Long-term operation of industrial-academic research and education

Hans Henriksson, SKC, Sweden

SKC

Swedish Centre for Nuclear Technology

Nuclear technology in collaboration between industry and academia

- Created in 1992 at KTH: soon 25 years!
- Swedish NPPs and Fuel manufacturer
- Research projects
  - Nuclear technology
  - Ageing of materials
  - Fuel development
- Education
  - M.Sc/B.Sc. programmes
  - Under-graduate courses
  - Advanced courses
- Total budget:
  3,5 MEUR / 3 year agreement

Vision and goals

SKC shall provide long-term support to ***securing knowledge*** *and* ***competence development*** *at an academic level for the Swedish nuclear technology programs. This shall be a basis for providing resources to the Swedish nuclear industry and its regulators.*
It means that SKC will contribute to a ***safe, effective*** *and thus* ***reliable nuclear energy production****, which is an important part of the Swedish energy supply.*

- Encourage students to choose nuclear technology education
- Provide resource of qualified personnel through attractive education
- Develop strong research groups in nuclear technology
- Perform research on account of the end-users of the SKC

SKC and the human capital needs from industry

Budget and activities

Present agreement runs for three years: 2014 - 2016

Total budget: 3,5 MEUR

Fixed funding: 0,5 MEUR/year (for three universities)

Project funding: 0,6 MSEK/year

Main project: Collaboration on Material, Ageing and Fuel: 0,4 MEUR/year

Annual Symposium:

Symposium 2015: 60 participants, 3 industrial talks, 14 PhD presentations, dinner, prizes

Participation at career days:

ARMADA (KTH), CHARM (Chalmers), UTNARM (Uppsala University)

The Sigvard Eklund Prize

- SKC rewards students the Sigvard Eklund Prize in three categories:
  - best BSc thesis work,
  - best MSc thesis work, and
  - best PhD thesis.

Winners 2015:
(from left) Cheuk Wah Lau (PhD), Giulio Imbalzano (MSc), Hans Henriksson (Director of SKC) Klara Insulander Björk (PhD), and Johan Larsson (BSc).

Research areas with direct industrial impact

Main programmes

- Reactor Physics
  - Reactor Diagnostics, Detectors and Measurement
  - Core Physics
- Nuclear Power Plant Technology and Safety
  - Plant Dynamics
  - Thermal Hydraulics
- Materials and Chemistry
  - Chemistry, Material Physics and Engineering
  - Fuel Technology

Project MÅBiL (Material, Ageing, Fuel):

- Study of materials with respect to Accident Tolerant Fuels (ATF)
- Study of materials with respect to ageing
- Study of nuclear physical processes during normal and transient conditions

Examples of education funded via SKC

Chalmers: ***International Master in Nuclear Engineering***

- Engineering oriented and aims at students with backgrounds in physics, chemistry, mechanical or electrical engineering.
- The only nuclear education in Sweden combining physics and chemistry in one educational program.

KTH: ***Master's Programme in Nuclear Energy Engineering:***

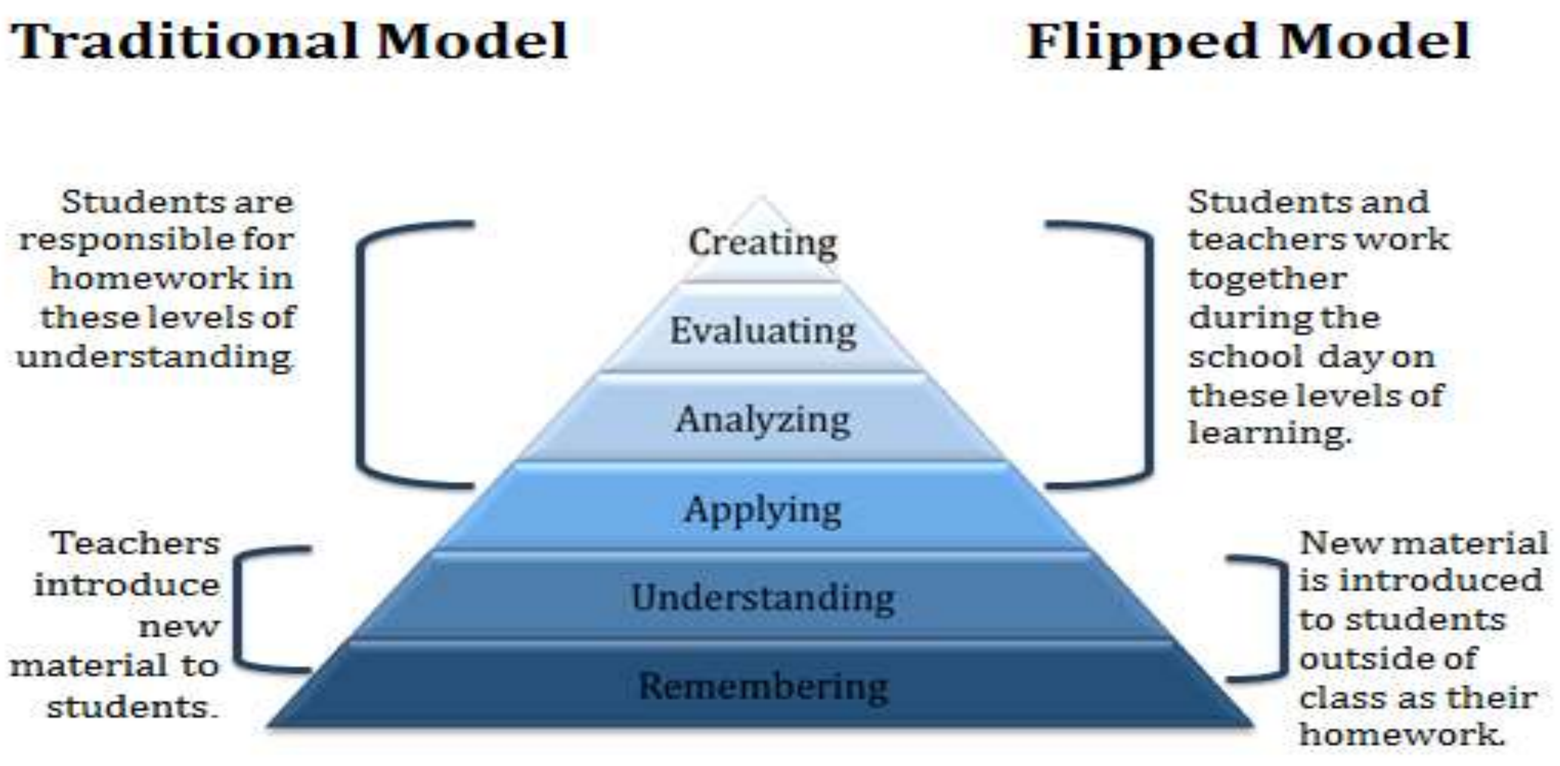
- Several elective courses choose from, and summer school activities (ex. CLAB nuclear repository).
- International profile with links to:
  - KIC InnoEnergy EMINE (European Master in Innovative Nuclear Energy Engineering): Dual Diploma with either Universities Paris-Saclay, Paris or Grenoble-INP
  - Dual Diploma with Tsinghua University, Beijing
  - Dual Diploma with KAIST (Korea Advanced Institute of Science and Technology)

Uppsala University: **Bachelor of science in nuclear engineering**

- Aims at increase volume of employable people available to the nuclear industry
- Cost-efficient training cost for industry
- Reduced need for on-the-job education and training.

Example of pedagogical approach - Chalmers

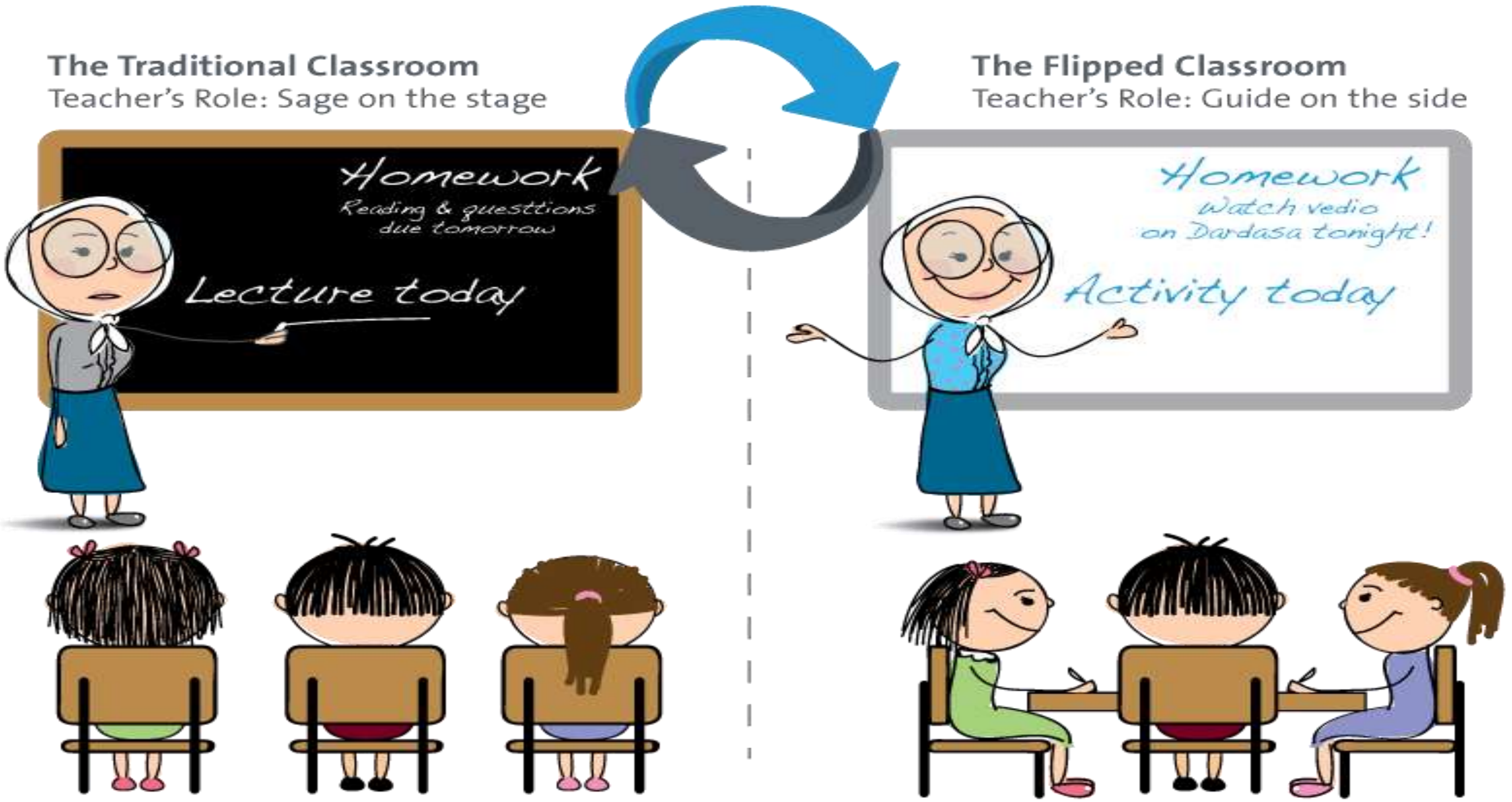
- Incentives in flipping:
  - Low-order thinking skills triggered in the classroom in the traditional model
  - High-order thinking skills triggered in the classroom in the flipped model



Revised Bloom's taxonomy
for the cognitive domain (2001)

Pre-class activities (out-of-class):

- Reading the lecture notes
- Watching the webcasts
- Answering the quizzes
- Sending possible questions and feedback to teachers



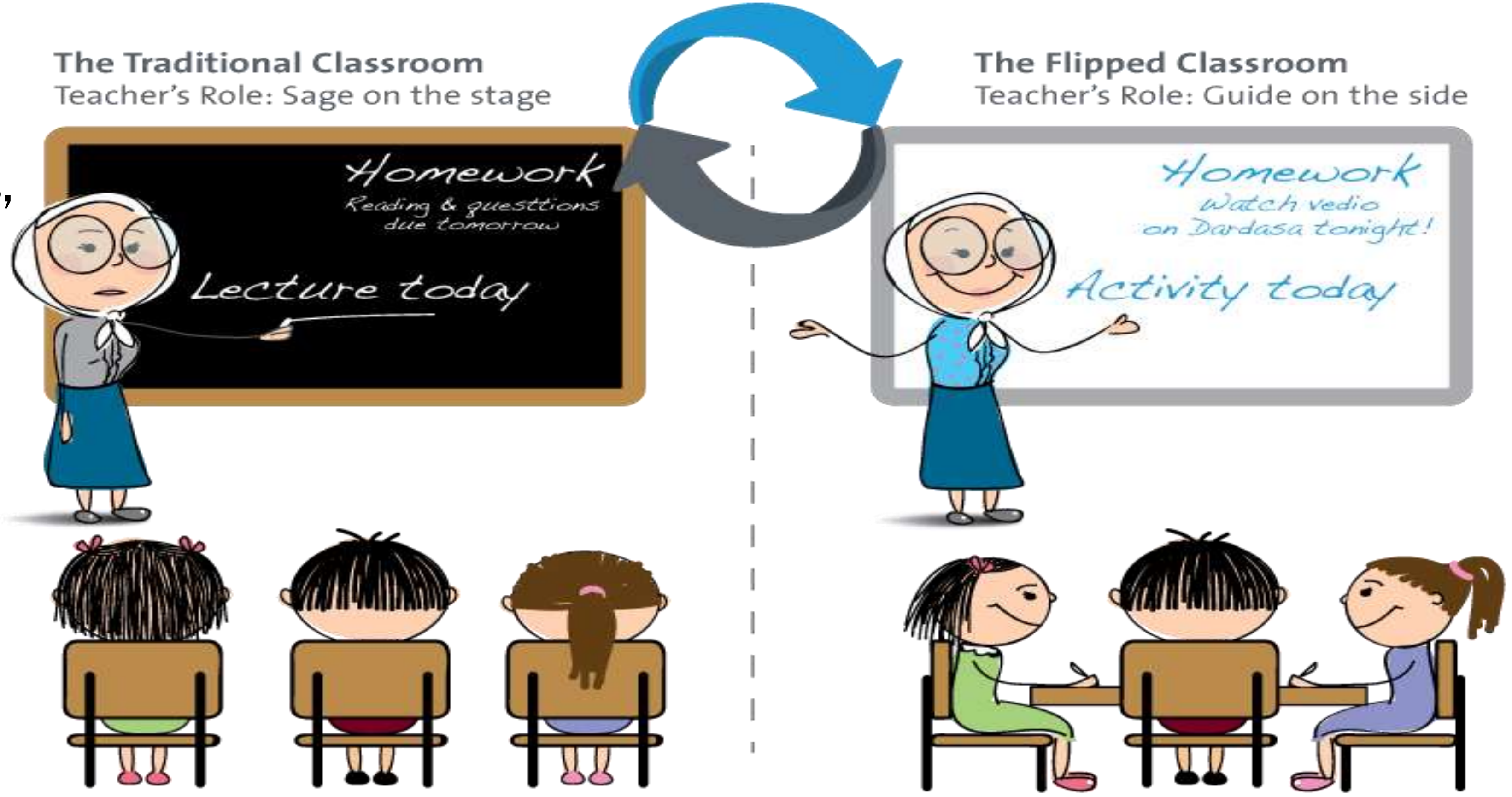
In-class & Post-class activities:

In-class activities

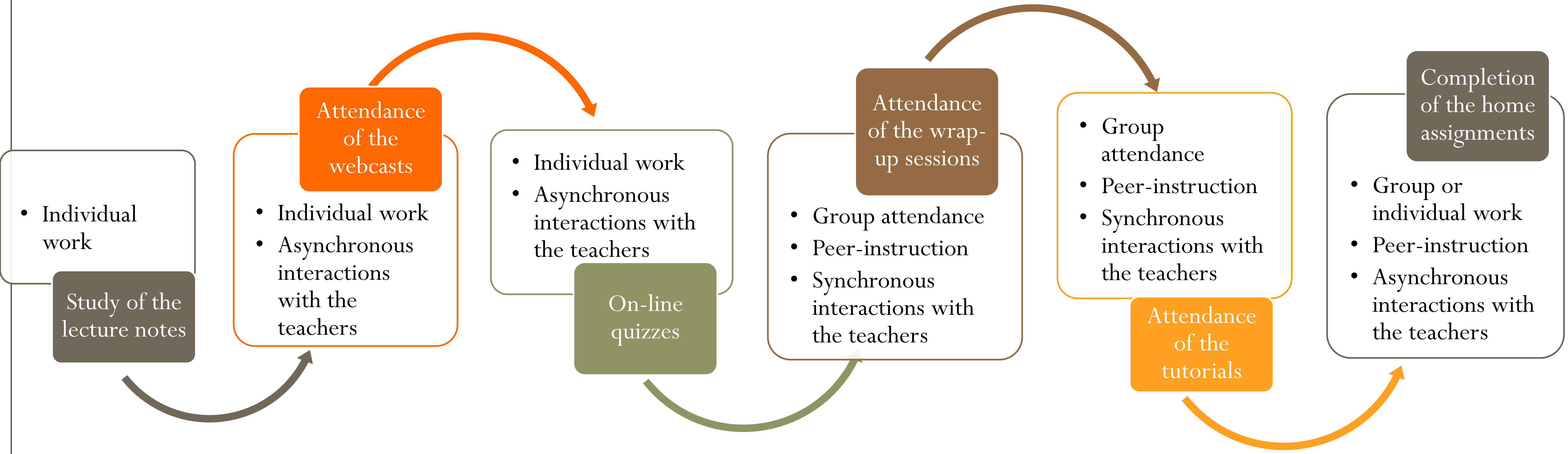
- Wrap-up sessions:
  brief chapter summary, quizzes, peer discussion, additional questions
- Tutorials
- (Laboratory exercises)

Post-class activities (out-of-class):

- Discussion fora
- Home assignments
- (Lab reports)

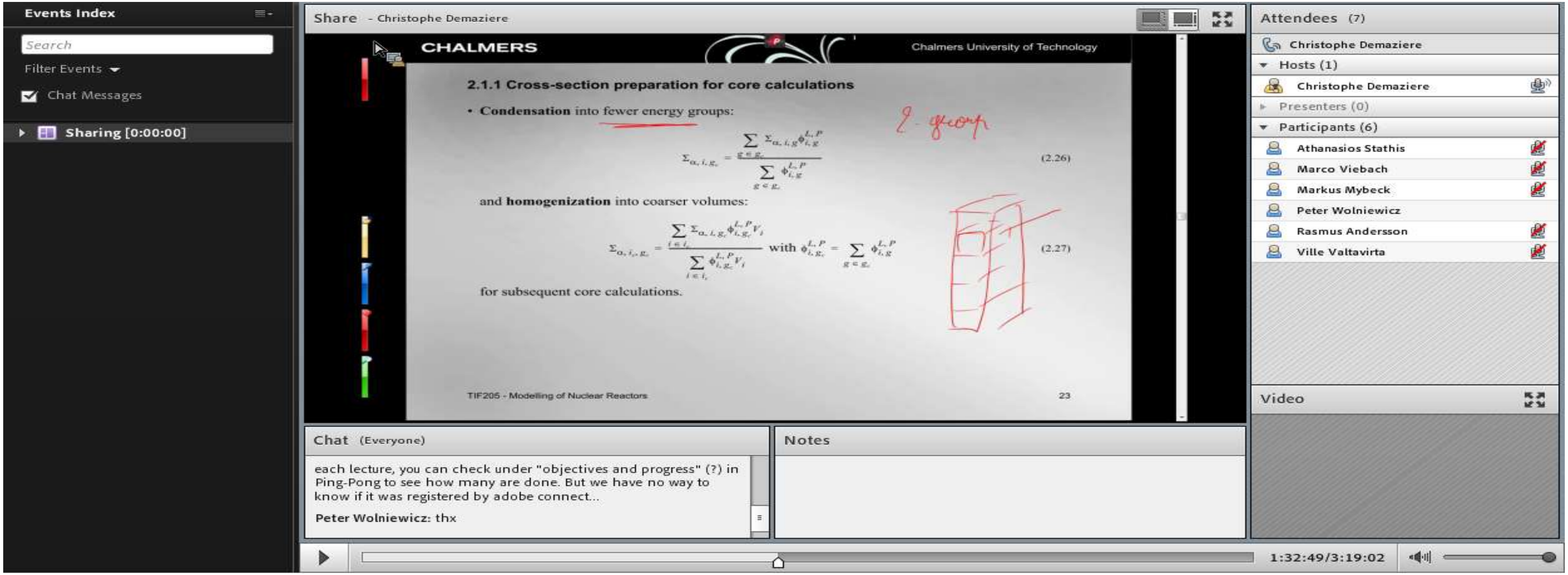


Chain of Class-pedagogy



IT tools used:

- Learning Management System: Ping-Pong
- Webcast recording and broadcasting: Mediasite
- Live sessions broad-casting and recording: Adobe Connect



E-learning platform for the KTH Master in Nuclear Energy Engineering

E-Learning:

On-line education

New-media education

Computer aided/supported education

Internet based education

Distance Education (partly E-learning)

MOOC:

Massive **O**pen **O**nline **C**ourses – MIT/Harvard initiative. Three software solutions: EdX, Coursera, Udacity

Incentives

Main mission of E-learning at KTH:

- “Campus-based” education supported by E-learning to enhance learning pace and student through-put.
- main platform for “education on demand” and “distance education” for NON-ACADEMIC customers: professional education for nuclear industry.
- **Self quality improvement** of pedagogical level: for example through video recording of lectures is self-stimulating to improve the pedagogical level.
- Improvement of educational level through home assignements and students own activities: ”Exerciser/Maple TA” module.
- Instant results of examinations and home/test assignments. Extremely important argument for an effective education. It meets very well students expectations.

Strategy for KTH E-learning platform – Four pillar strategy

Pillar I: Video navigation

Objective:
- Promotion of the program for potential applicants
- Navigation through the program to select elective courses.

DONE

Means: short video clips (pitches) of each course

Pillar II: Support for Campus education

Objective:
- Support and optimization of "on-campus" education
- Enhanced learning pace and through-put.
- Interactivity with students

On-going

Means: Video presentations of all lectures and student projects.
"Exerciser" for home assignments, examinations and projects.
E-learning lab instructions

Pillar III: E-learning for International programs

Objective:
Support for navigation and program insight for exchange students.

Means:
Link to Pillar I and II at KTH and corresponding web-locations at partner Universities.
Live seminars and/or selected lectures of interest.

Pillar IV: Distance education

Objective:
Tailored education and specially developed distance education courses: "education on demand" for non-academic stakeholders

Means:
Pillar I and II adopted to distance education.

Webinars: streamed lectures on line.
Interactivity with students

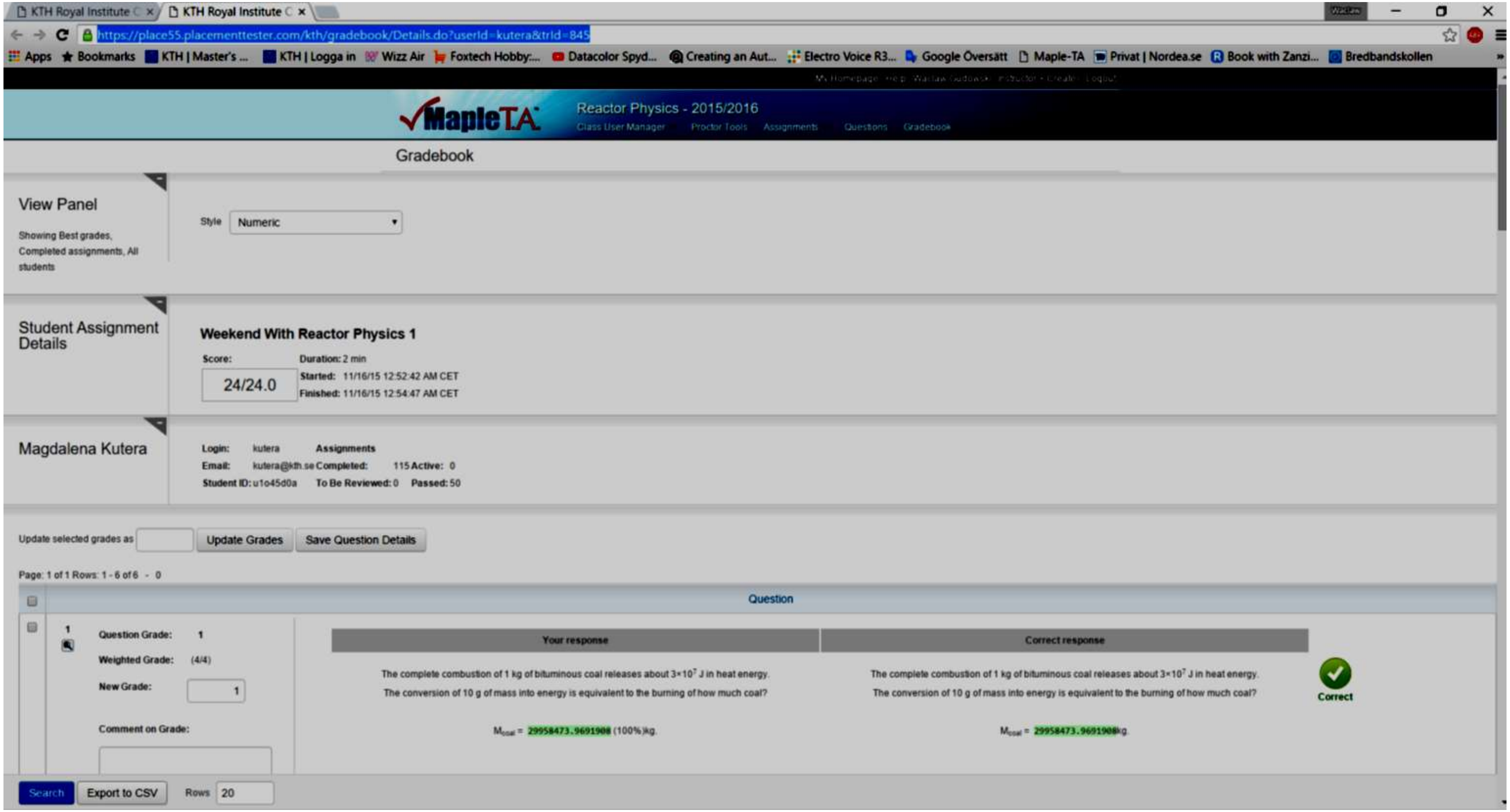
Pillar II: under testing and implementation:

Exerciser module: Maple Software – MapleT/A and next version Maple – Möbius
Courses under processing:
Reactor Physics SH2600 (9ECTS) and SH112N (Preparatory course in physics)

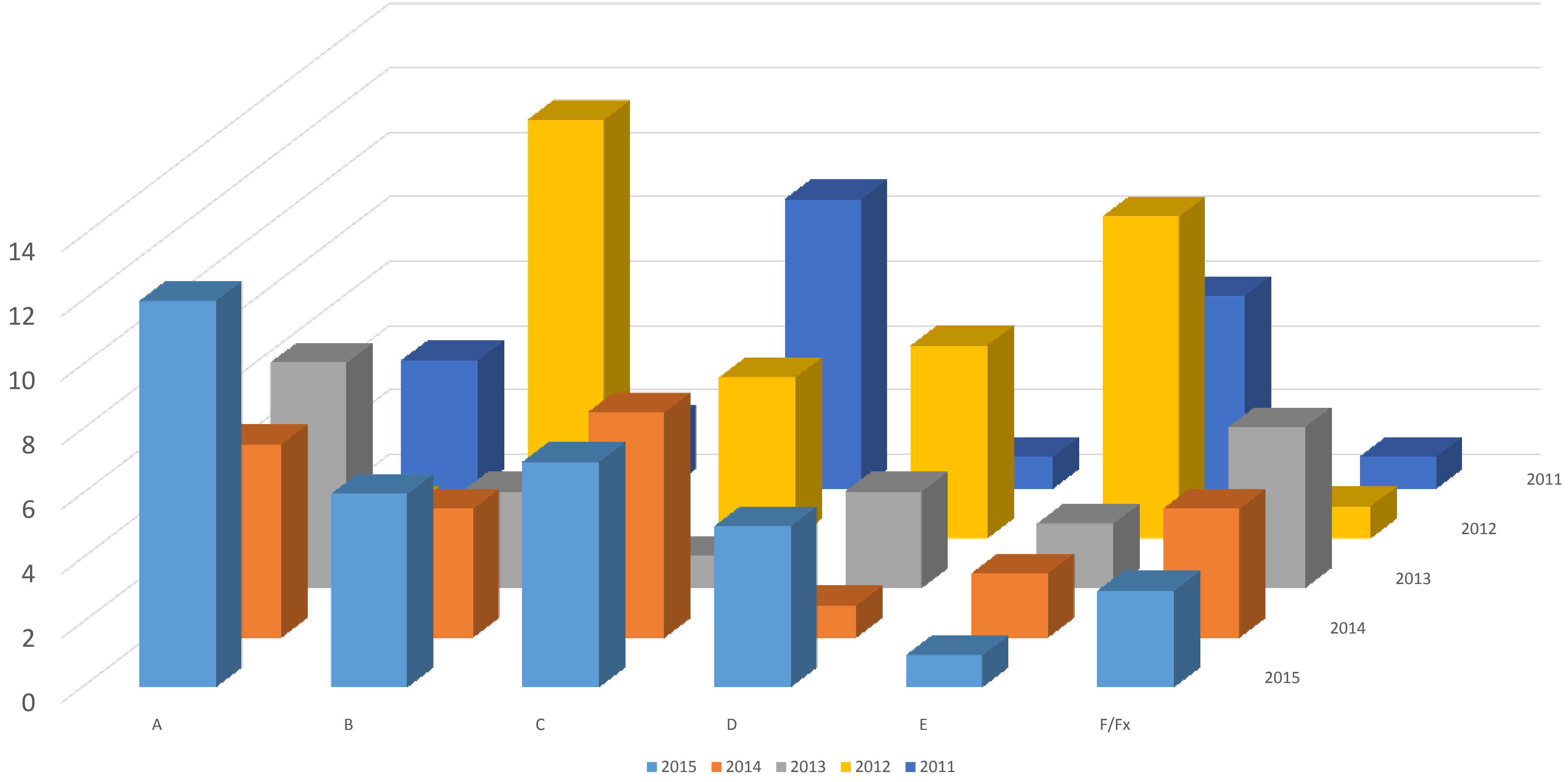
FIRST E-LEARNING EXAM AT KTH – January 15, 2016. SUCCESS, in spite of some small problems. Every student got DIFFERENT RANDOMISED problems. No practical risks for copying.

As preparation for this exam: 9 Home Assignments in MapleT/A, each week, corrected and discussed on the spot.

Example from E-learning exam: Maple T/A "Exerciser" tool



Reactor Physics Examination Grade Distribution



Pillars III and IV: more work needed

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for many more years to come!

Thank you!

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