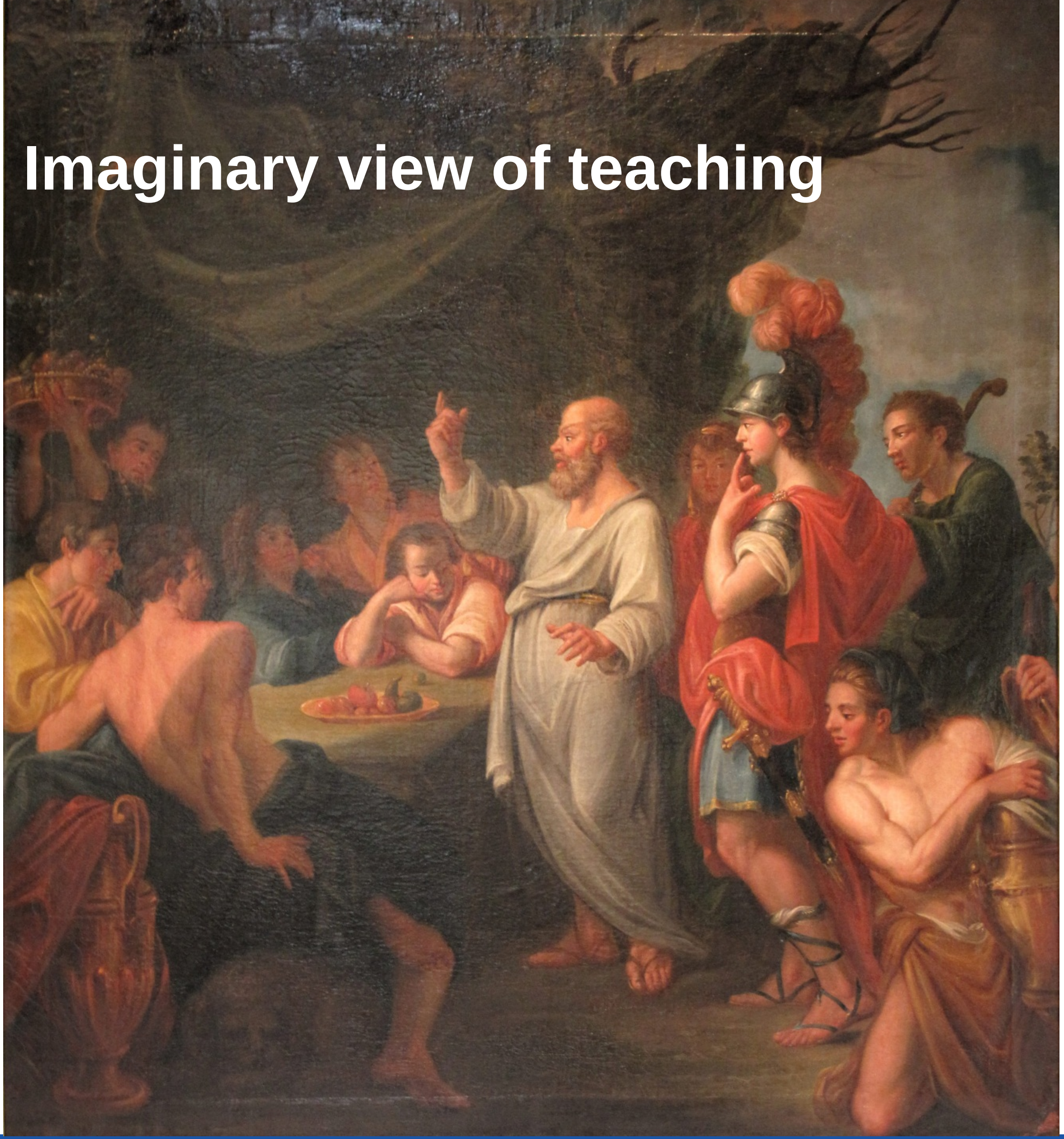
KTH ROYAL INSTITUTE
OF TECHNOLOGY

Lectures flop, so flip the classroom

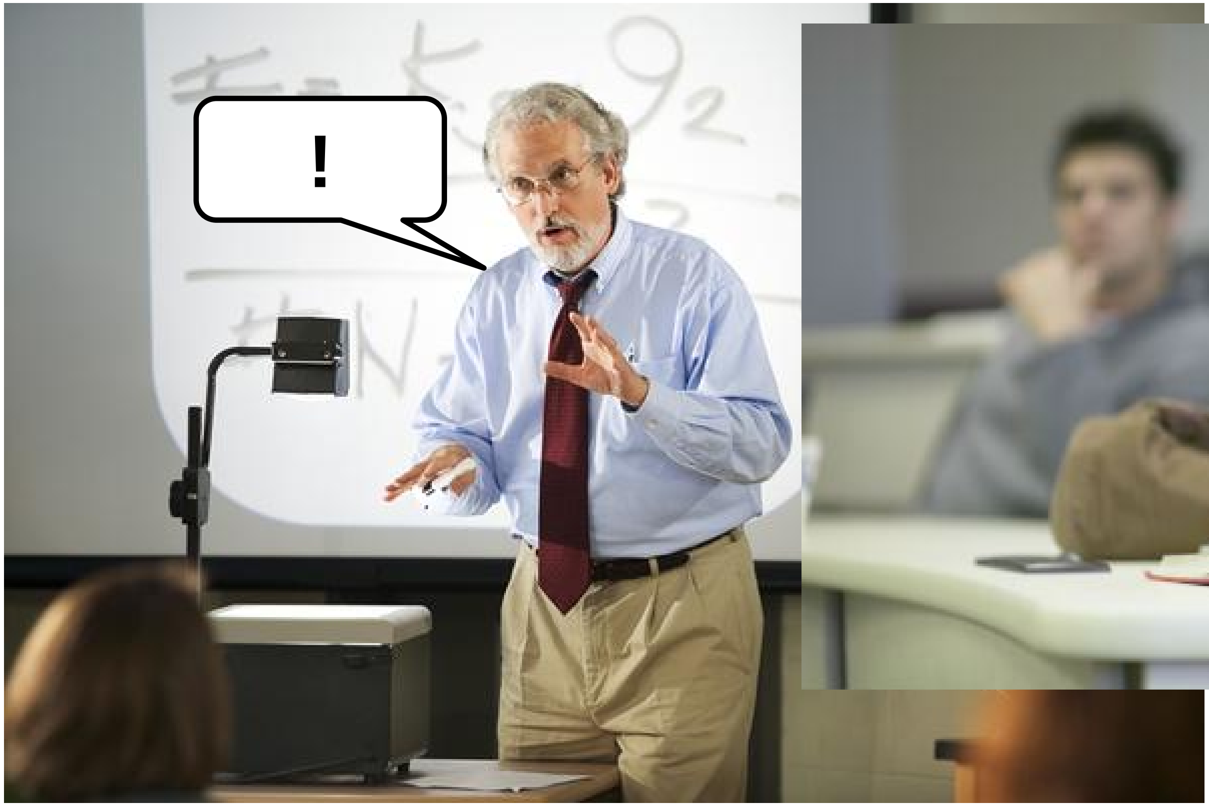
Gunnar Karlsson
School of Electrical Engineering

Imaginary view of teaching



Real view of teaching

Broadcasting problem – flow control and compatibility



Technology-enhanced learning

Your Own Private Socrates

Any point: Tradeoff of cost vs coaching

YOPS

MOOC

UDACITY Learn. Think. Do.

iversity

coursera

Future Learn

edX

Outline of remainder

- The case for active learning
- Peer instruction
- Flipped classroom
- Experiences at KTH
- Structure of a flipped course with peer instruction
- Learning management tool and learning analytics
- Active learning at distance and scale
- A proposal for an undergraduate MOOC College
- A reason why education must improve
- Conclusion

The case for active learning

PNAS

Active learning increases student performance in science, engineering, and mathematics

Scott Freeman[a,1], Sarah L. Eddy[a], Miles McDonough[a], Michelle K. Smith[b], Nnadozie Okoroafor[a], Hannah Jordt[a], and Mary Pat Wenderoth[a]

[a]Department of Biology, University of Washington, Seattle, WA 98195; and [b]School of Biology and Ecology, University of Maine, Orono, ME 04469

Edited* by Bruce Alberts, University of California, San Francisco, CA, and approved April 15, 2014 (received for review October 8, 2013)

To test the hypothesis that lecturing maximizes learning and course performance, we metaanalyzed 225 studies that reported data on examination scores or failure rates when comparing student

225 studies in the published and unpublished literature. The active learning interventions varied widely in intensity and implementation, and included approaches as diverse as occasional group

*“active learning leads to increases in examination performance that would **raise average grades by a half a letter**, and that **failure rates under traditional lecturing increase by 55%** over the rates observed under active learning.”*

Peer instruction to activate the class

Peer Instruction: Ten years of experience and results

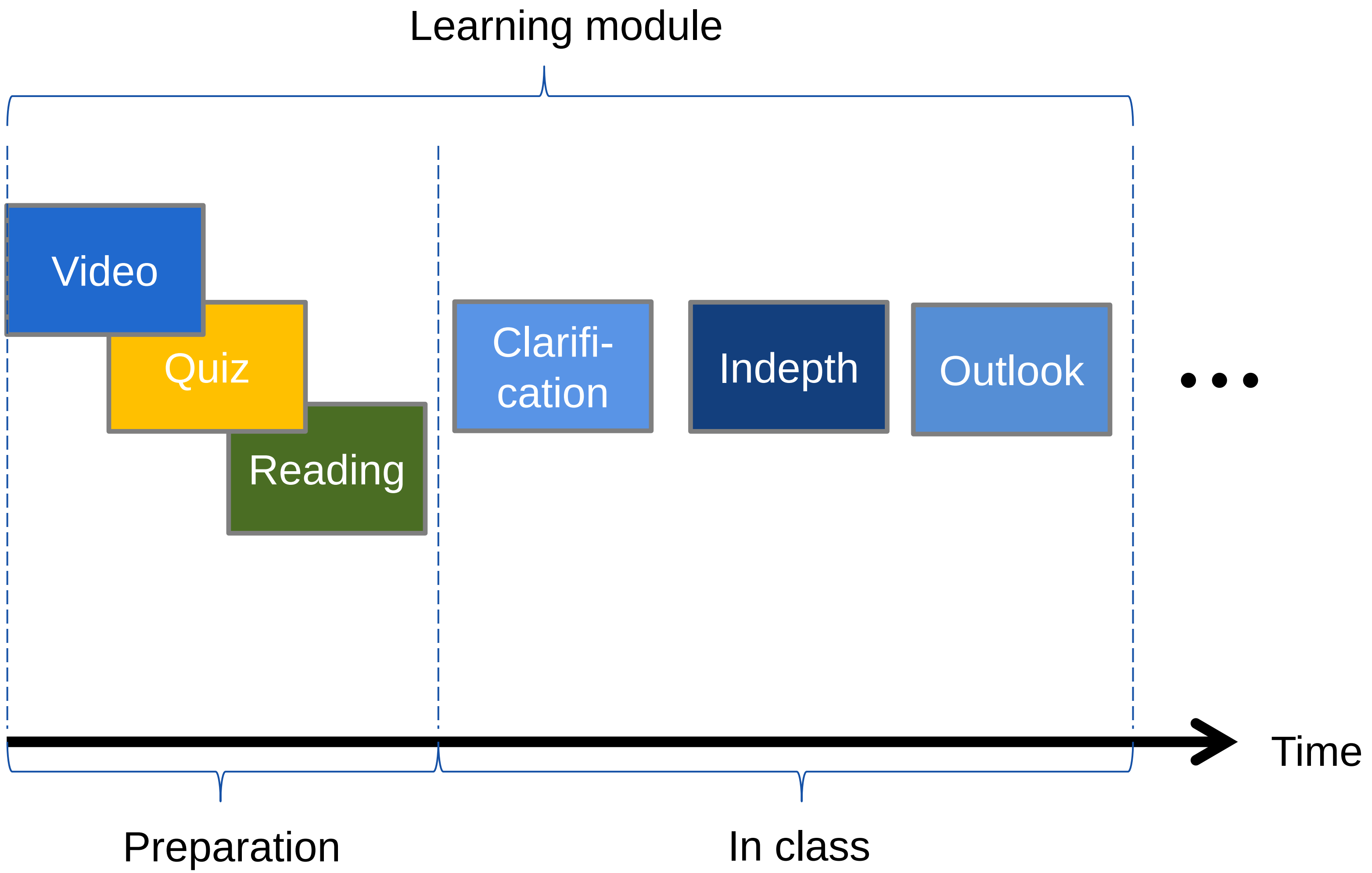
Catherine H. Crouch and Eric Mazur[a)]
Department of Physics, Harvard University, Cambridge, Massachusetts 02138

(Received 21 April 2000; accepted 15 March 2001)

We report data from ten years of teaching with Peer Instruction (PI) in the calculus- and algebra-based introductory physics courses for nonmajors; our results indicate increased student mastery of both conceptual reasoning and quantitative problem solving upon implementing PI. We

- Ask a question, let them think
  - Take answers by clickers, hands in the air, colored cards
  - Do not give any feedback
- Let students work two-by-two
  - New answer
- Compare the outcomes of the two rounds of answers and discuss the question

Using online material: Flipped classroom and peer instruction



Active learning at KTH

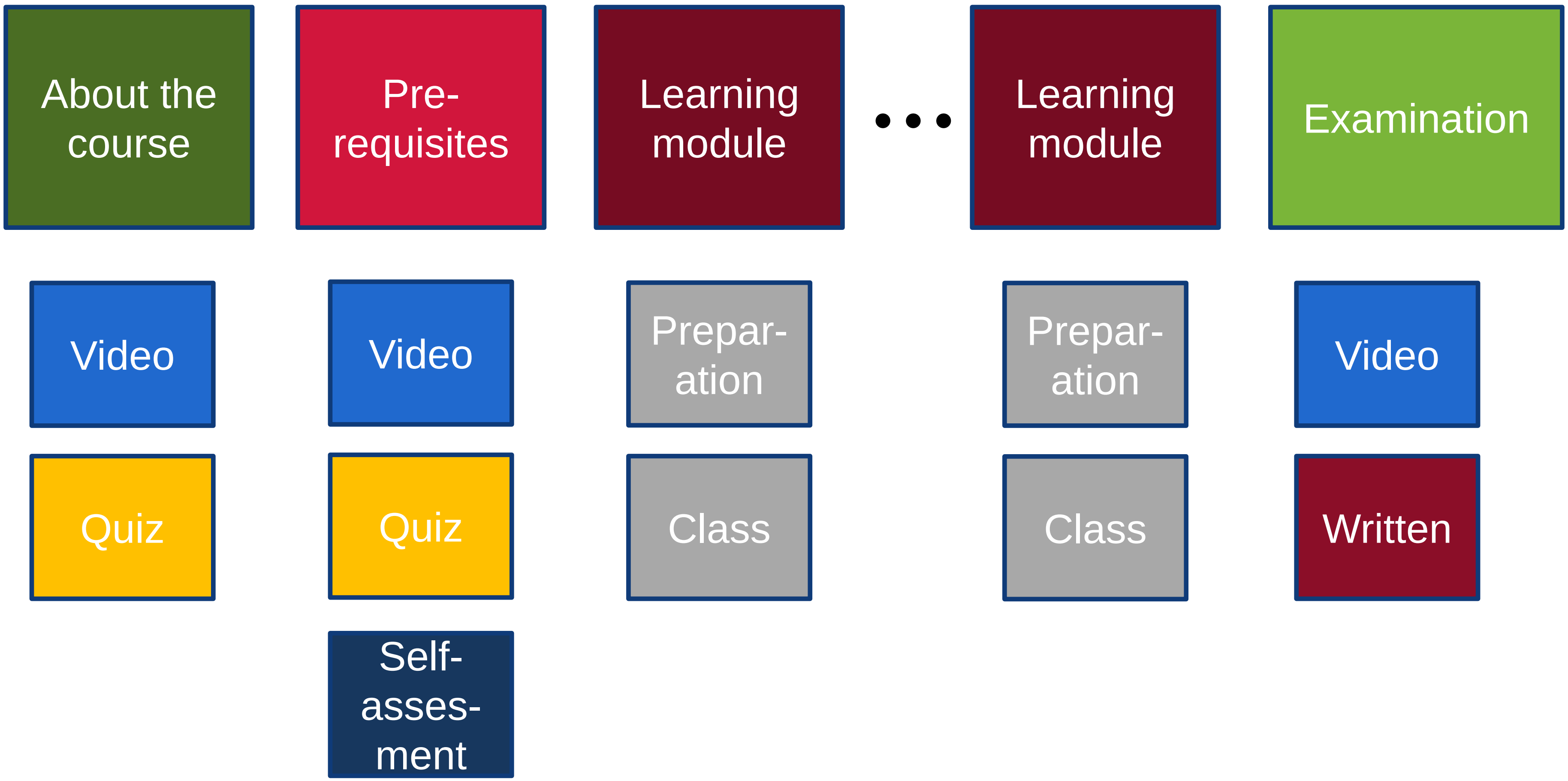
Flipped classroom and peer instruction

- Now used in courses in all five-year engineering programs
- Positive outcomes; no teacher who has tried wants to return to old practice
- Student resistance in the beginning; now they are used to active teaching and might demand it for all courses

Voluntary effort, bottom up

- Neither incentives nor pressure for teachers to change
- Peer pressure and student expectations might lead to wide-scale adoption
- A reward structure would be beneficial
- And time to restructure and develop a course

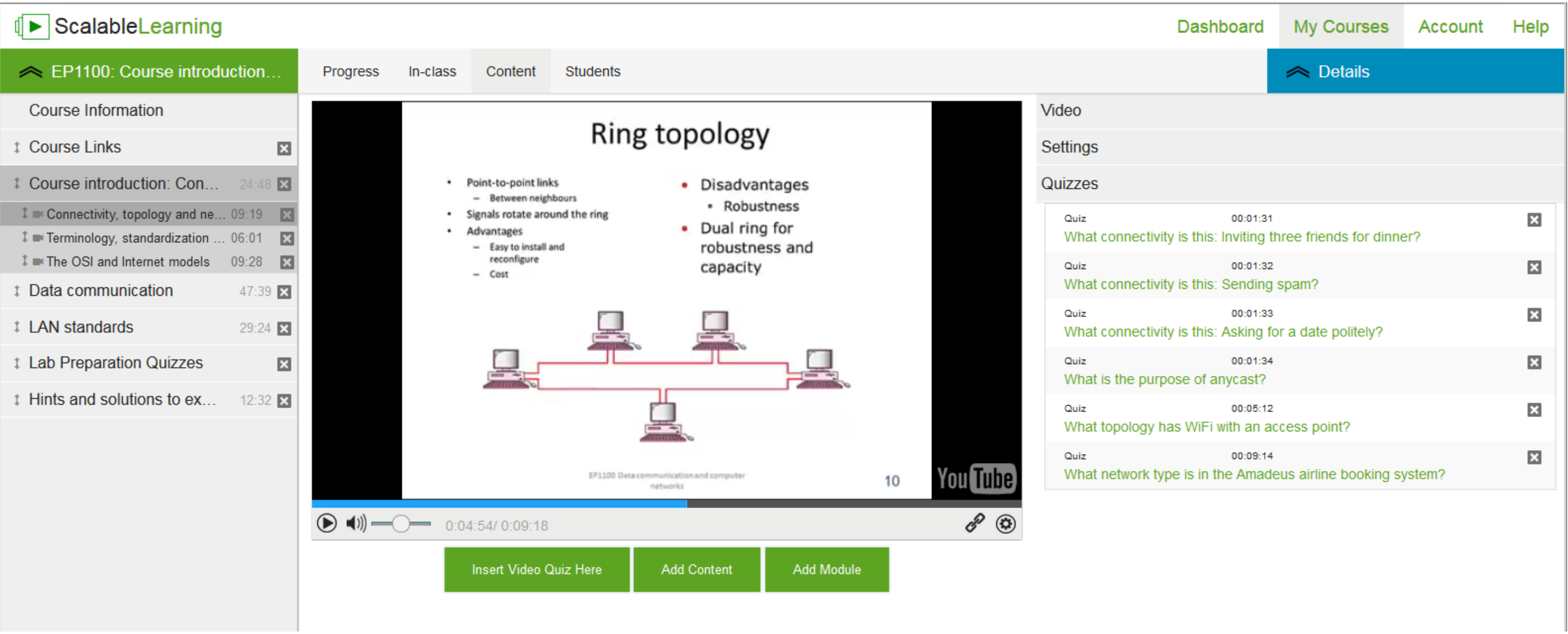
Structure of a course

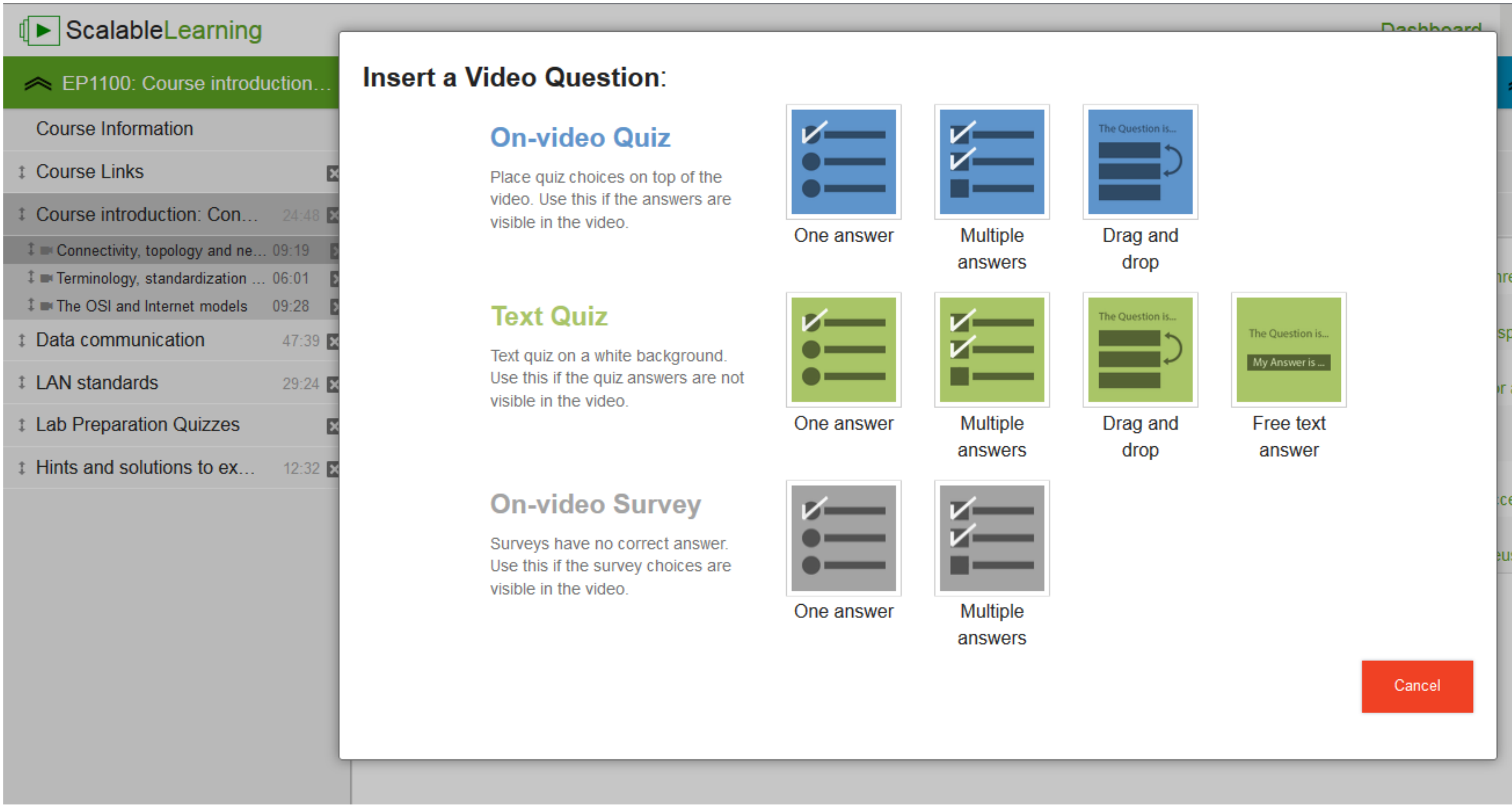


Use of learning management system

Scalable learning, developed by SICS Swedish ICT

- Easy to provide videos to students
- Add multiple-choice and free-text questions
  - Machine graded
- Get individual student data on progress and difficulties
- Use any video material
  - eliminating need to provide own material
  - TED talks, OER, recorded television and film


ScalableLearning
Dashboard
My Courses
Account
Help
EP1100: Course introduction…
Progress
In-class
Content
Students
Details
Course Information
Course Links
Course introduction: Con… 24:48
Connectivity, topology and ne… 09:19
Terminology, standardization … 06:01
The OSI and Internet models 09:28
Data communication 47:39
LAN standards 29:24
Lab Preparation Quizzes
Hints and solutions to ex… 12:32
Ring topology
Point-to-point links
Between neighbours
Signals rotate around the ring
Advantages
Easy to install and reconfigure
Cost
Disadvantages
Robustness
Dual ring for robustness and capacity
EP1100 Data communication and computer networks
10
YouTube
0:04:54/ 0:09:18
Insert Video Quiz Here
Add Content
Add Module
Video
Settings
Quizzes
Quiz 00:01:31
What connectivity is this: Inviting three friends for dinner?
Quiz 00:01:32
What connectivity is this: Sending spam?
Quiz 00:01:33
What connectivity is this: Asking for a date politely?
Quiz 00:01:34
What is the purpose of anycast?
Quiz 00:05:12
What topology has WiFi with an access point?
Quiz 00:09:14
What network type is in the Amadeus airline booking system?


ScalableLearning
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LAN standards 29:24
Lab Preparation Quizzes
Hints and solutions to ex… 12:32
Insert a Video Question:
On-video Quiz
Place quiz choices on top of the video. Use this if the answers are visible in the video.
One answer
Multiple answers
The Question is...
Drag and drop
Text Quiz
Text quiz on a white background. Use this if the quiz answers are not visible in the video.
One answer
Multiple answers
The Question is...
Drag and drop
The Question is...
My Answer is ...
Free text answer
On-video Survey
Surveys have no correct answer. Use this if the survey choices are visible in the video.
One answer
Multiple answers
Cancel

ScalableLearning

Dashboard | My Courses | Account | Help

EP1100: Select a Module

- Course Information
- Course Links
- Course introduction: Conc... 24:48
- Data communication 47:39
- LAN standards 29:24
- Lab Preparation Quizzes
- Hints and solutions to extr... 12:32

Progress | Content | Students

Course Progress | Progress Graph

✓ Finished Not on Time ✓ Finished on Time ✖ Not Finished

	Course Links	Course introduction: Concepts, models and examples	Data communication	LAN standards	Lab Preparation Quizzes	Hints and solutions to extra problems
Names of students	✓	✓	✓	✖	✓	✓
	✓	✓ (1 days)	✖	✖	✓	✖
	✓	✓	✓	✓	✓	✖
	✓	✓	✓	✓	✓	✖
	✓	✓	✓	✖	✓	✖
	✓	✓ (3 days)	✓	✖	✖	✖
	✓	✓	✓	✓	✓	✖
	✓	✓	✓	✖	✓	✖
	✓	✓	✖	✓	✓	✖
	✓	✓	✖	✓	✓	✖

Learning analytics

Useful data from learning management system

- Learn study habits of those who success and fail
- Early warning to those who run risk of failing
- Indications of deficient material and inherent difficulty
- Adapt in-class meetings to performance on preparatory material

Risks

- Sensitive with respect to personal integrity
  - Basically IQ tests run on large populations

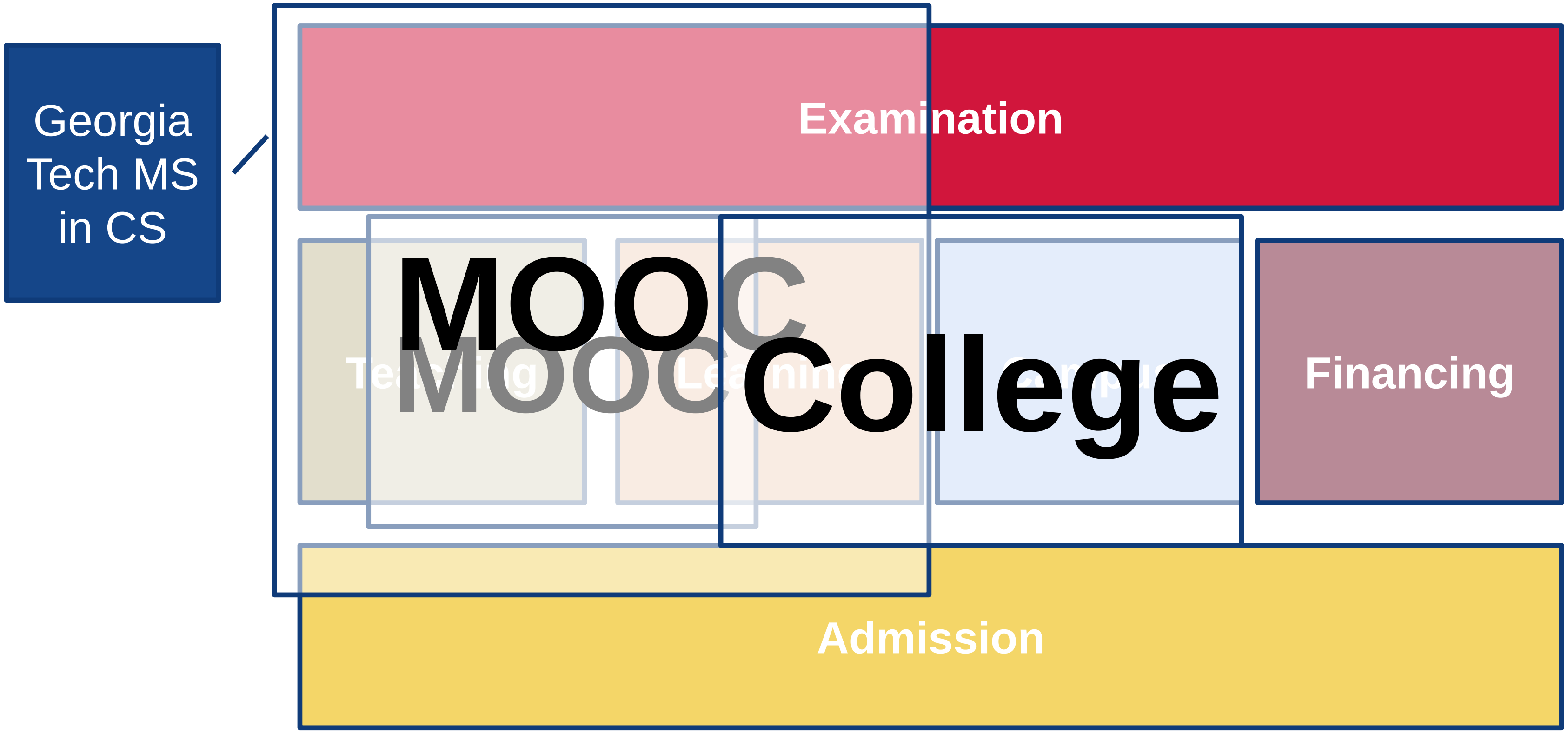
Mitigation of risk

- Identifiable data only needed for student and teacher
- Random identifier for linking results across courses

Active learning at distance and scale

- KTH Summer Mathematics www.sommarmatte.se
  - Online bridging course , nationwide
  - Started in 2005; 71 000 students to date
  - For credit, students obtain financial aid
  - Throughput 50 percent
- Current project at SICS Swedish ICT on professional distance education
  - Challenges
    - Scheduling and priorities
      - Work tasks, family, own time
    - Academic studies in the past
    - Work in progress, no results yet
- Peer instruction requires system support
  - To group students who are in phase
  - Provide protocol to follow; control of process
  - Produce material following exercise as feedback on the different alternative answers
- Clarity on structure, approach and purpose
  - Minimize structural uncertainty
  - …

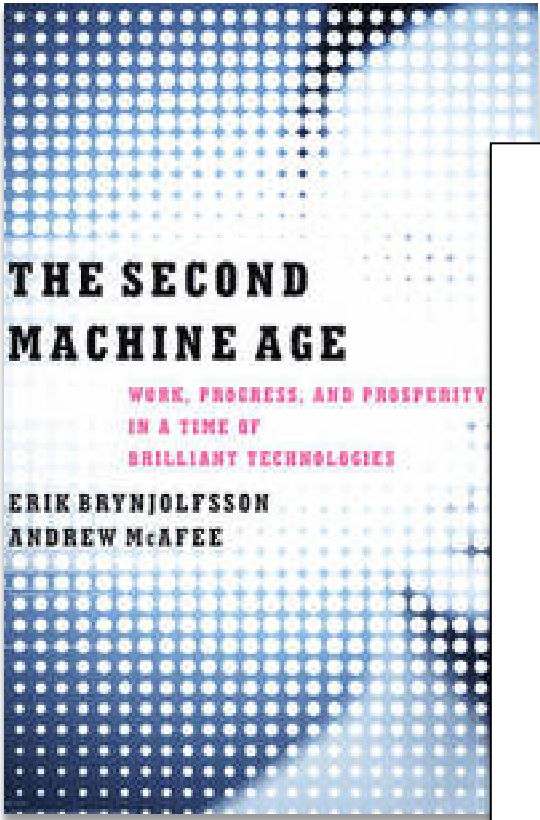
Higher education and MOOCs

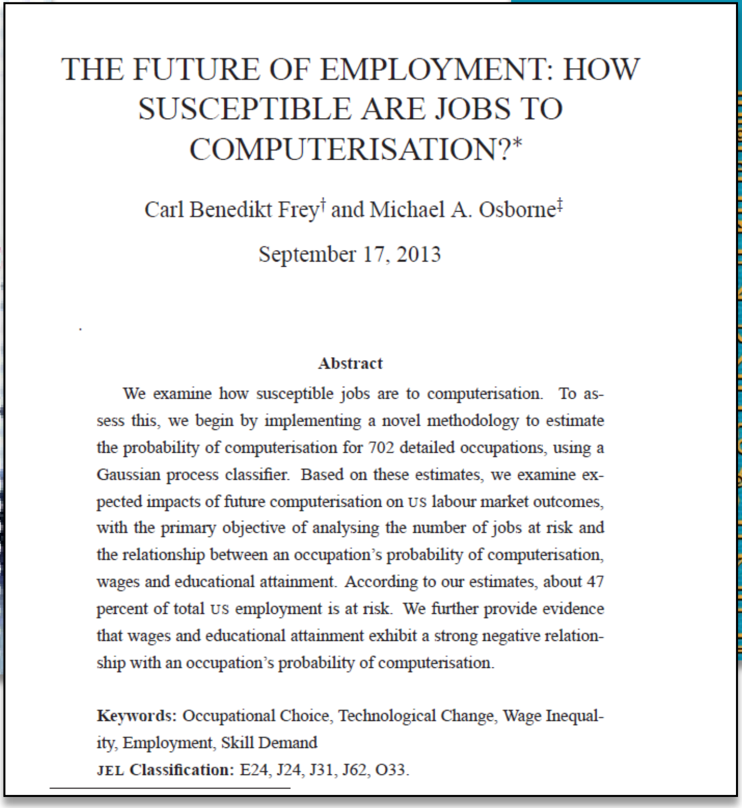


Organization for MOOC-based education

- Hard to be a student without context
  - no peer pressure, no support and no socializing
  - where to study, when and how?
- My proposal: The MOOC College
  - Organize studies
  - Activate students and
  - Life-long learning
- Study coaches
  - Individual study plan of MOOCs
  - Organize study groups with tutors
  - Add extracurricular activities
  - Examination and certification by external partners

A coming societal challenge





THE FUTURE OF EMPLOYMENT: HOW SUSCEPTIBLE ARE JOBS TO COMPUTERISATION?*

Carl Benedikt Frey† and Michael A. Osborne‡

September 17, 2013

Abstract

We examine how susceptible jobs are to computerisation. To assess this, we begin by implementing a novel methodology to estimate the probability of computerisation for 702 detailed occupations, using a Gaussian process classifier. Based on these estimates, we examine expected impacts of future computerisation on US labour market outcomes, with the primary objective of analysing the number of jobs at risk and the relationship between an occupation's probability of computerisation, wages and educational attainment. According to our estimates, about 47 percent of total US employment is at risk. We further provide evidence that wages and educational attainment exhibit a strong negative relationship with an occupation's probability of computerisation.

Keywords: Occupational Choice, Technological Change, Wage Inequality, Employment, Skill Demand

JEL Classification: E24, J24, J31, J62, O33.

A coming societal challenge

A new need

- Retraining, continuous development
- Staying ahead of the machines

Suggestions

- Less initial full-time study
  - too big investment of uncertain usefulness
- Blend work and studies throughout life
  - Studies adapted to present and future work
  - Suited to situation in life
    - for increased wellbeing
    - applicable skills and knowledge
  - Re-certification of
    - acquired skills and knowledge
    - whenever needed
  - Life-long service contract with place of learning

Conclusion

Teaching should be based on scientific knowledge

- Active learning provably superior to passive teaching
- Substantial improvements cannot be ignored

Flipped classroom with peer instruction works well

- Tested at scale at KTH in different subjects
- Simple default to get faculty started
- Open for experimentation by teachers

Learning management systems are useful

- Self-corrected quizzes
- Monitoring of individual progress
- Learning data for feedback to students and teachers alike

Distributed large-scale teaching require active learning

- Important to consider students' learning situation and environment
- Socializing around learning
- Peer instruction possible at distance with appropriate system support

Conclusion

The age of automation increases need for effective learning

- Skills and knowledge obsoleted by machines
- Recurrent retraining might be needed
- Large initial investment in studying might not pay off

Continuous learning for

- staying competitive vis-à-vis machines
- increased life quality and meaning
- orderly democratic society and optimism about the future

Thank you for your attention!

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