WP2: Update on training activities

Ygor Aguiar (CERN)

RADNEXT 2nd Annual Meeting – 9-10 May 2023
https://indico.cern.ch/e/radnext-2023

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101008126

Introduction

- Besides communication, dissemination and exploitation, WP2 also has a focus on training activities in the radiation effects domain with the main goals to :
  - → educate people on the fundamentals related to radiation effects in electronics;
  - → attract more engineers and scientists to the field.

- WP2 relies on two important training modalities:
  I. Online training activities via webinars and a dedicated Massive Online Open Course (MOOC) on radiation effects in electronics, and;
  II. In-person training opportunities via the organization of international schools and workshops.

In-person training

SERESSA, the Radiation Effects International School

*Pictures from Unsplash.

SERESSA 2022 – Geneva, Switzerland

General Chairs

- Ygor AGUIAR (CERN, Switzerland) and Raoul VELAZCO (CNRS-TIMA, France)

Program Chair

- Jaime ESTELA (Spectrum Aerospace, Germany)

Local Chair

- Rubén GARCÍA ALÍA (CERN, Switzerland)

Poster Chairs

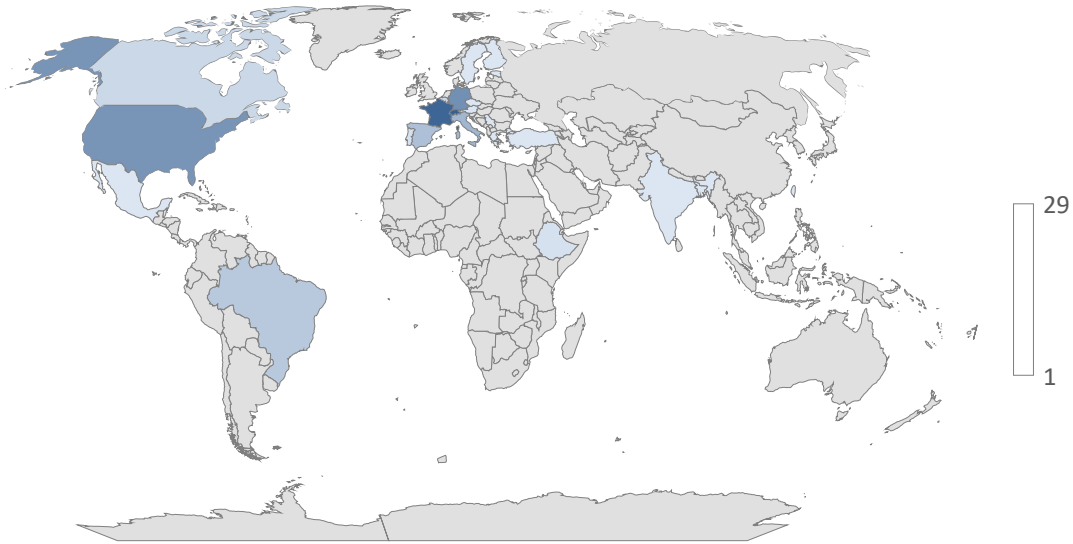
- Ygor AGUIAR (CERN, Switzerland) and Andrea CORONETTI (CERN, Switzerland)

- 24 lectures + 2 software trainings + 1 poster session
  - USA 6, France 5, Germany 5, Switzerland 4, Italy 2, The Netherlands 1, Spain 1, Canada 1 and Brazil 1.
  - Lecture material is available on Indico: https://indico.cern.ch/e/seressa2022

- Supported by the **CERN R2E project** and **RADNEXT European project**
  - Grant agreement No 101008126
  - Thanks Pablo and Sabrina for the support from PMO.

Some statistics

- Total of 152 participants
- 17% of woman
- 38% are MSc or PhD students
- 20+ countries:
  - Switzerland – 29
  - France – 28
  - Germany – 19
  - United States – 18
  - Italy – 11



Technical Program

18th International School on the Effects of Radiation on Embedded Systems for Space Applications

from **Monday, 5 December 2022 (07:30)** to **Friday, 9 December 2022 (19:00)**

Monday, 5 December 2022	Tuesday, 6 December 2022	Wednesday, 7 December 2022	Thursday, 8 December 2022	Friday, 9 December 2022
08:00 **Registration**				
08:30 **School Opening**				
09:00 **Fundamental Mechanisms of Non-Destructive SEEs in Devices and Circuits**	09:00 **Introduction to G4SEE: a toolkit for simulating radiation effects in electronics I** - David Lucsanyi (CERN)	09:00 **Introduction to G4SEE: a toolkit for simulating radiation effects in electronics II** - David Lucsanyi (CERN)	09:00 **Introduction to OMERE: a tool for space environment and radiation effects on electronics devices I**	09:00 **Introduction to OMERE: a tool for space environment and radiation effects on electronics devices II**
09:50 **Coffee Break**	09:50 **Coffee Break**	09:50 **Coffee Break**	09:50 **Coffee Break**	09:50 **Coffee Break**
10:10 **SEE effects on VLSI devices: challenges and solutions** - Luca Sterpone	10:10 **Radiation Hardness Assurance (RHA)** - Stephen Buchner (Naval Research Laboratory)	10:10 **The Value of "Test-As-You-Fly": Modernizing FPGA Experimentation And Data Analysis for Critical Space Missions** - Melanie Berg (Founder/CEO of Space R3 LLC)	10:10 **Accelerator Radiation Environment and Neutron Effects in Electronics** - Matteo Cecchetto (CERN)	10:10 **Mitigation of Soft Errors at Circuit Level** - Ricardo Reis (UFRGS)
11:00 **Sensitivity characterization of SRAM-based FPGA against SEU and SET**	11:00 **COTS in (Deep) Space** - Hans-Juergen Sedlmayr (DLR)	11:10 **Radiation Hardening by Software: Advanced FDIR and Redundancy Concepts with COTS in Space**	11:00 **Introduction to 'Radiation to Materials': methodologies and examples** - Matteo Ferrari	11:00 **CELESTA project**
12:00 **Lunch break**	12:00 **Lunch break**	12:00 **Lunch break**	12:00 **Lunch break**	12:00 **Lunch break**
13:30 **TID Mechanisms in Nanometer-Scale Microelectronic Technologies** - Stefano Bonaldo (University of Padova)	13:30 **Radiation Mitigation Techniques for Mixed-Signal Circuits** - Daniel Loveless (University of Tennessee Chattanooga)	13:30 **System-Level Design and Radiation Test Methodologies based on a novel Software-Defined Radio Architectu…**	13:30 **Analyzing data extracted from radiation tests in advanced SRAMs**	13:30 **Exam**
14:20 **Modeling Cumulative Radiation Effects in Semiconductor Devices and Integrated Circuits** - Hugh Barnaby (ASU)	14:20 **The RADNEXT irradiation facility network** - Andrea Coronetti (CERN - University of Montpellier (FR))	14:20 **The Phoenix GPS Receiver for Rocket and Satellite Applications: An Example for the Successful Utilization…**	14:20 **Accurate Abstraction and High Level Modeling and Validation of SEE in Electronic Systems**	14:10 **School Closure**
15:10 **Coffee Break**	15:10 **Coffee Break**	15:10 **Coffee Break**	15:10 **Coffee Break**	14:40 **Visits to CERN installations**
15:30 **Error rate prediction for programmable circuits: methodology, tools and studied cases**	15:30 **The challenges of testing COTs devices at European Irradiation Facilities**	15:30 **Single-Event Effect Criticality Analysis** - Anthony Sanders Jonathan Allen Pellish	15:30 **Poster Session**	
16:20 **Modelling and prediction of Single Event Transient and Single Event Upset** - Frédéric Wrobel	16:20 **Fundamentals of the Pulsed-Laser Technique for Single-Event Effects Testing**			
		19:00 **Social Dinner**		

SERESSA 2022

Andrea Coronetti presenting RADNEXT during SERESSA.

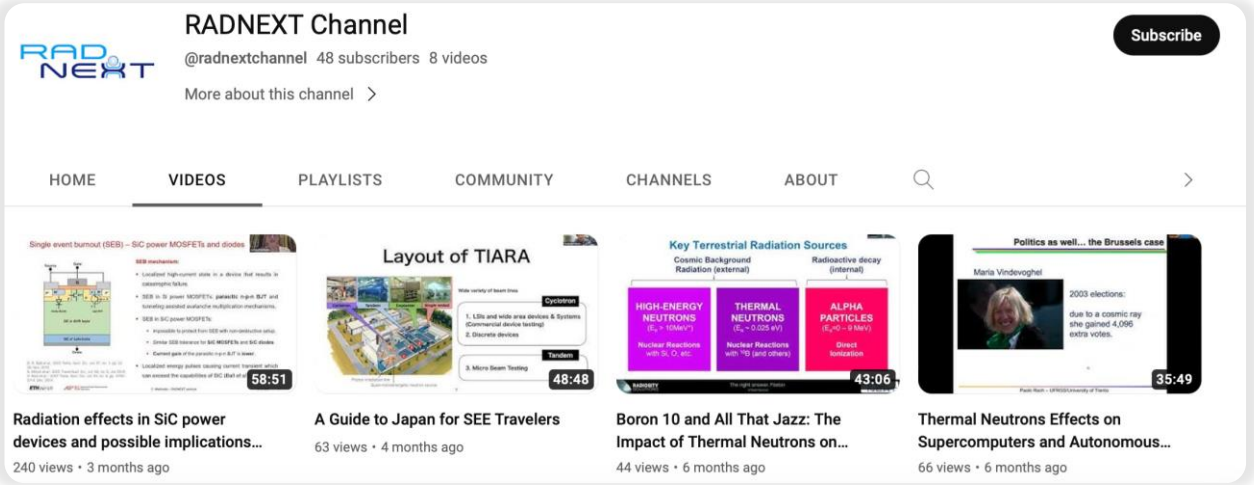
On-line training

From webinars to a dedicated MOOC

RADNEXT Webinar Series

- Webinar series **on present and future irradiation facilties around the world**:
  - 7 webinars were organized with an average attendance of 70 participants
  - Recorded videos available on RADNEXT YouTube Channel
  - More information in Ennio's talk and soon to be released in the Deliverable Report D2.3
  - Stay tuned via our RADNEXT page on LinkedIn for the upcoming webinars.

Subscribe to our channel!



MOOC: **RadiationX**

Radiation Effects in Electronics: from accelerators to space

What is a MOOC?

Massive **O**pen **O**nline **C**ourse

Thousands of students

For anyone and free of charge!

Web-based course using online platforms such **EdX**, **Coursera**, …

RADNEXT MOOC

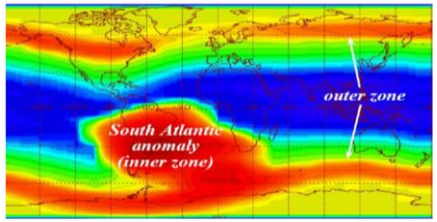
Radiation Effects in Electronics: from Accelerators to Space

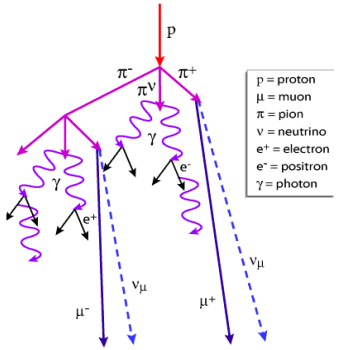
- Very first MOOC on the topic
- Duration: 5 weeks (*self-paced*), 5-7 hours per week
- Target audience: undergraduate and graduate students in Physics or Engineering
- Expected launch date: 03/2024

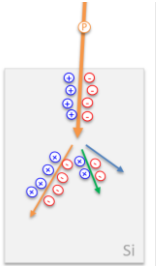
- Support from MOOC design team of the **KU Leuven Learning Lab**
  - Multimedia and design support
  - 30+ MOOCs developed or in development
  - 190+ countries reached
  - More than 300k enrolments
  - Average of **1000 participants per run**

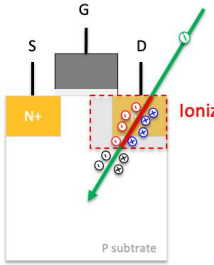
Preliminary proposed program

- Module 1: **Radiation Environment**
  - Space radiation
  - Atmospheric radiation
  - Artificial radiation environment (particle accelerators...)
- Module 2: **Particle Interaction**
  - Ionization (Direct and Indirect)
  - Displacement
  - Modelling codes I
- Module 3: **Radiation effects on electronics**
  - SEE
  - TID and DD
  - Modelling codes II
- Module 4: **Mitigation techniques**
  - Hardening by Process
  - Hardening by Design
- Module 5: **Testing methodologies**
  - European Standards for Space Missions
  - Guideline of best practices beyond standards



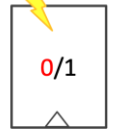


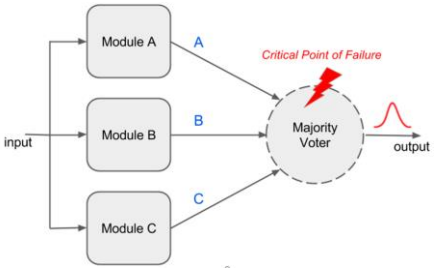


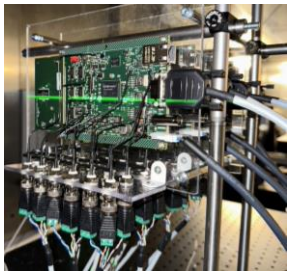


Ionization track path

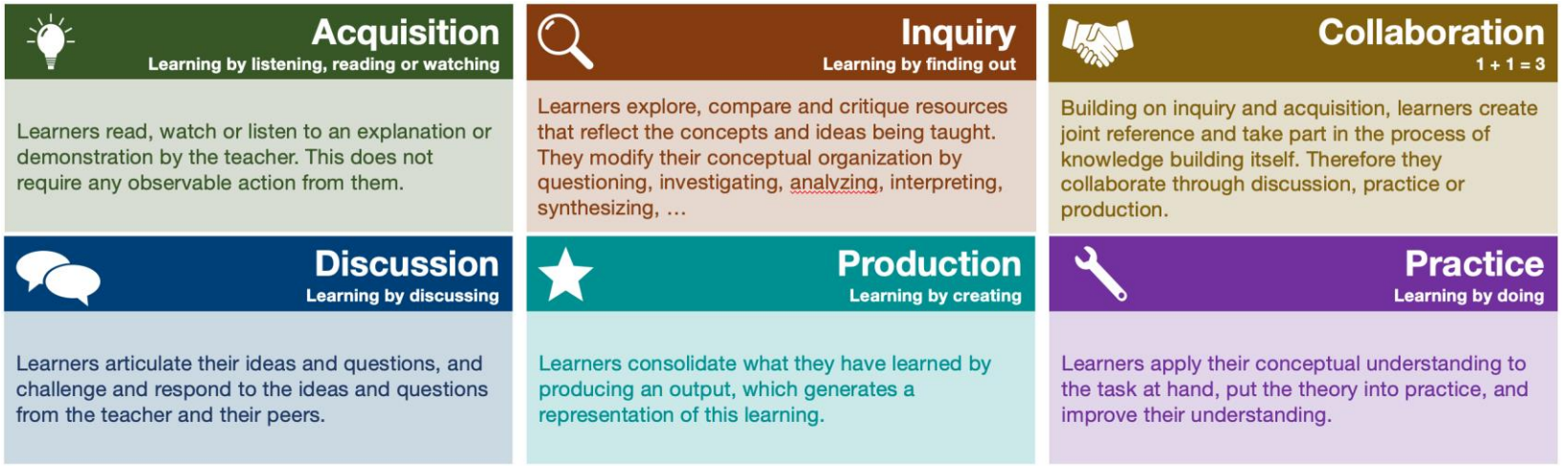
Single-Event Upset (SEU)







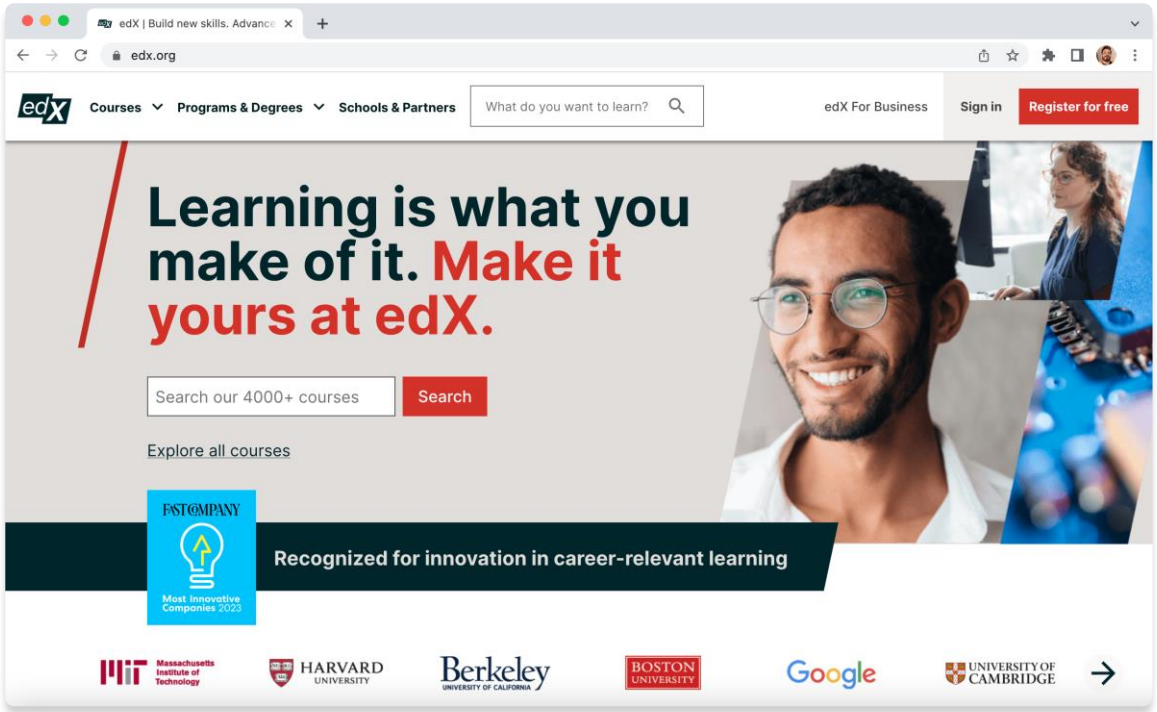
Learning activities



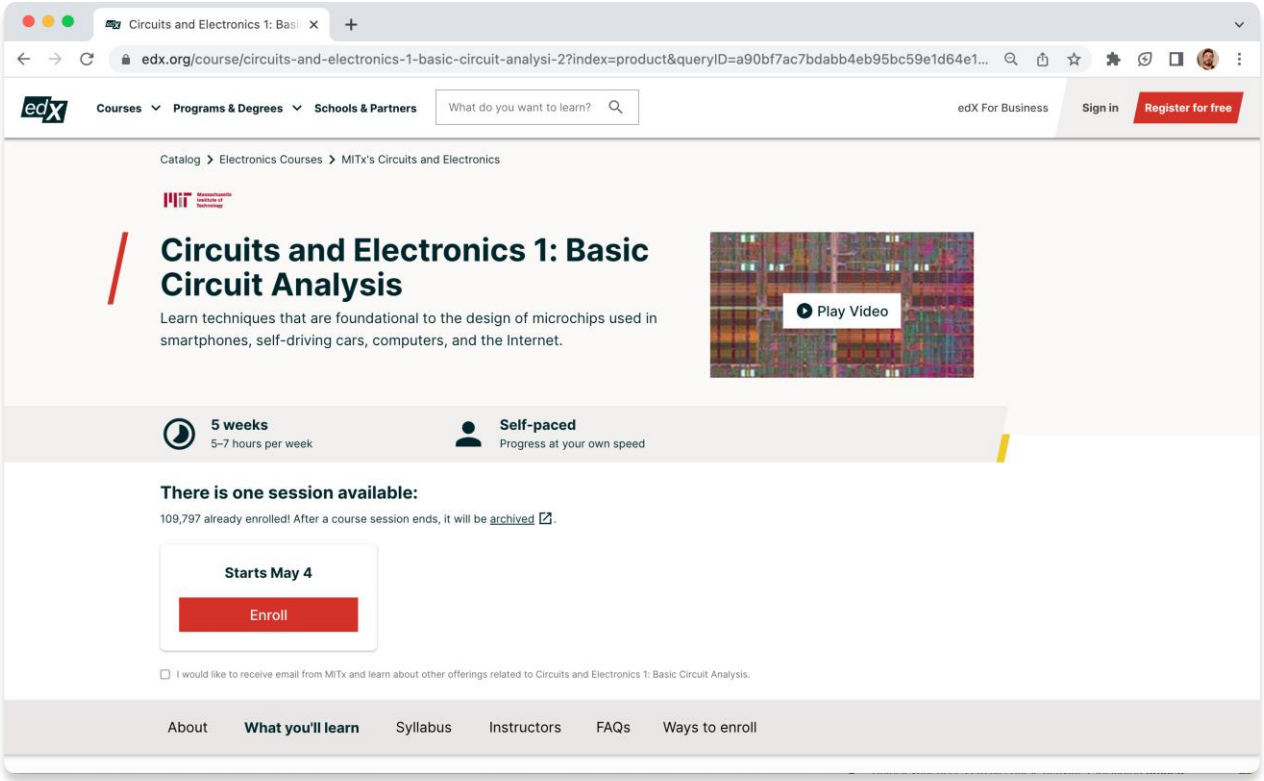
KU LEUVEN LEARNING LAB

EdX platform

- Launched in 2012 by **Harvard** and **MIT**
- Several universities with proven reputation (MIT, Harvard, Berkeley, …)
- 4000+ courses and more than 110 million enrolments to this date
- Two training modalities:
  - Audit track (*Free*)
  - Verified track (*Paid*)



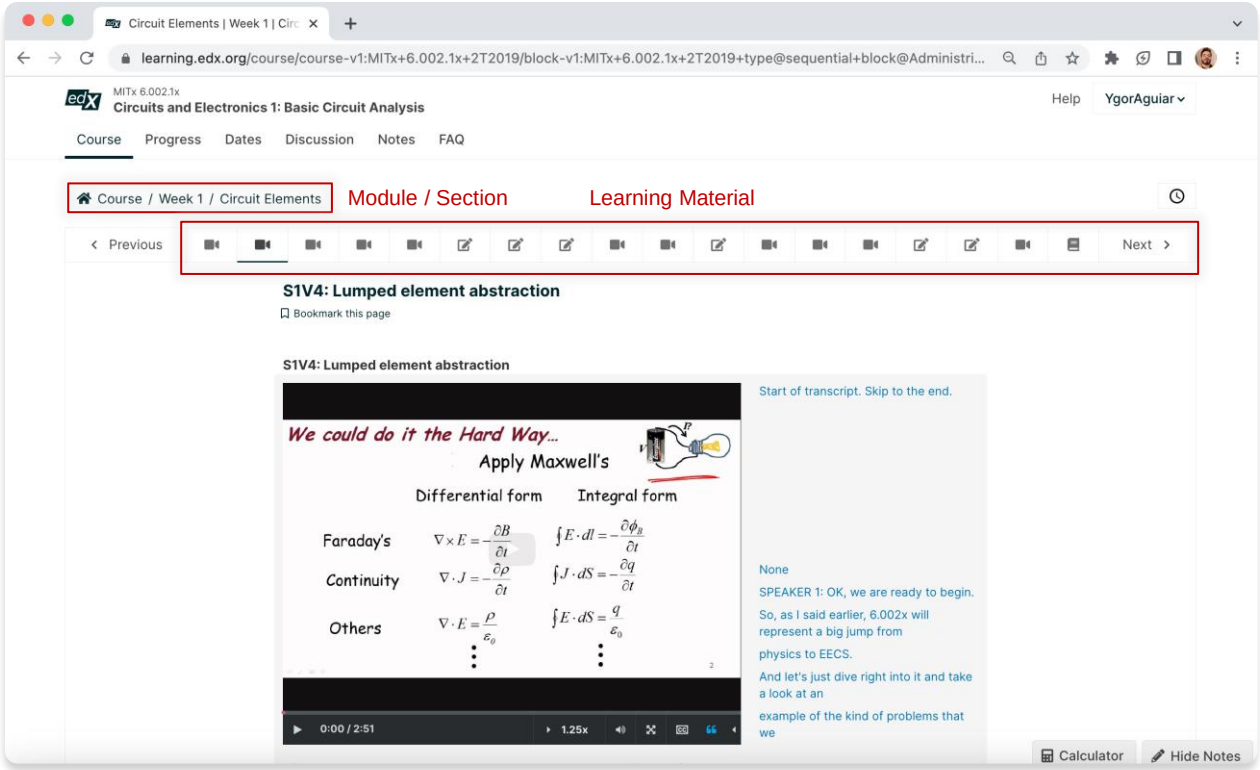
MOOC Example



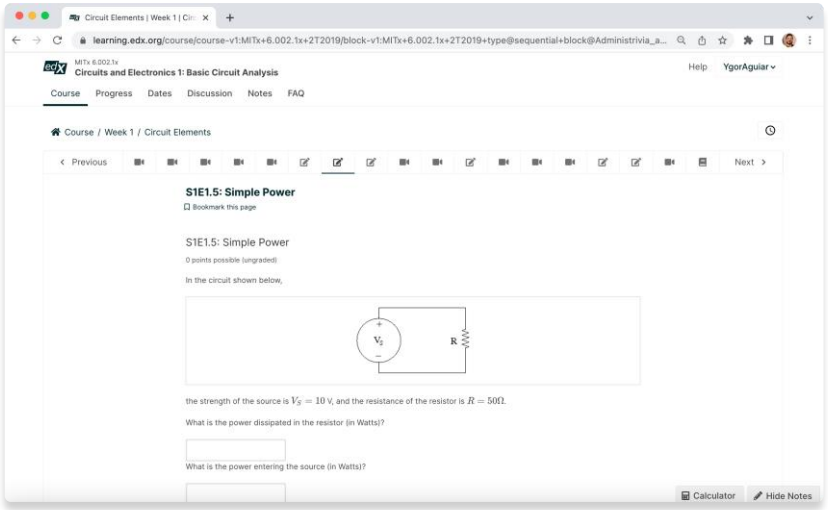
Learning material

Several types of content:

- **Video lectures**
  - Screencast and talking head
  - Short videos up to 7min max
- **Interactive quizzes**
  - Multi-select, drag and drop, word cloud, text input…
- **Discussion forums**

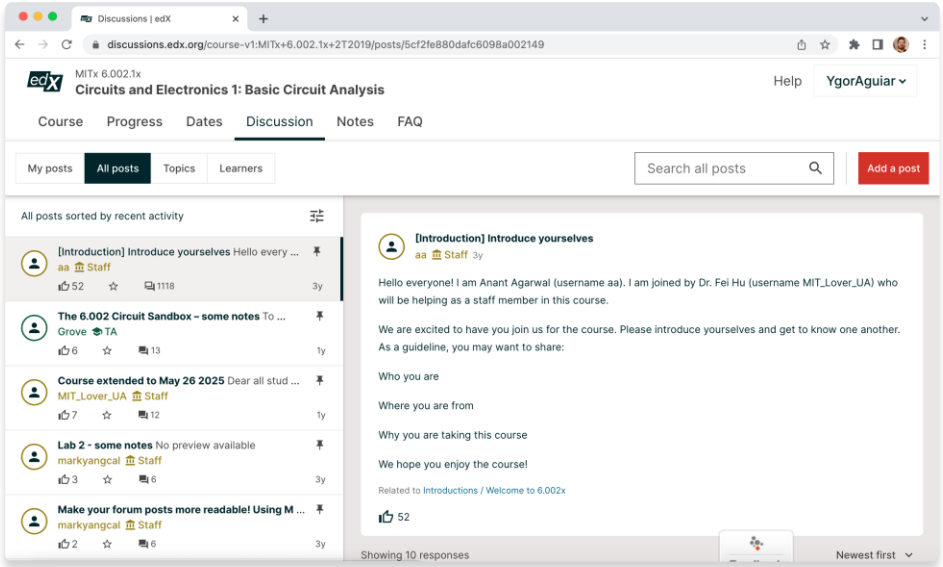


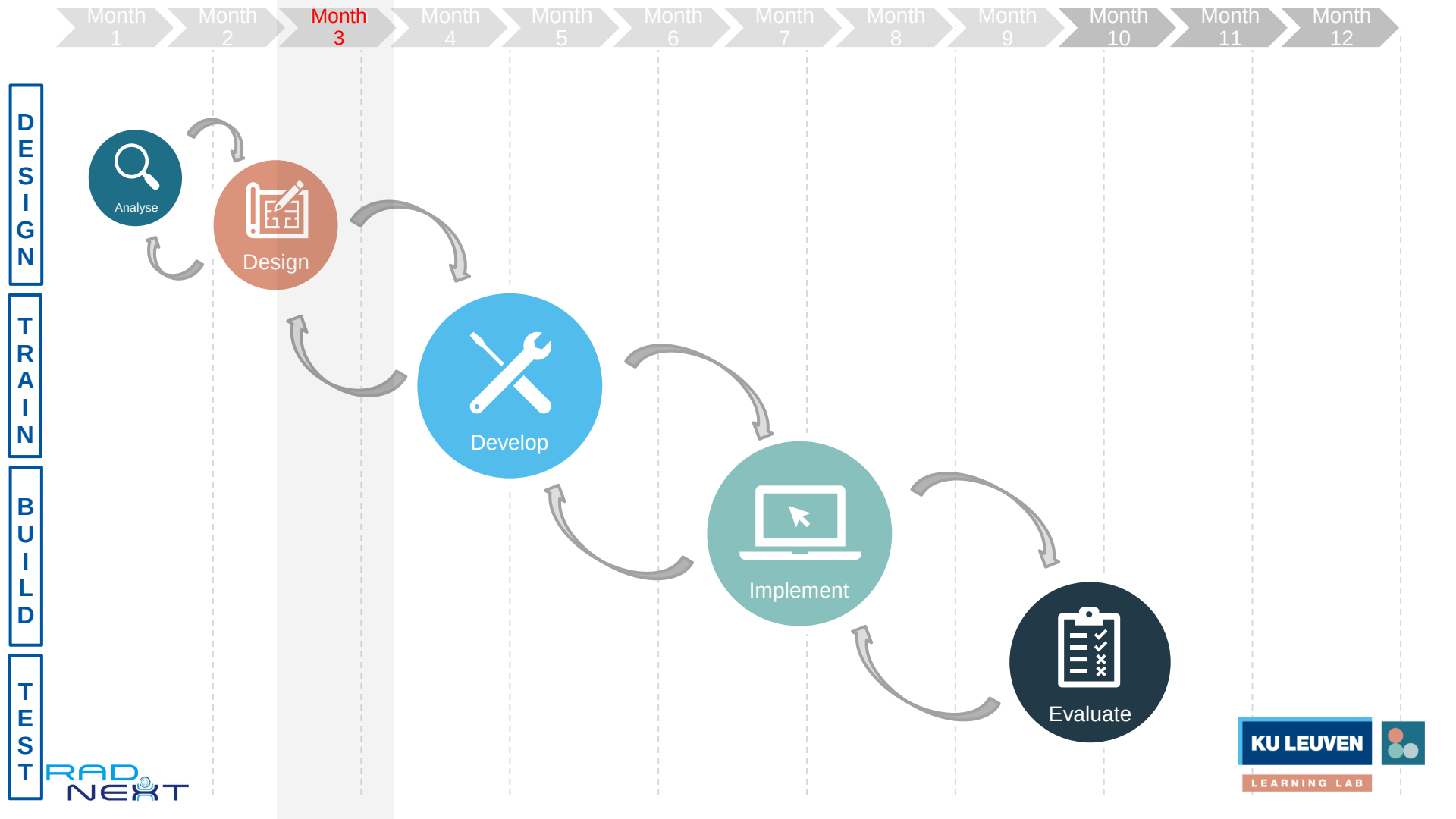
Learning material



Quiz

Discussion Forum




Month 1
Month 2
Month 3
Month 4
Month 5
Month 6
Month 7
Month 8
Month 9
Month 10
Month 11
Month 12
DESIGN
TRAIN
BUILD
TEST
Analyse
Design
Develop
Implement
Evaluate
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LEARNING LAB

Conclusion

- Training opportunities have been organized for on-line and in-person participation.
- An international school on radiation effects was organized at CERN with more than 150 participants from more than 20 countries.
- Webinar series exploring present and future facilities around the world has been proposed, recorded and uploaded on RADNEXT Youtube channel.
- A Massive Open Online Course (MOOC) is under development for the EdX platform with the support of KU Leuven team.

Thanks for your attention!

RADNEXT, Sevilla, España