OLI methodology can cut learning time with 50%


Olle Bälter

Associate Professor in Human-Computer Interaction

Head of Technology Enhanced Learning, KTH
Open Learning Initiative (OLI) @ CMU 2008

• Randomized case-control
• Case: calendar time reduced from 15 > 8 weeks
• Case: contacts per week reduced from 4 > 2 + OLI
• Equal study time per day
• Equal or better exam and retention (6-8 months) results

Knowledge Model, KTH

Learning Objective 1-7

- Question 1 on LO 1-3
- Question 2 on LO 3-4
- Question 3 on LO 6-7
- ...

...
Knowledge Model, OLI

Learning Objective 1

- Skill 1
  - Question 1 on skill 1
  - Question 2 on skill 1
  - ...

- Skill 2
  - Question 1 on skill 2
  - ...

- ...


Example - Statistics

Learning objective

Skill

Measures of center

Mean

Question 1 on Mean

Question 2 on Mean

... on Mean

Median

Question 1 on Median

... on Median
Example

Learning objective:
Relate measures of center and spread to the shape of the distribution, and choose the appropriate measures in different contexts.

Skill:
Being able to calculate mean values
Example question

What is the mean of 5, 6, 5, 5, 7, 6, 13, 9?

a) 5
b) 6
c) 7
d) 8
Example question feedback

What is the mean of 5, 6, 5, 5, 7, 6, 13, 9?

a) 5
Incorrect: This is the mode. The mean is the sum of all ...

b) 6
Incorrect: This is the median. The mean is the sum of all...

c) 7
Correct: The mean is the sum of all numbers divided ...

d) 8
Incorrect: This is the count of all numbers. The mean is ...
Learning Curve

Risk of wrong answer

Addition

# attempts
WARNING
ELEKTRISKT
STÄNGSEL

1156567

GRANNGÅRDEN
ETABL 1860
Advantages

- Teachers: fix what went wrong immediately (flipped classroom) **based on skills**, not questions
- Course Developer: refine the **right details** of the course
- Students: focus on what is **not mastered** yet
- Supplementary training: focus on **what is new / not yet mastered**
Method strengths

• This is not rocket science, nor new-age
• Can be introduced incrementally
  • Module by module in a course
  • Increasing technology support to increase the feedback
• Platform independent (but require answer dependent feedback)
• Time saving in the long run
How Many Repetitions are Enough to Enable Student Mastery?

Olle Bälter, Dawn Zimmaro, Candace Thille, "Estimating the Minimum Number of Opportunities Needed for All Students to Achieve Predicted Mastery". Smart Learning Environments, 2018, 5:15
Learning Curve

Risk of wrong answer vs. Mean

- Mastery level at approximately 20% risk of wrong answer
- # attempts increasing along the x-axis
How Many Repetitions are Enough to Enable Student Mastery?

• Eight (8)

• Datasets from four different courses: Statistics, Biology, Psychology and Engineering Statics

• 3,813 students from varying types of colleges and universities

• 1.2 million transactions

Olle Bälter, Dawn Zimmaro, Candace Thille, "Estimating the Minimum Number of Opportunities Needed for All Students to Achieve Predicted Mastery". Smart Learning Environments, 2018, 5:15
Comparisons Statistics course

<table>
<thead>
<tr>
<th>College type</th>
<th>Log Mean + 2SD (20%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Associate’s colleges</td>
<td>7.2</td>
</tr>
<tr>
<td>Baccalaureate colleges</td>
<td>6.4</td>
</tr>
<tr>
<td>Master’s colleges</td>
<td>6.6</td>
</tr>
<tr>
<td>Doctoral colleges</td>
<td>6.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>College type</th>
<th>Log Mean + 2SD (10%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Associate’s colleges</td>
<td>7.8</td>
</tr>
<tr>
<td>Baccalaureate colleges</td>
<td>7.1</td>
</tr>
<tr>
<td>Master’s colleges</td>
<td>7.3</td>
</tr>
<tr>
<td>Doctoral colleges</td>
<td>6.7</td>
</tr>
</tbody>
</table>

Mean number of attempts to reach mastery
Comparison other courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Log Mean + 2SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology: 50 KCs</td>
<td>5.3</td>
</tr>
<tr>
<td>Biology: 25 KCs</td>
<td>5.5</td>
</tr>
<tr>
<td>Engineering Statics</td>
<td>6.8</td>
</tr>
<tr>
<td>Engineering Statics 10%</td>
<td>9.8</td>
</tr>
<tr>
<td>Psychology</td>
<td>6.1</td>
</tr>
</tbody>
</table>
COURSES

AMERICAN ENGLISH SPEECH
ARABIC FOR GLOBAL EXCHANGE
ANATOMY & PHYSIOLOGY
ARGUMENT DIAGRAMMING
BIOCHEMISTRY
ELEMENTARY FRENCH I
ELEMENTARY FRENCH II
ENGINEERING STATICS
HEALTH INFORMATION TECHNOLOGY
INTRODUCTION TO BIOLOGY
INTRODUCTION TO CHEMISTRY
INTRODUCTION TO PSYCHOLOGY
LOGIC & PROOFS
MEDIA PROGRAMMING
MODERN BIOLOGY
PRINCIPLES OF COMPUTING
PROBABILITY & STATISTICS
STATISTICAL REASONING
STEM FOUNDATIONS
STEM READINESS
Vad händer på KTH?

• 2017:
  • Svensk översättning av Stanfords *Principles of Computing* i OpenEdX,
  • Moduler i Interaktionsprogrammering, i Canvas
• 2018:
  • Introduktionskurs i Python, i Canvas + Möbius
• 2019:
  • Introduktionskurs i Java i CMUs plattform, för SDA, delas med Lunds universitet
• 2020:
  • version 2 och 3 av kursen ovan,
  • PoC som en MOOC.
  • Dynamisk mekanik?
  • MDI-modul?
  • Safety and cyber-security in cyber-physical systems?
What to do with the saved time?

• Reduce the time to graduation?
• More content?
• Better content?
• Pay back the investment?
• More time for research?
• Increase the quality of education?
Levels of OLI-integration

1. Answer-depending feedback
2. Mix text, interactive activities, and questions on the same page with feedback from each question individually
3. Log all answers to feed the ML-algorithm
4. Share course with other universities
Example question with feedback

What is the mean of 5, 6, 5, 5, 7, 6, 13, 9?

a) 5  
Incorrect: This is the mode. The mean is the sum of all ...

b) 6  
Incorrect: This is the median. The mean is the sum of all...

c) 7  
Correct: The mean is the sum of all numbers divided ...

d) 8  
Incorrect: This is the count of all numbers. The mean is ...
Från flippad till ur-(ute)flippad undervisning
Introduktion

Varför- hälsa

• Stillasittande – orsak till 6% av världens dödsfall (WHO)
• Studenter – 6h /dag på universiteten (Luleå)

Varför – bättre seminarier, piggare studenter och lärare

Q1. The discussions at the seminar became?
Q2. After the seminar, you felt?
Q3. The quality of the seminars became?
Q4. The possibilities to speak my mind became?
Q5. The possibilities to hear what the others had to say?
Q6. We stayed on topic?
Q7. The seriousness became?

N= 131

Krav på seminarieledare

• Ställa en timer och starta den
• Gå och lyssna samtidigt (ibland även säga något)
• Hålla lagom takt
• Leda sammanfattningar i helgrupp
• Hitta tillbaka till startpunkten
Subgruppindelning

• Gruppledarna delar in sin grupp i undergrupper om idealt tre personer (1, 2, 3)

• Dessa trepersonersgrupper utser själva en ordförande vars ansvar är att:
  • Se till att subgruppen håller sig till ämnet
  • Se till att alla kommer till tals
  • Se till att alla ämnen diskuteras
  • Hålla avståndet (ca 5 m) till framförvarande subgrupp
  • Summera det intressantaste inför hela seminariegruppen
Reflektioner

• Inte för alla sorters seminarier (böcker, datorer, anteckna)
• Lokal behövs fortfarande (regn, alla kan/vill inte gå)
• Små grupper
• Lämplig omgivning behövs
• Positivt för efterföljande lektioner – pigga studenter & lärare