

- Ton Blaazer
- Wessel Joren
- Sara Lopes van den Broek
- Saskia van Es

## Collaboration

- All involved BSc students

