Undervisningsstrategier för att instruera och stärka studenter i förmågan att ta eget ansvar

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The proposal

• First biology course
• To teach students strategies for deep learning through course design
  – Flipped classroom
  – Peer tutoring
  – Continuous formative evaluation and feedback
  – Concept inventories around common misconceptions
What we did

• Multiple case studies for each of ten subjects (≈ previous lectures)
  – Not from course book if possible

• Discussion questions illuminating learning outcomes
  – Evolution
  – Math
  – Statistics
  – Society
  – Ethics
What the students did

• Read the course book
• Self-grading test until full score.
• Meet in pre-assigned group
  – biology students (1st semester)
  – teacher students (3rd/5th semester)
• Discuss course book
• Discuss case study questions
Lesson with teacher

• With full class
  – Summary of most important/difficult parts
  – Go through questions emailed from students

• Make cross groups
  – Students share case study highlights
  – Construct mind-map
  – Discuss questions of general nature
The good

• Enjoyed by the teacher.
• Active students (limited recreational surfing)
• Worked with the course material
  – Working week = 40 hours
• Attended non-compulsory lessons
Attendance at lessons

Class attendance

% attending

2016

2017

class

% attending

1 2 3 4 5 6 7 8 9 10

Attendance at lessons
The good

• Liked by the students
  – Half-time evaluation
  – Similar evaluation scores as traditional course

• Learned most from group discussions and identified what they hadn’t understood.

• Easy to ask teacher

![Course evaluation score chart](image-url)
The bad

• Initial enthusiasm wore off
  – Increasing demands from chemistry

\begin{align*}
\text{2016} & : p < 0.01 \\
& \quad c = -0.81
\end{align*}

\begin{align*}
\text{2017} & : p < 0.05 \\
& \quad c = -0.75
\end{align*}
The bad

• Initial enthusiasm wore off
• More students came to group meetings without having prepared (or not at all).
  – Identified this as problematic
• Teacher experienced limited feedback from students
  – Were their “correct answers” the same as yours?
  – How do you get them to ask when they don’t know???
The ugly
Grades 2014 - 2016

• Passing rates
  – 2014: 95 %
  – 2015: 84 %
  – 2016: 71 %

• 2016 Many far from passing:
  – 25 % more than 5 points away
  – And several more

2014 vs 2015: p = 0.406
2014 vs 2016: p = 0.005**
2015 vs 2016: p = 0.002**
Evolution results as bad as chemistry results

$\text{Evolution results as bad as chemistry results}$

$p = 0.064$

$p = 0.100$

$p = 0.737$
Grasping for straws...
Weak students?
Grades on the chemistry course

<table>
<thead>
<tr>
<th>Grades</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>U</td>
<td></td>
<td></td>
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<tr>
<td>5</td>
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</tr>
</tbody>
</table>

2014 vs 2015: p = 0.467
2014 vs 2016: p = 0.054
2015 vs 2016: p = 0.016*
Grasping for straws...
A question of maturity?
Teacher students’ grades

Percent students

<table>
<thead>
<tr>
<th>Grade</th>
<th>2015</th>
<th>2016</th>
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<tbody>
<tr>
<td>U</td>
<td></td>
<td></td>
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<td>G</td>
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<tr>
<td>VG</td>
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p = 0.712
2017: Back in the saddle

• Clearer learning outcomes
  – Explicitly stated rather than implied through questions

• In class communal identification of important knowledge

• Written feedback on case studies/cross group discussions

• Half-time evaluation of group studies and restructuring of groups
Grades 2014 - 2017

Students grades

<table>
<thead>
<tr>
<th>Year</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>0.406</td>
<td>0.006**</td>
<td>0.205</td>
</tr>
<tr>
<td>2015</td>
<td>0.002**</td>
<td>0.017*</td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td></td>
<td></td>
<td>0.083</td>
</tr>
</tbody>
</table>
Improved results on Concept inventory

Concept inventory results

Average percentage correct answers across questions

Pre course

Post course

p = 0.001
High attendance correlated with high exam performance

**2016**

- Correlation coefficient: $c = 0.280$
- Significance level: $p = 0.149$

**2017**

- Correlation coefficient: $c = 0.588$
- Significance level: $p = 0.001$
Attendance helps exam performance (?)

![Graph showing the relationship between class attendance and calibrated exam points. The graph includes a trend line with a slope and a p-value of 0.002**.](image)

- $c = 0.396$
- $p = 0.002**$
Exam performance not "helped" by attending non-evolution classes

Halftime evaluation

Written assignment feedback

$p = 0.529$

$p = 0.089$
Working in groups helps exam performance (?)

First groups 2017

Second groups 2017

p = 0.186

p = 0.366
From the teacher’s perspective

• Fun to prepare (-> over ambitious cases)
• Lessons were rewarding
  – Handle 60 students without problem (12 and 10 groups respectively)
  – Low work input during course
  – Get to know students
  – Noisy
  – Right type of room needed
2018: The road ahead?

• Reorganize order
  – Group discussion -> full class -> case study -> cross groups

• More emphasis on teacher students leading group discussions

• More emphasis on students identifying what is important

• But, how to improve
  – group dynamics
  – student -> teacher communication
  – going beyond the bare minimum
Confidence: pre course – post course

- Discuss scientific concepts with my friends and family
  - Confidence score: $p = 1$

- Think critically about scientific findings I read about in the media
  - Confidence score: $p = 0.07837$

- Determine what is and is not valid scientific evidence
  - Confidence score: $p = 0.1026$

- Make an argument using scientific evidence
  - Confidence score: $p = 0.0828$

- Determine the difference between science and pseudoscience
  - Confidence score: $p = 0.3424$

- Interpret tables and graphs
  - Confidence score: $p = 0.68$

- Understand scientific processes behind important scientific issues in the media
  - Confidence score: $p = 0.09074$

- Understand the science content of this course
  - Confidence score: $p = 0.02335$
Pre course confidence: male - female

Discuss scientific concepts with my friends and family
Confidence score: p = 0.06043

Think critically about scientific findings I read about in the media
Confidence score: p = 0.001271

Determine what is and is not valid scientific evidence
Confidence score: p = 0.3011

Make an argument using scientific evidence
Confidence score: p = 0.6382

Determine the difference between science and pseudoscience
Confidence score: p = 0.1583

Interpret tables and graphs
Confidence score: p = 0.5234

Understand scientific processes behind important scientific issues in the media
Confidence score: p = 0.03045

Understand the science content of this course
Confidence score: p = 0.001439
Post course confidence: male - female

Discuss scientific concepts with my friends and family
Confidence score: $p = 0.4589$

Think critically about scientific findings I read about in the media
Confidence score: $p = 0.8043$

Determine what is and is not valid scientific evidence
Confidence score: $p = 0.9082$

Make an argument using scientific evidence
Confidence score: $p = 0.8414$

Determine the difference between science and pseudoscience
Confidence score: $p = 1$

Interpret tables and graphs
Confidence score: $p = 0.2258$

Understand scientific processes behind important scientific issues in the media
Confidence score: $p = 0.9104$

Understand the science content of this course
Confidence score: $p = 0.2373$