GRE@T-PIONEER

Teaching advanced courses in a sustainable manner – example from the GRE@T-PIONEeR project

31 October 2024

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CHALMERS

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BACKGROUND

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- **Declining student enrolment** in "nuclear engineering" at European universities, with specialized courses being phased out
- **Ageing workforce** in the nuclear industry

➢**Challenge** to **maintain competence** for the more than 100 reactors in operation in Europe providing 25% of based load electricity

BACKGROUND

- **Advanced courses** = often offered as intensive onsite "workshops" or "summer courses"

➢ Too condensed format to lead to "efficient" learning

➢ Issuance of certificates of attendance (with no real measure of engagement, progress and understanding)

- **Online and hybrid learning environments** = more accessibility and flexibility

➢ Often low engagement and high drop-out rates

BACKGROUND

- “Innovative” learning design proposed in the GRE@T-PIONEeR project (Horizon 2020 project), having for objectives:
  - To offer **advanced** courses
  - In a **flexible** manner
  - Having a **high engagement** of the participants in the activities
  - Making sure that the **participants successfully learn** the concepts/principles/methods
  - And having a **worldwide coverage**

WHAT IS GRE@T-PIONEeR?

WHAT IS GRE@T-PIONEeR?

- **18** university teachers from **8** different universities in **6** different countries
- Main **goals** of the project:
  - Maintain or further develop **competences** in **computational and experimental nuclear reactor physics and safety**
  - Deliver **top-class courses** using **state-of-the-art pedagogical methods** (active learning through flipping)
  - Create a **community** of **reactor physicists**

COURSE OFFERING

COURSE OFFERING

- **9 course modules** offered:
  - Nuclear cross-sections for neutron transport
  - Neutron transport at the fuel cell and assembly levels
  - Core modelling for core design
  - Core modelling for transients
  - Reactor transients, nuclear safety and uncertainty and sensitivity analysis
  - Radiation protection in nuclear environment
  - Hands-on exercises on the AKR-2 training reactor
  - Hands-on exercises on the CROCUS training reactor (onsite only)
  - Hands-on exercises on the BME training reactor

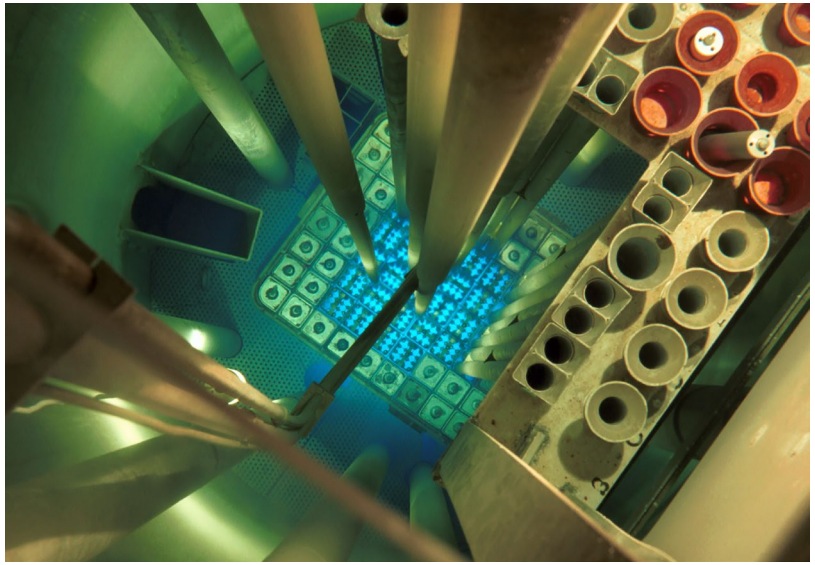
➢ **More info and registration at https://great-pioneer.eu/register**

COURSE OFFERING

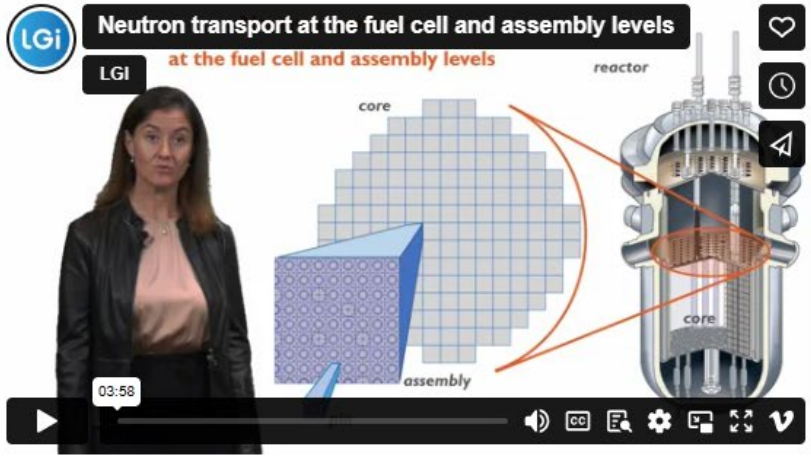
- **Hands-on** exercises at the 3 **training reactors**:

AKR-2
TUD, Dresden, Germany

CROCUS
EPFL, Lausanne, Switzerland



BME Training Reactor
BME, Budapest, Hungary

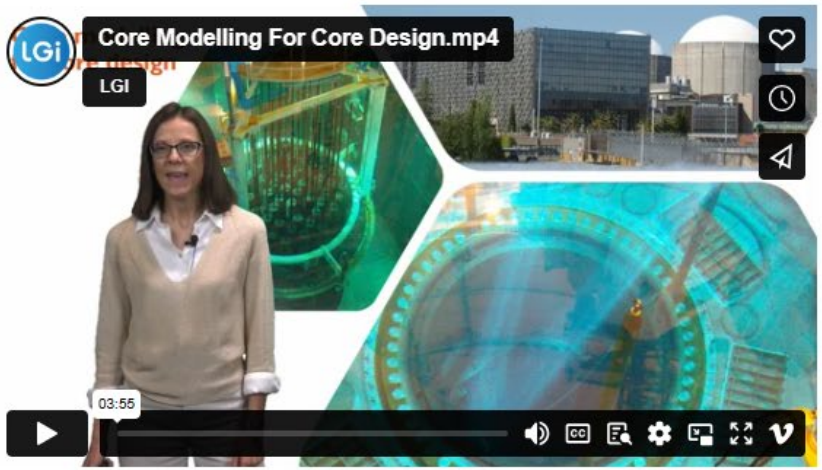


NEUTRON TRANSPORT AT THE FUEL CELL AND ASSEMBLY LEVELS

- The principles of probabilistic methods in steady-state conditions for fuel cell and assembly calculations.
- The principles of deterministic methods in steady-state conditions, their approximations, and their range of validity for fuel cell and assembly calculations.
- The use of those methods for macroscopic cross-section generation.

DOWNLOAD COURSE LEAFLET

EXAMPLES OF COURSE VIDEOS +



CORE MODELLING FOR CORE DESIGN

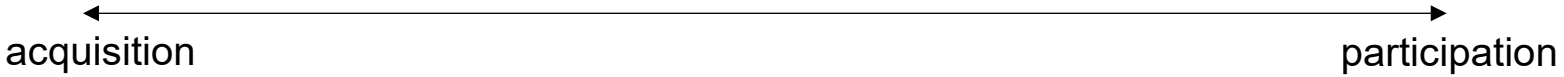
- The principles of probabilistic methods in steady-state conditions for core calculations.
- The principles of deterministic methods in steady-state conditions, their approximations, and their range of validity for core calculations.
- The use of those methods for reference calculations or for core design, operation and safety analysis.

DOWNLOAD COURSE LEAFLET

PEDAGOGICAL METHOD

PEDAGOGICAL METHOD

- Flipping:



Sfard, A. (1998). On two metaphors for learning and the dangers of choosing just one. Educational researcher, 27(2), 4-13.

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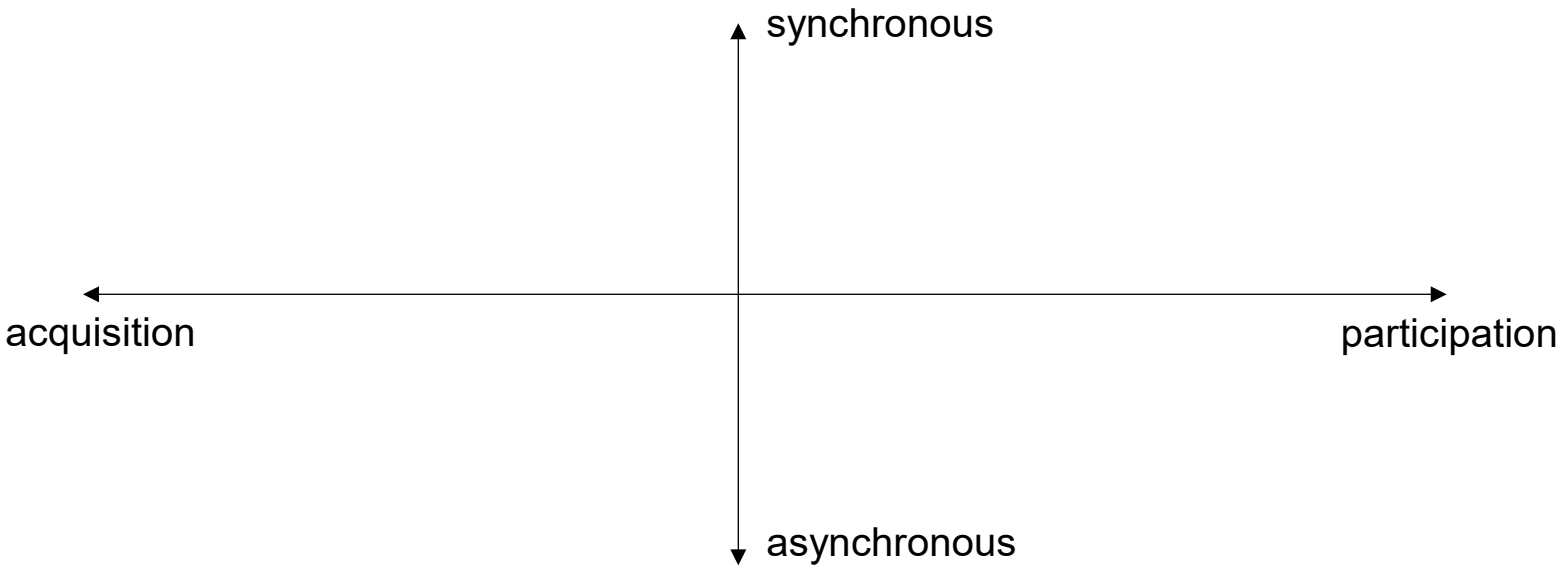

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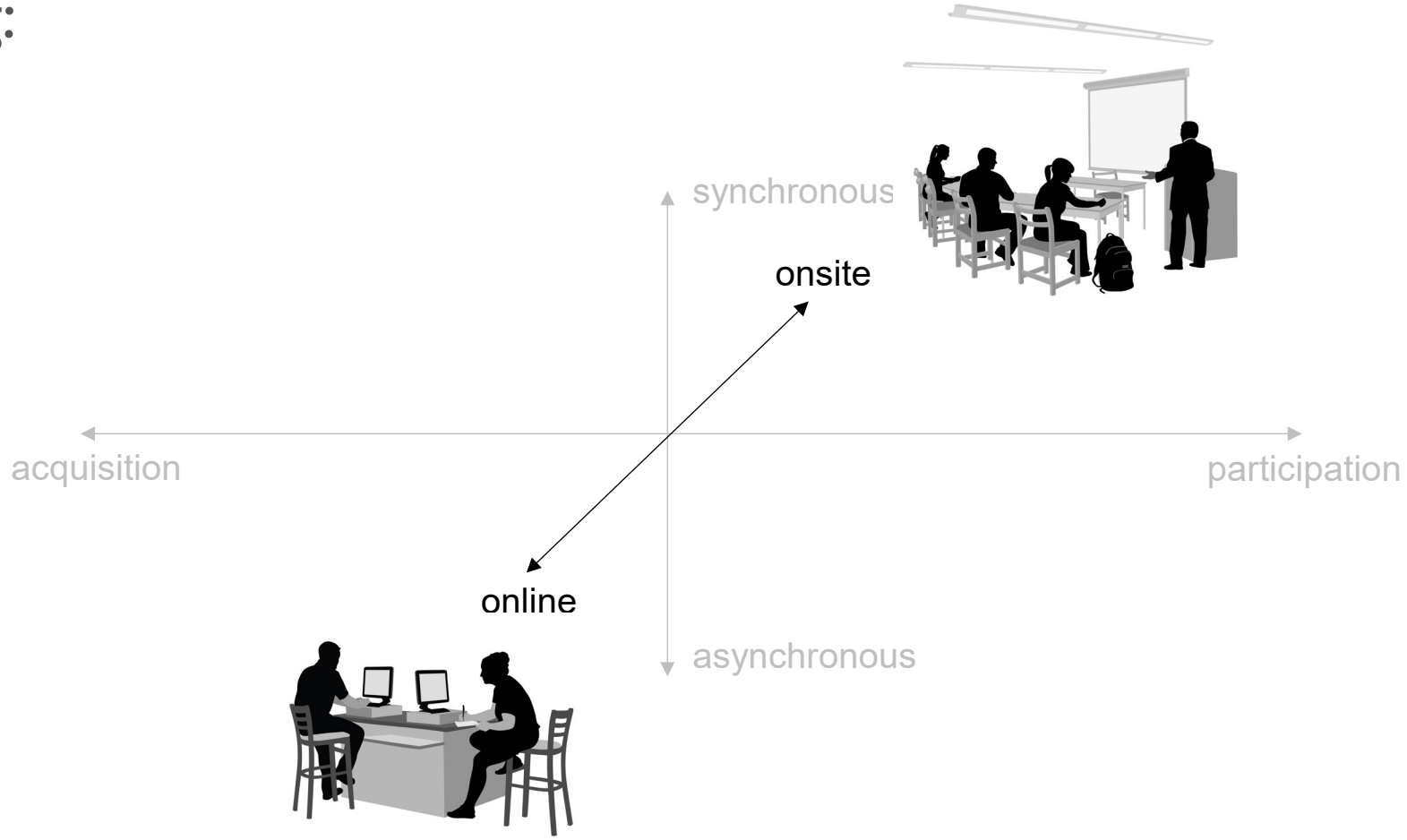

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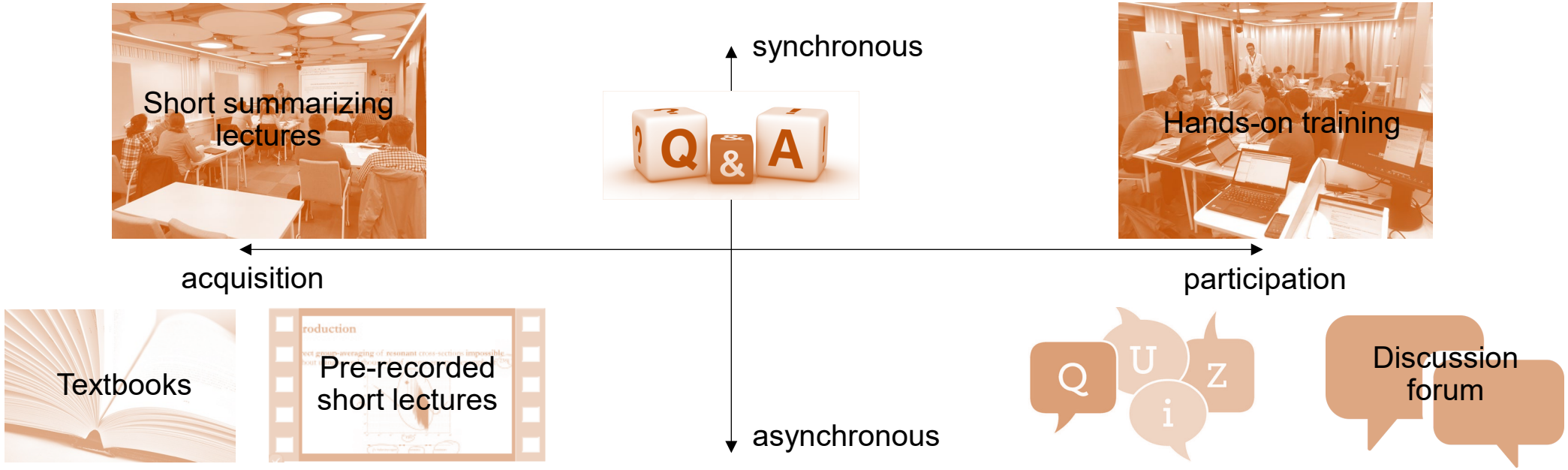

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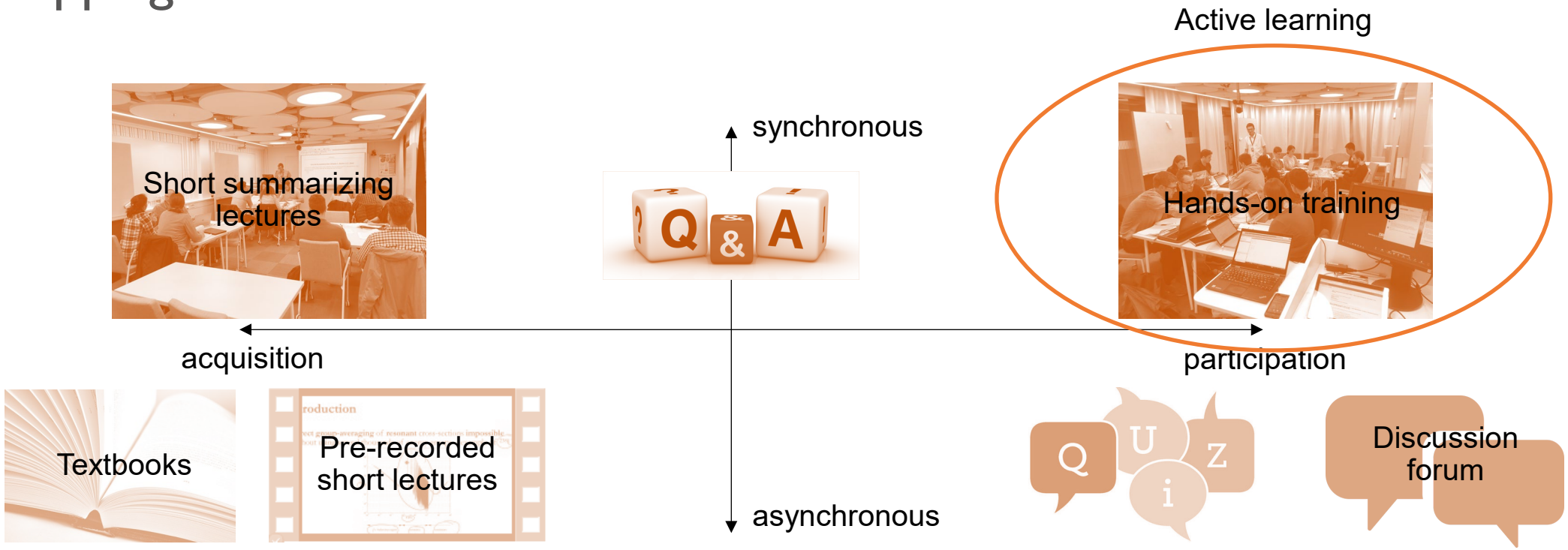

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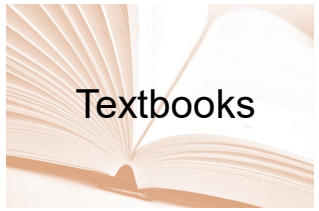
PEDAGOGICAL METHOD

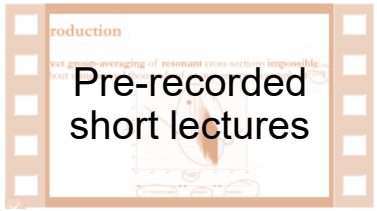
Synchronous hybrid learning phase concentrated on **5 consecutive days/course**

synchronous

acquisition

participation





asynchronous

Hrastinski, S. (2008). Asynchronous and synchronous e-learning. Educause Quarterly, 31(4), 51-55.

Asynchronous online learning phase spread on **4 weeks/course** (self-paced learning)

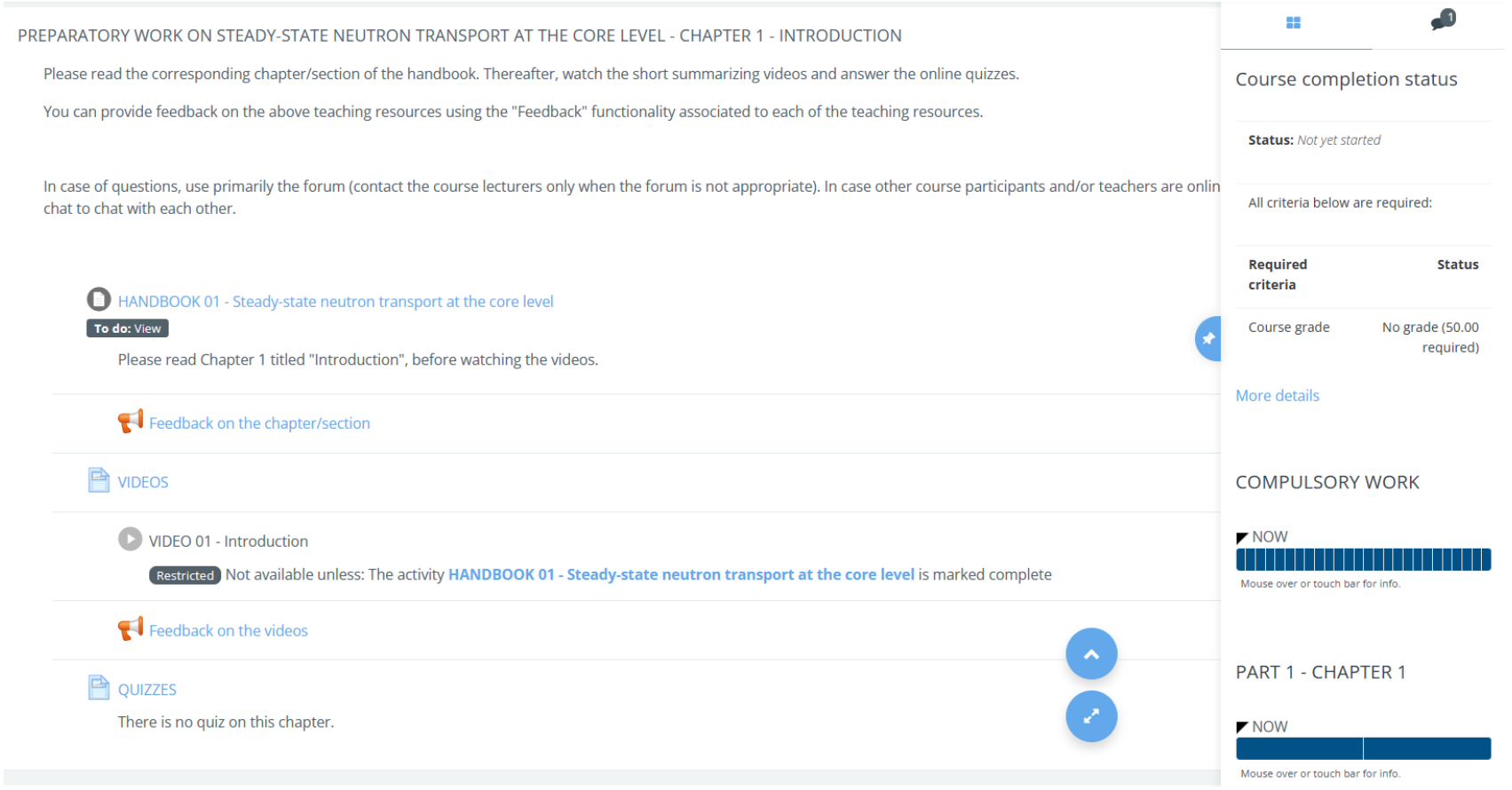
PEDAGOGICAL METHOD

- For the 8 courses delivered in the academic year 2022/2023, **number of resources developed**:
  - 12 handbooks
  - 133 video lectures
  - 611 asynchronous quizzes
  - 298 synchronous quizzes
  - 115 assignments

➢ **Major undertaking**

PEDAGOGICAL METHOD

- **Delivery** of **all teaching resources** (asynchronous and synchronous) via a **Learning Management System** (LMS):



PEDAGOGICAL METHOD

- **Delivery** of **all teaching resources** (asynchronous and synchronous) via a **Learning Management System** (LMS):
  - **Compulsory learning sequence** to be followed (parts of the resources are locked until selected activities are completed)
  - Students can see their **progress** (completion) and **grades** (performance) at all times
  - **Access** to **synchronous elements** only possible if **sufficient asynchronous work completed** (50% of the preparatory work)
  - **Course certificate only delivered** if the participants get at least **50 points** (out of 100)

PEDAGOGICAL METHOD

- **Active learning** techniques used during the **synchronous sessions**:
  - **Short summarizing lectures** followed by "**quizzes**", with or without prior group discussions
  - Heavy use of **computer simulation tools** with different objectives:
    - **Implementing** nuclear reactor **modelling techniques** introduced in the other course elements
    - **Checking** the proper **understanding** of key concepts via small assignments
    - **Checking** the proper **use** of third-party nuclear simulation software against some reference solutions

➢ **Highly-structured** sessions

ANALYSIS OF THE TWO FIRST EDITIONS

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- Meta-analysis of all courses offered during the academic year 2022/2023:
  - Nuclear cross-sections for neutron transport
  - Neutron transport at the fuel cell and assembly levels
  - Core modelling for core design
  - Core modelling for transients
  - Reactor transients, nuclear safety and uncertainty and sensitivity analysis
  - Radiation protection in nuclear environment
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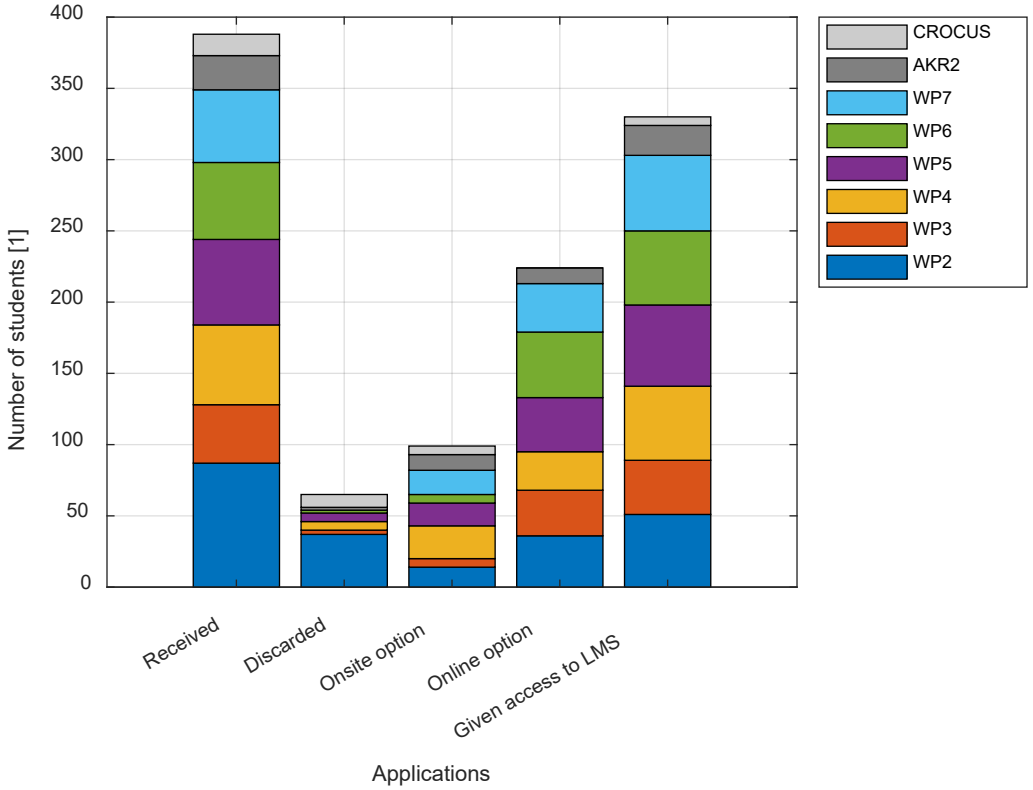
ANALYSIS OF THE TWO FIRST EDITIONS

- Student statistics for academic year 2022/2023:



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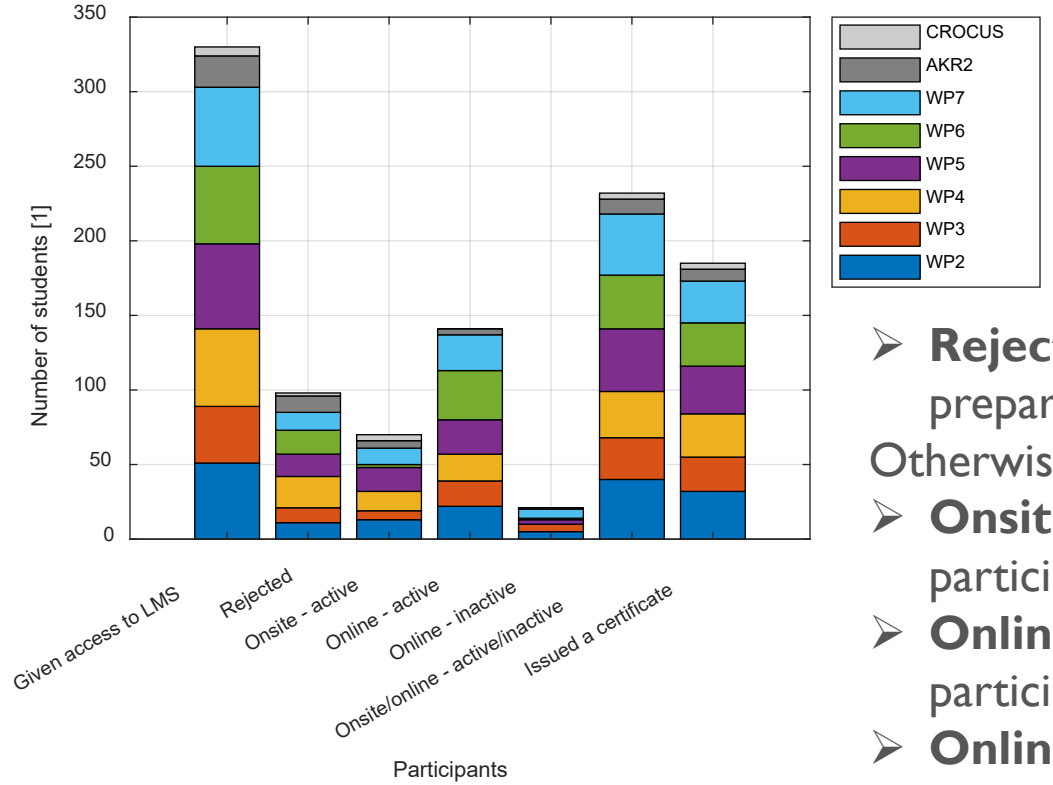


- **Rejected**: did not reach 50% in preparation

Otherwise

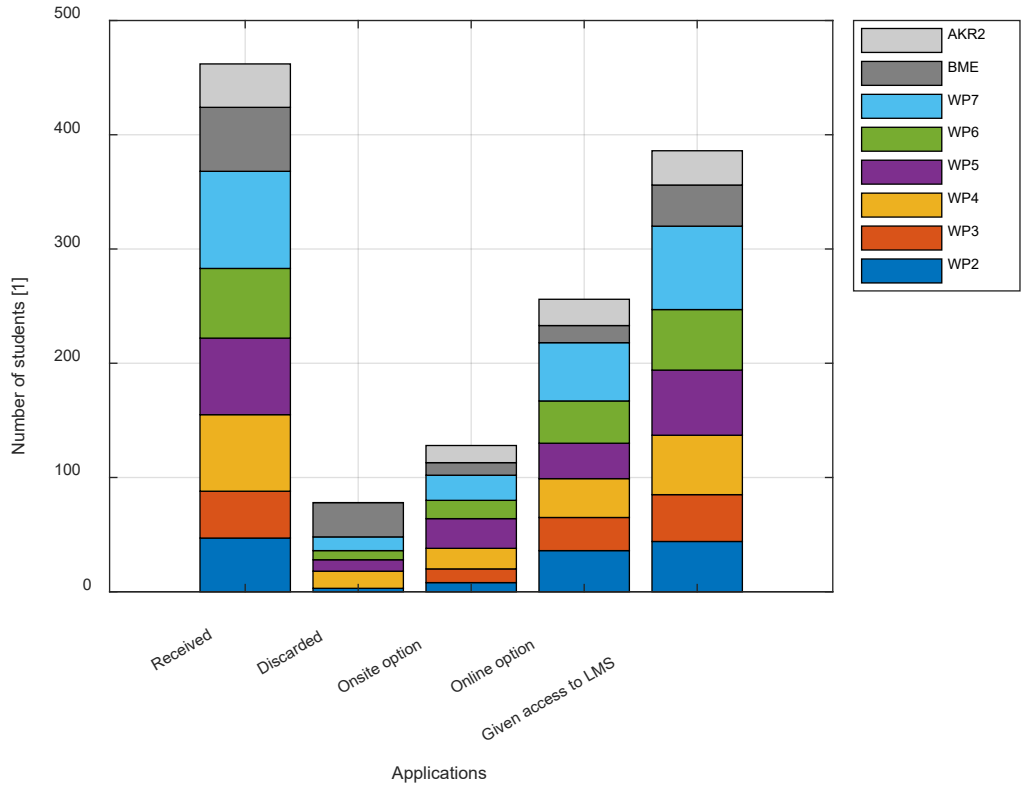
- **Onsite – active**: came for onsite participation
- **Online – active**: accepted for online participation, and did "show up"
- **Online – inactive**: accepted for online participation, but did not "show up"

ANALYSIS OF THE TWO FIRST EDITIONS

- Student statistics for academic year 2022/2023:
  - **389 applicants**
  - 65 rejected applications (upper limit for each course set to 50 participants)
  - ➢ **324 accepted applications** (100 onsite and 224 online)
  - ➢ **330** persons granted access to the LMS (late registrations)
  - **232 participants qualified for the synchronous sessions** (with 70 onsite and 162 online)
  - **185 participants received a course certificate** (70 onsite and 115 online)

ANALYSIS OF THE TWO FIRST EDITIONS

- Student statistics for academic year 2023/2024:



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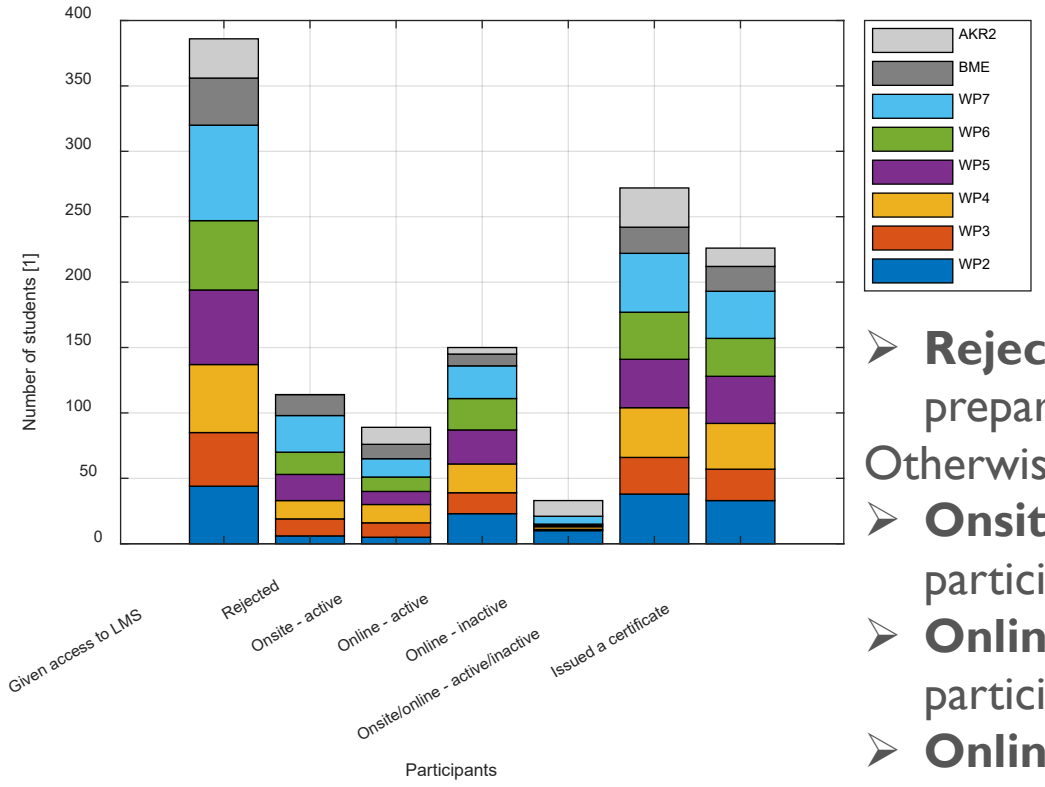

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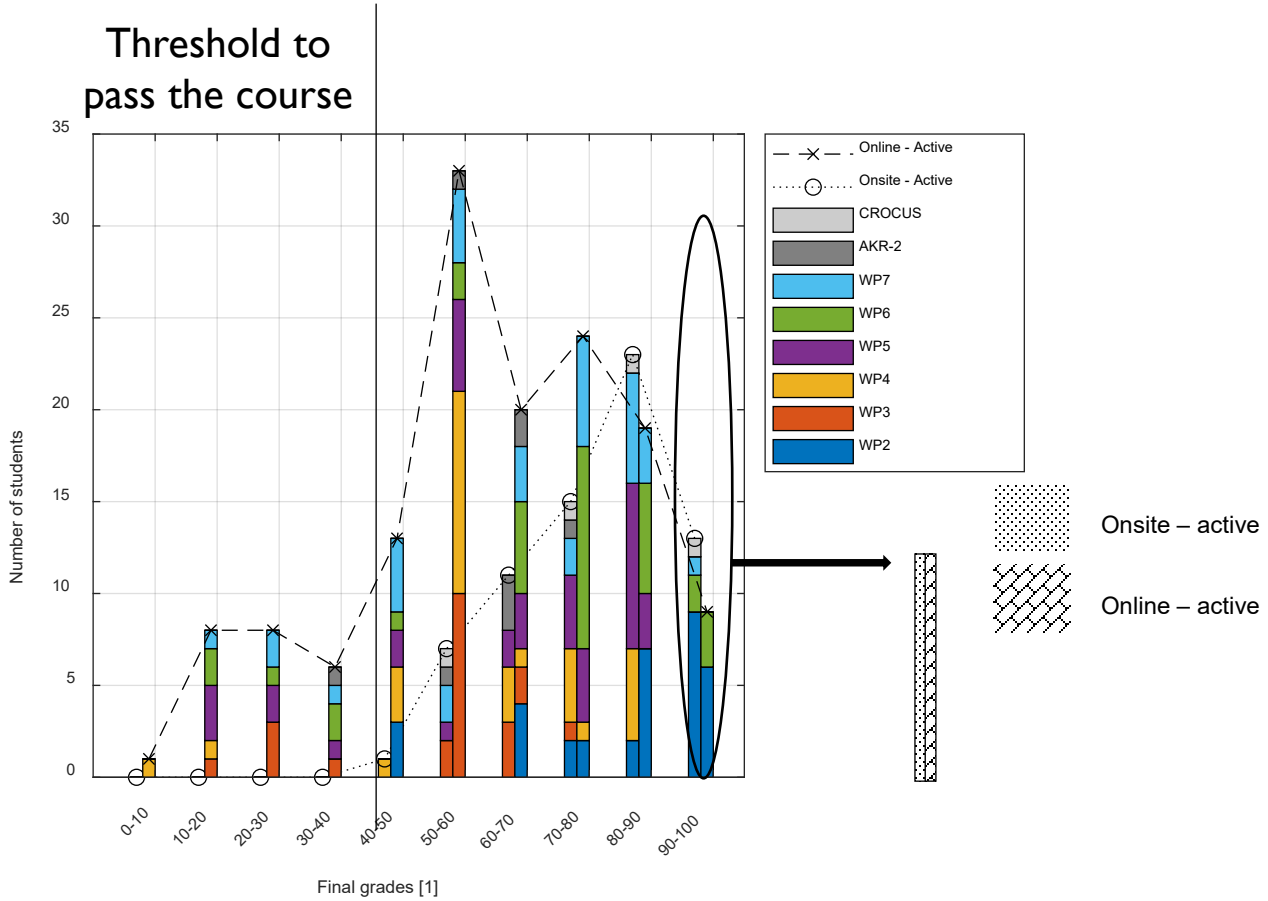
ANALYSIS OF THE TWO FIRST EDITIONS

- Student statistics for academic year 2023/2024:
  - **462 applicants**
  - 78 rejected applications (upper limit for each course set to 50 participants)
  - ➢ **384 accepted applications** (128 onsite and 256 online)
  - ➢ **386** persons granted access to the LMS (late registrations)
  - **272 participants qualified for the synchronous sessions** (with 89 onsite and 183 online)
  - **226 participants received a course certificate** (89 onsite and 137 online)

ANALYSIS OF THE FIRST EDITION

ANALYSIS OF THE FIRST EDITION

- **Final grades:**



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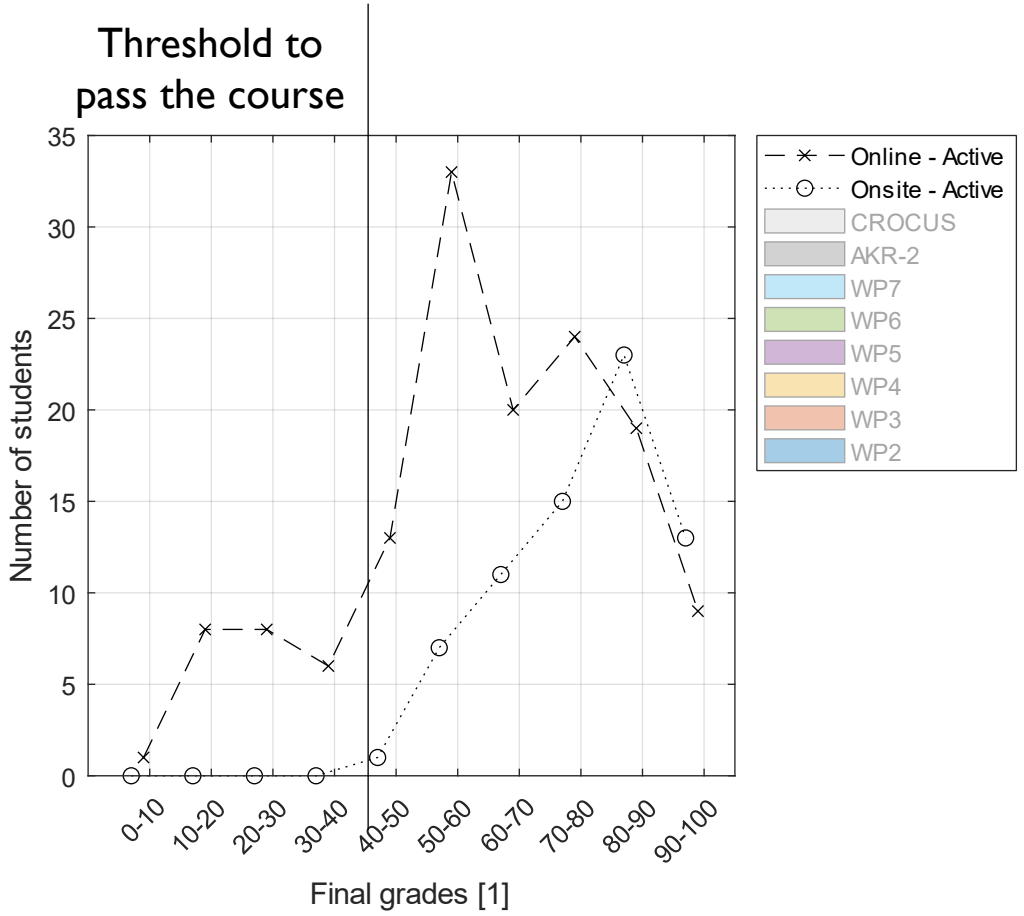
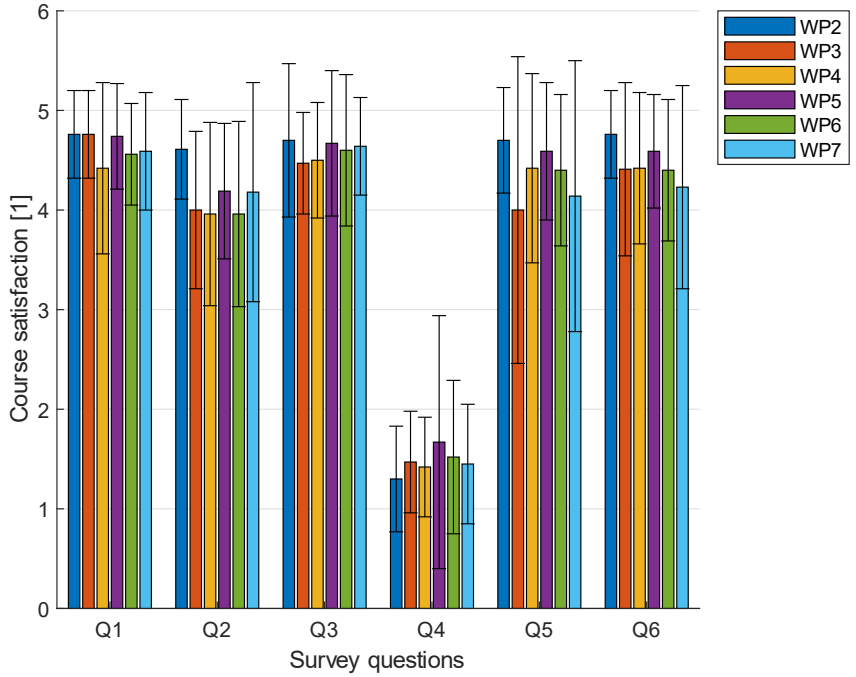


ANALYSIS OF THE FIRST EDITION

- **Participants' own perception** of the course:



Q1: I benefited from this course.
Q2: This course met my expectations.
Q3: I experienced and learned new things in this course.
Q4: The content covered in this course was NOT interesting.
Q5: I would like to take more courses like this one.
Q6: I would recommend this course to others.

ANALYSIS OF THE FIRST EDITION (courtesy: C. Stöhr)

- Thematic analysis of "things" participants liked (N=27):

1. Practical Exercises / Tools / Codes / Software (16)
2. Course Materials / Handbooks / Slides / Sources (11)
3. Well-explained Topics / Quality of Teachers (9)
4. Organization / Course Structure / Preparation (9)
5. Networking / Interactions with Students and Professionals (6)
6. Inclusive Atmosphere / Support from Teachers and Students (5)
7. Flipped Classroom / Teaching Methods (3)
8. Flexibility / Pace / Online Learning (2)
9. Real-world Applications / Industry Relevance (2)
10. Multidisciplinary / Diverse Backgrounds (2)

ANALYSIS OF THE FIRST EDITION (courtesy: C. Stöhr)

- Thematic analysis of "things" participants did not like (N=27):

1. Time Constraints and Pace (17 items)
2. Content and Instruction (13 items)
3. Technical Issues and Software (11 items)
4. Course Structure and Topics (6 items)
5. Workload and Assignments (5 items)
6. Course Format and Recommendations (4 items)
7. Instructor-related Issues (3 items)

CONCLUSIONS

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- Success rate of the participants granted access to the LMS:
  - 55.3% (for academic year 22/23)
  - 58.5 % (for academic year 23/24)
- Success rate of the participants qualified for the synchronous sessions:
  - 75.6% (for academic year 22/23)
  - 83.1% (for academic year 23/24)
- **Success rate of the participants taking at least one activity during the synchronous sessions:**
  - 91.5% (for academic year 22/23) – 100% for the onsite participants and 87.0% for the online participants
  - 94.6% (for academic year 23/24) – 100% for the onsite participants and 91.3% for the online participants

CONCLUSIONS

- **Very good outcomes** in terms of **participation, engagement** and **completion**
- **Significant differences** between **onsite** and **online** participants

➢ **"Strategic" learning** for the **online** participants?

➢ **High workload** to be combined with **other duties**?

➢ Personal note: most rewarding work on my career!

Youssef Badr • 1st

Senior Nuclear and Radiation Engineering student at Alexandria...

1d •

I don't usually like posting course completion certificates, but this time in particular I feel like I have to. When I signed up for this course months ago I thought it's going to be a surface level introduction course, not because of the advertisement of the course, but rather because of the restrained time period of "5 days".

Not only was I proven wrong, this course ended up being one of the most challenging academic materials I had to face in quite sometime. I was absolutely blown away by the materials, and honestly a little taken aback by the resources and the exercises (Brush up on your Matlab skills, trust me). Some of them I still have to locate the time to try again later.

I am writing this to thank Prof. Demaziere, Prof. Sandra Dulla, Prof. Máté, and the amazing community of professional and graduate students I got exposed to and introduced to. It's amazing what GREAT-PIONEER is doing for Nuclear Education. I was very grateful for this opportunity, and will definitely be trying to take more Great-Pioneer courses in the future, and would recommend them to all my colleagues.

OUTLOOK

OUTLOOK

- Project **ending** formally at the end of **October 2024**
- Willingness from all academic partners offering the courses to **continue** offering the courses **every second year**
- Many requests/questions already received about when the courses will be re-offered
- Desire from all partners to have the courses **as cheap as possible** (or with a very little course fee) in the future to educate/train nuclear emerging countries

OUTLOOK

- **Application sent to SSM to cover some of those costs** (for 4 years, possibly to be extended by 4 years)

➢ **Application granted** on June 28 and covering costs for LMS, necessary software, webpage (updates and maintenance), communication activities and salary costs for Chalmers

➢ **Committed to re-offer the GRE@T-PIONEeR courses** in the academic years 2025/2026 and 2027/2028

Thank you!

Contact details:

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