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# MOOC – Massive Open Online Courses: how to develop a MOOC for engineering courses

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# The Context


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# The Context

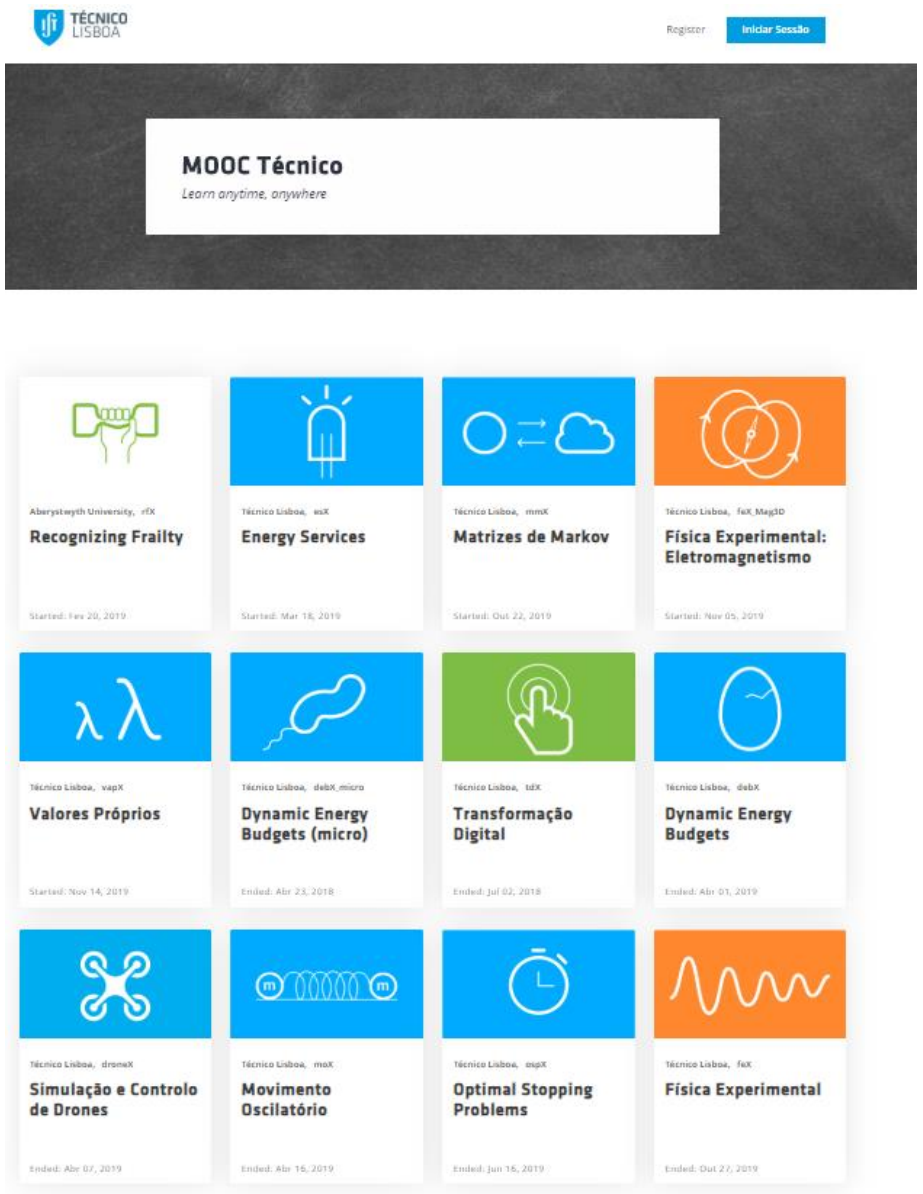
- Strong MOOC increase on a global scale, particularly from the most prestigious universities (MIT, Stanford University, etc...).
- As a national and international reference engineering school, TÉCNICO wants to be present in the area...



"In the first year, three courses of MOOC Técnico were developed: Markov Matrices (mmX), Experimental Physics (feX) and Energy Services (esX)."

https://courses.mooc.tecnico.ulisboa.pt/

courses.mooc.tecnico.ulisboa.pt



# The Problem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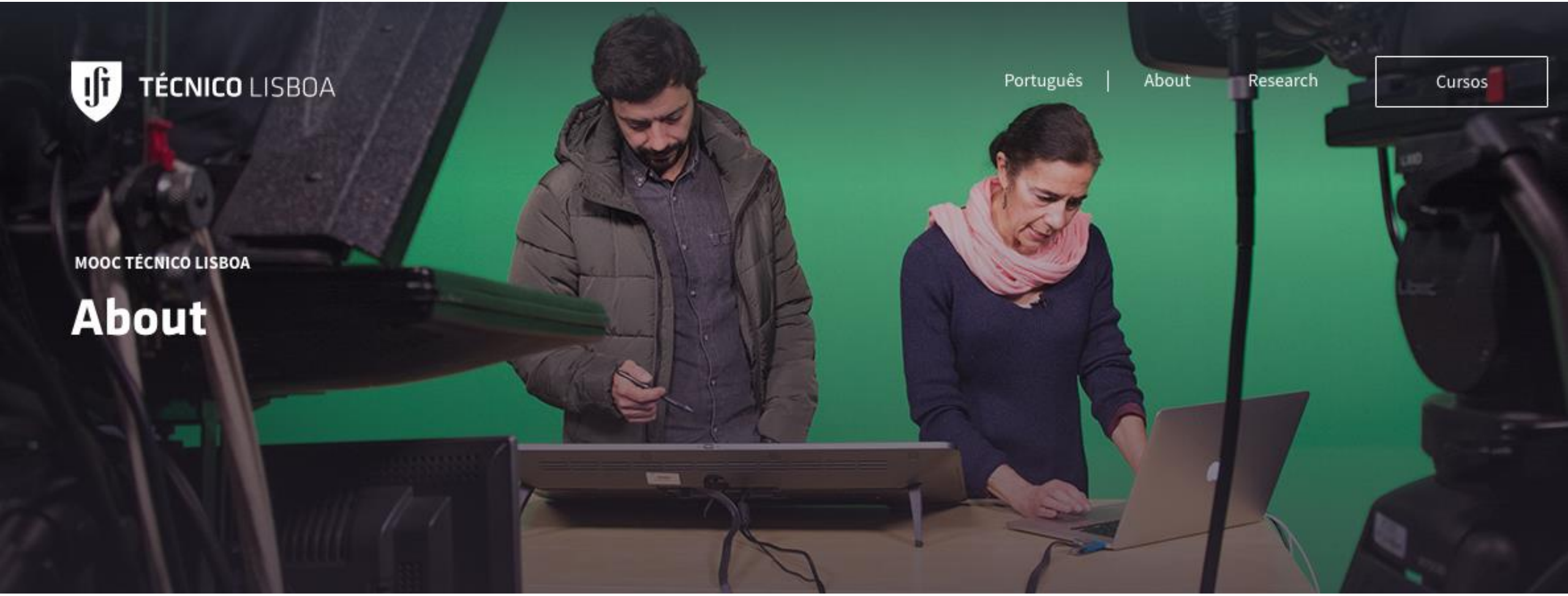
# The Problem

**MOOCs entail several challenges for institutions and educators**

- What new challenges could represent the creation of MOOC courses?
- How to take advantage of the teaching experience (lectures) for this new way of teaching and learning?
- How to help these teachers develop courses taking advantage of the pedagogical potential of MOOC?

"The design and production represented a completely different kind of scientific-pedagogical trial than the one experienced by teachers, when they develop a curriculum for a given standard course, or a rehearsal for presencial classes, or even when they prepare different sorts of course materials."

# The Opportunity



# The Opportunity

Project financing (2014) - *Video Design for MOOC: challenges in the design and production of basic science materials*

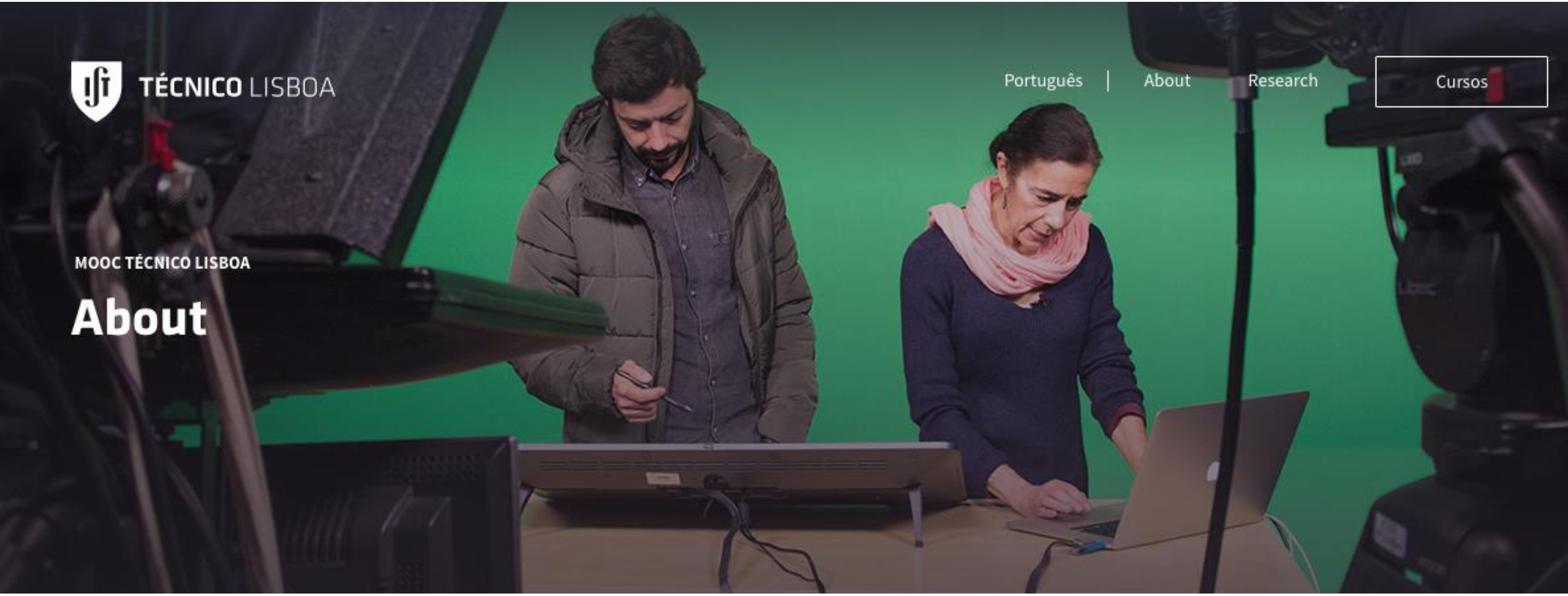
TÉCNICO LISBOA + U LISBOA | UNIVERSIDADE DE LISBOA ie Instituto de Educação

Scientific competence in the STEM areas

Technical competence in the production areas (multimedia, video, etc.)

Scientific competence in the pedagogical areas

# The Rationale



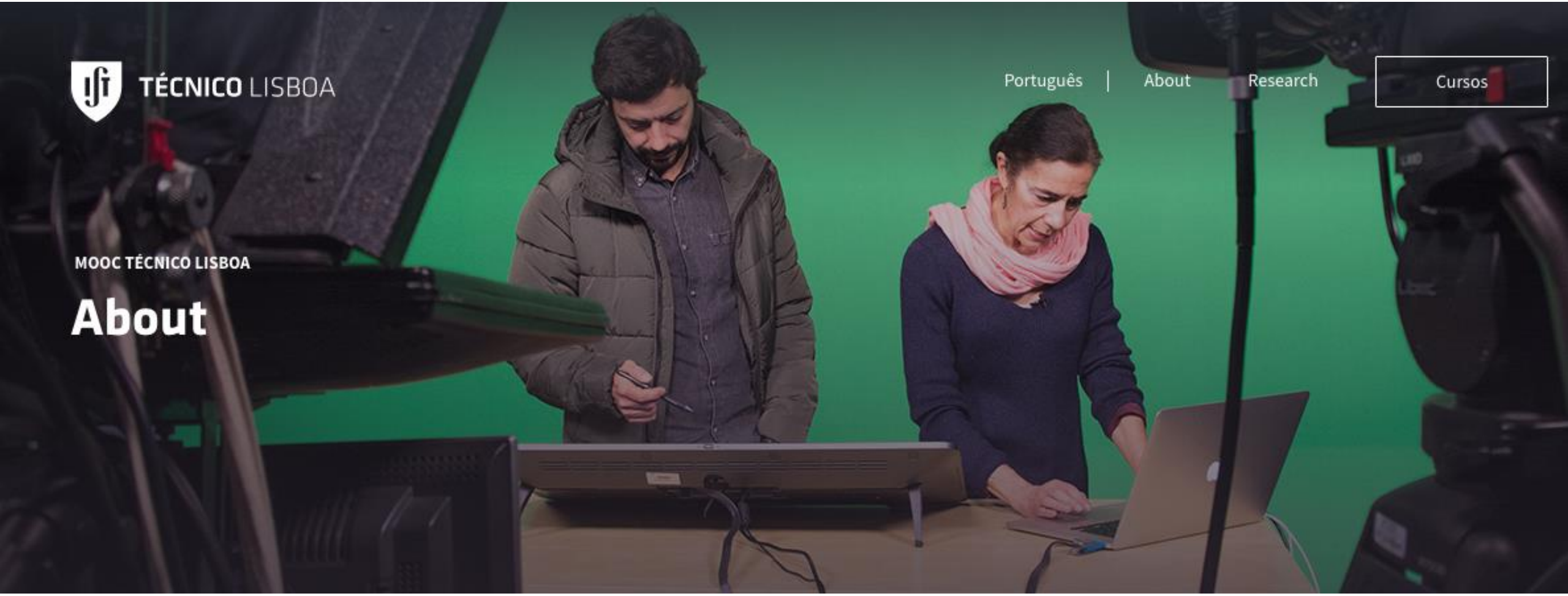
# The Rationale

*MOOC courses are very demanding compared to traditional courses and therefore efforts should be made at design time to plan them properly*

- MOOC are a disruptive alternative to traditional education (McAuley et al. 2010)
- New teaching methods (Kop et al. 2011, Sharples et al. 2013)
- Assessment methodologies for large groups of students (Sandeen 2013)
- Potential of online technologies to do things differently (Costa et al. 2012)
- The importance of image, multimedia, video, etc. (Mayer 2009)

**Bet on curriculum design principles**

# The Guidelines for teachers



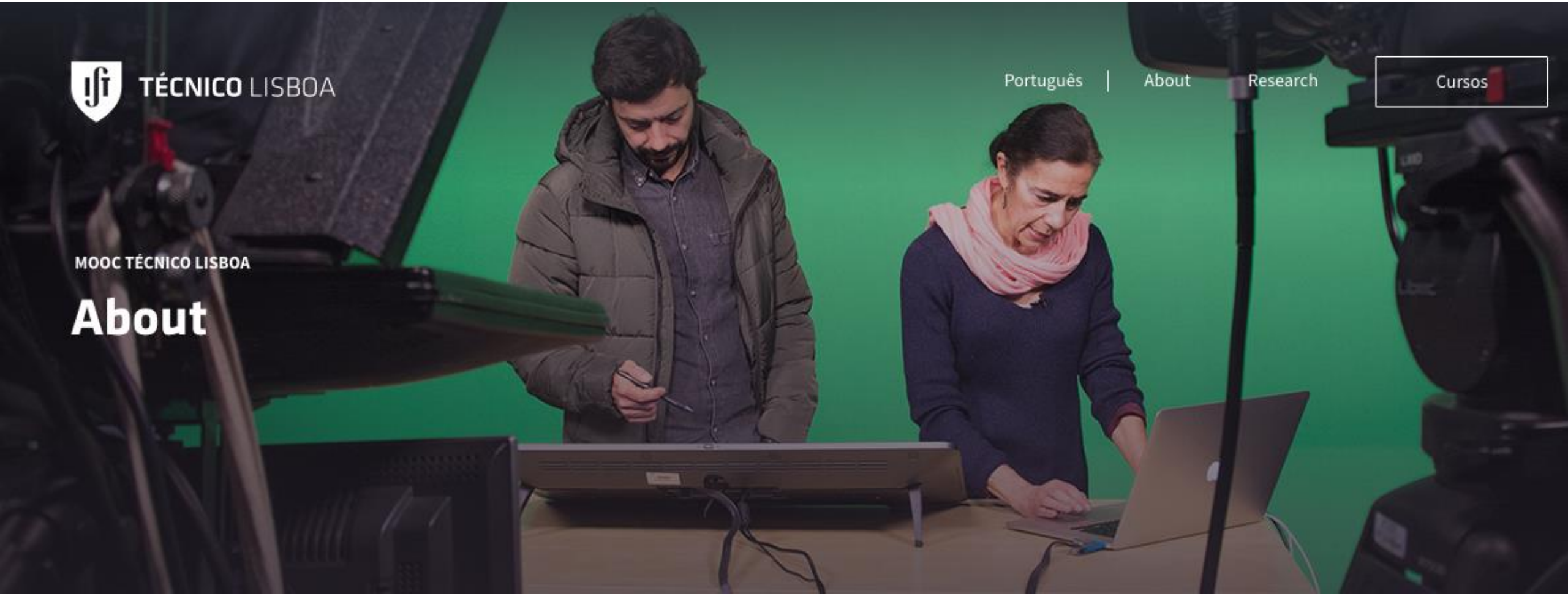
# The Guidelines for teachers

**Bet on curriculum design principles**

## The learning journey:

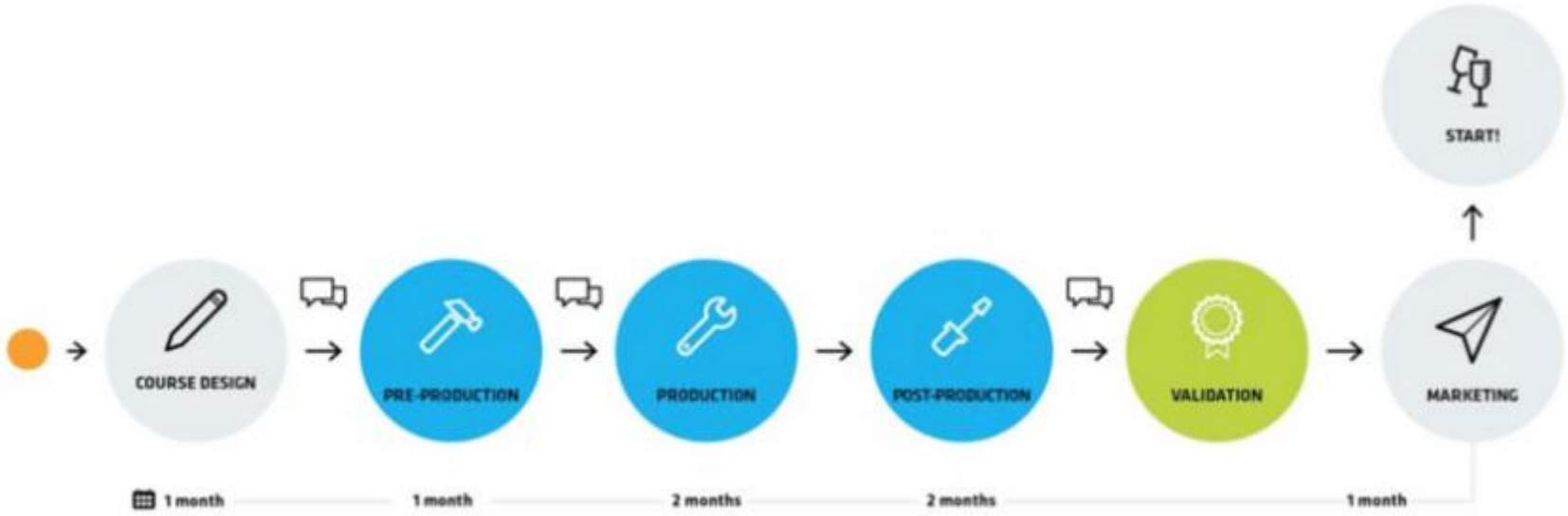
- To define what (SKA) participants must acquire during the course...
- To define how and when to assess those acquisitions (formative and summative activities, time for feedbak, etc.)...
- To create original video lectures explaining the concepts easily and clearly...
- To use additional materials that learners can follow easily to complement teachers' speech and study offline...
- To stimulate and moderate the individual participation of students...
- To promove colaborative work...

# The Course production



# The Course production

- The development of the courses, its technical and pedagogical preparation, and its content production and the multimedia educational resources are assured by the **multidisciplinary team** of the Multimedia and e-Learning Center (NME) of the Computer and Network Services (DSI) of Técnico Lisboa.

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# The first course


https://courses.mooc.tecnico.ulisboa.pt/courses/course-v1:IST+mmX+2017/about

# The first course (Markov Matrices)

*In practice, for the design of the first course, the instructor/teacher made the following choices:*

- Preparation of each planned video, as a learning content unit in different formats (introductory, theoretical/expository, tutorial/demonstrations, etc.) and with the help of graphics to frame and illustrate the main concepts;
- Preparation of a storyboard for each video recording, which included the alternating sequence of moments of expository talking, moments of interaction with previous prepared slides displayed in the (Wacom) tablet, moments of screencast using numerical spreadsheets and also interactive demonstrations;
- Integration and linkage to formative and summative assessment quizzes, which allow better self-assessment and evaluation of learning results by the participants and foster deep learning;
- Integration and linkage to numerical and computational applications, easily downloadable, that can be useful for answer practice questions (self-assessment) and solve problems of assessment quizzes;
- Integration of units of discussion forums planned to be moderated in each subtopic, after each learning content unit: video, practice question and demos.

# From the classroom to the MOOC

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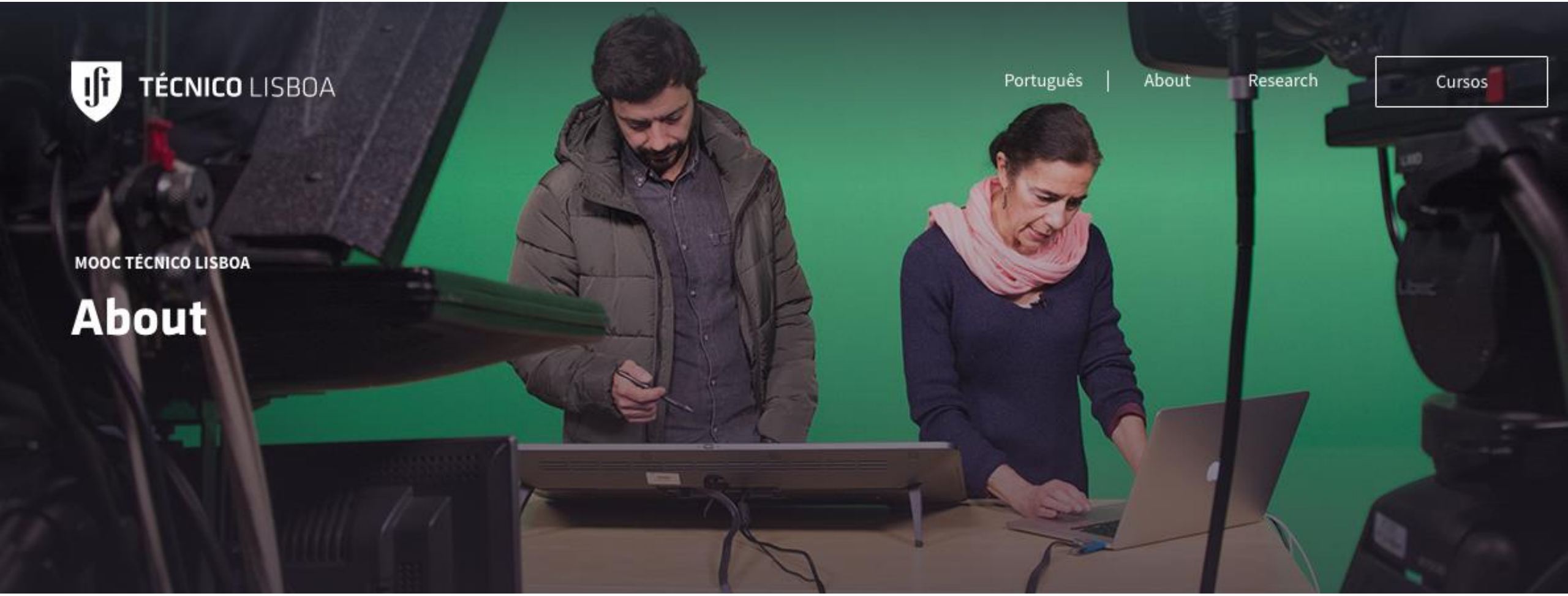
# Classrooms vs. MOOCs



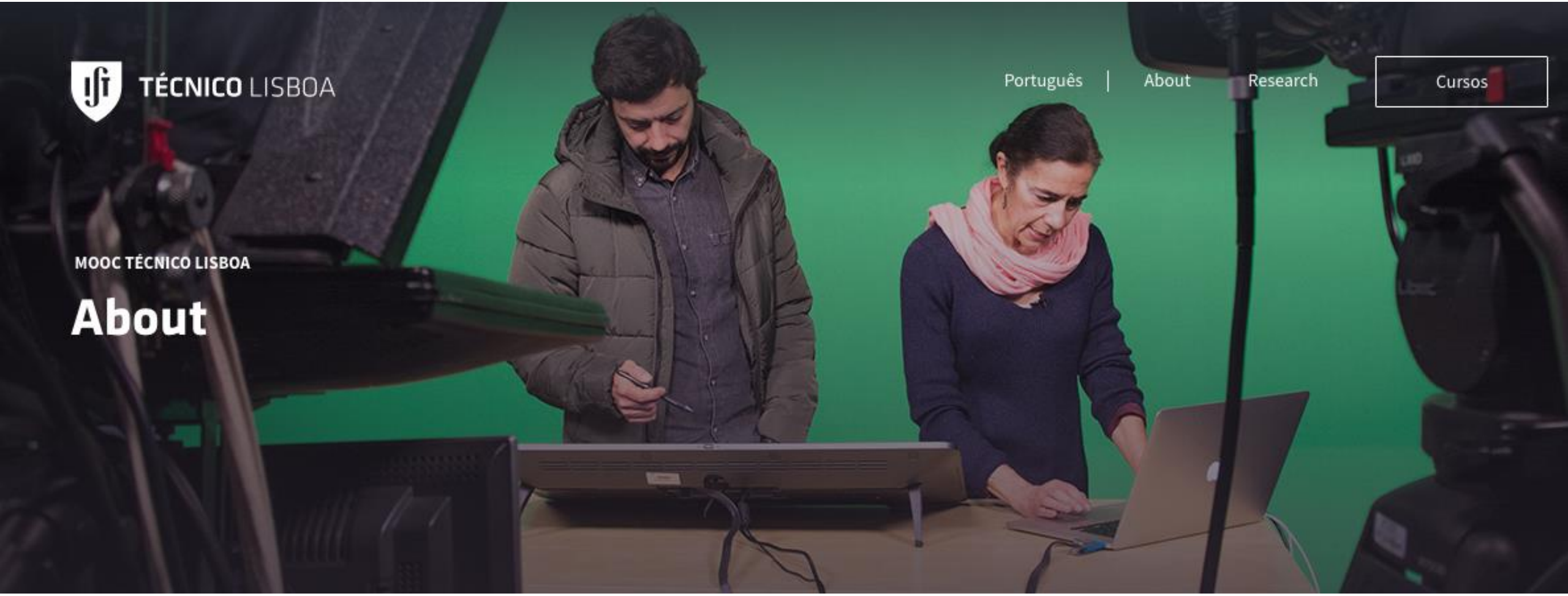
# Classrooms

- Traditional engineering School teaching methodology
    - 20 to 30 slides per hour of class that covers several topics
    - Supporting texts (books, lecture notes)
    - Exercises that aggregate several concepts from classes and require several intermediate calculations

# MOOCs constraints

- Short videos between 2 to 7 minutes
    - One video per topic
- Exercises
    - Simple activities to support the concept described in the video

# Methodology



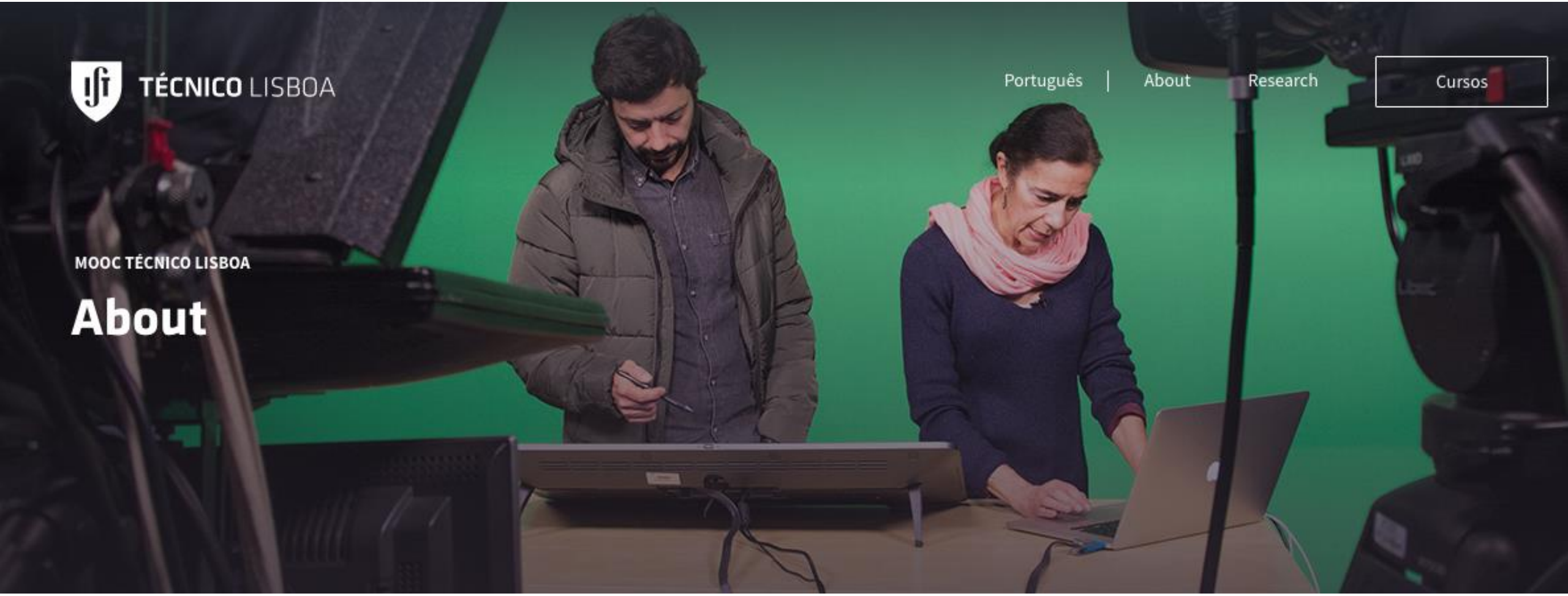
# How to go from Classroom to MOOCs?

- The original slides and exercises work!
  - *However, they need to be adapted*

# Methodology to adapt classroom material to MOOCs

- 1 – Divide the slides of one class in topics
- 2 – Divide the slide contents in more concise and direct slides
- 3 – Write a script for each slide
- 4 – In the slides with figures, make sure you find a open source or make your own
- 5 – Define one simple exercise per video

# Example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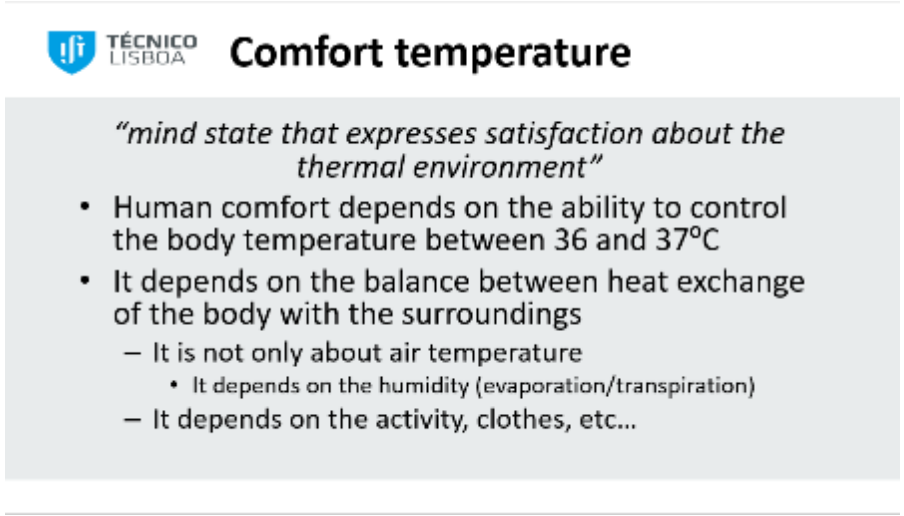
# Example of changing 1 slide to 10 seconds of video

- – Original slide



# Example of changing 1 slide to 10 seconds of video

2 – Divide the slide contents in more concise and direct slides

**Temperature regulation of the human body**

The human body needs to maintain the internal temperature between 36 and 37°C

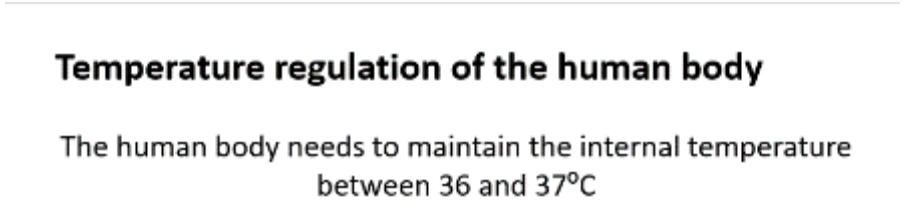
**The energy balance of the human body**

The body needs to balance the heat exchange of the body with the surroundings

# Example of changing 1 slide to 10 seconds of video

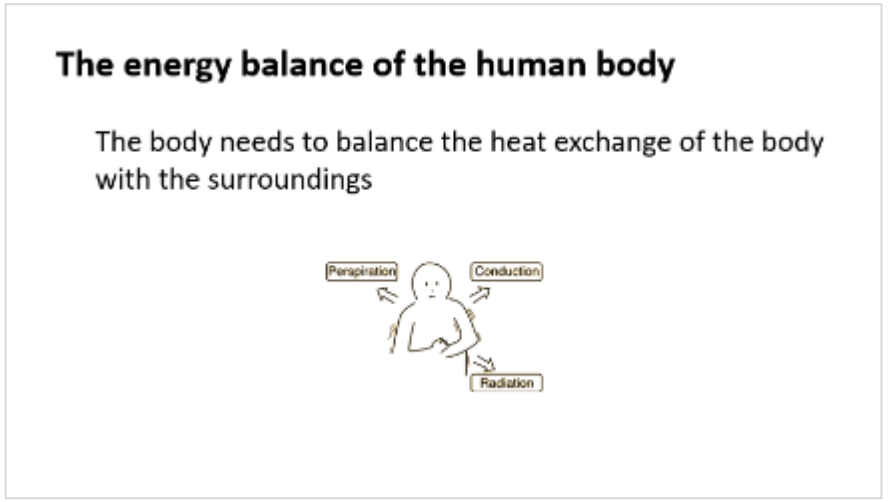
3 - Write a script for each slide

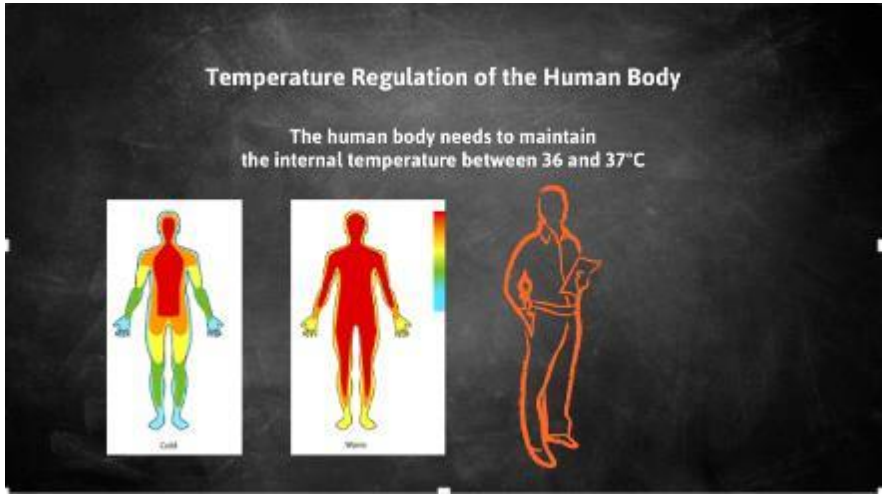
*The human body needs to maintain its temperature somewhere between 36 to 37ºC and we are able to do it reasonably well when the surrounding or ambient temperature is between 20ºC and 50ºC*



# Example of changing 1 slide to 10 seconds of video

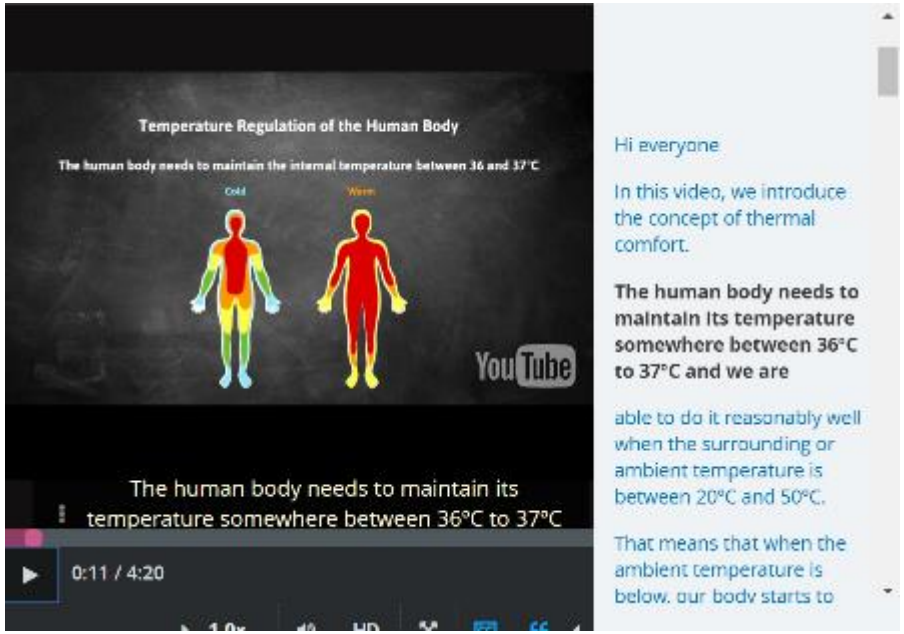
4 - In the slides with figures, make sure you find a open source or make your own



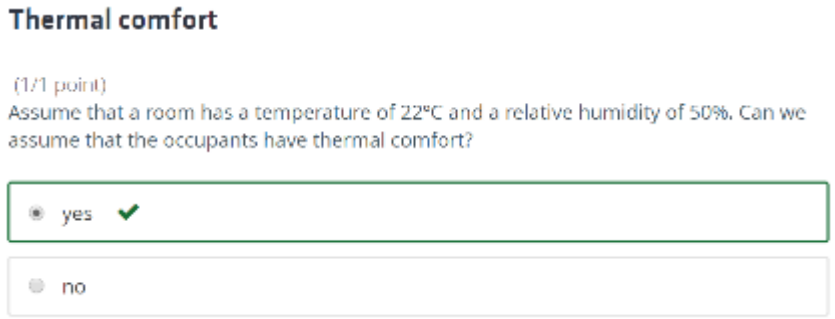
# Example of changing 1 slide to 10 seconds of video

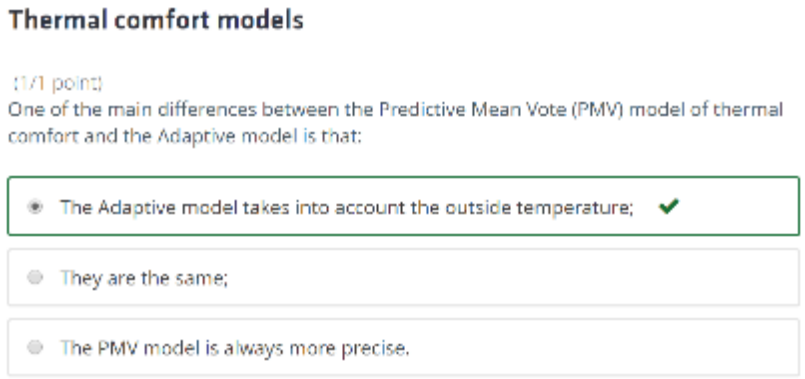
- Final result in video



# Example of changing 1 slide to 10 seconds of video

5 – Topic/video exercise



# Example of changing 1 slide to 10 seconds of video

6 – Evaluation Exercise

**Estimating the heating service of a room**

(10/10 points)
Consider an office with the following characteristics

- the dimensions are: 4 m width; 10 m length; 3 m height;

- only one wall to the external with an area of 4*3, where 25% of the area is a window. The U value of the wall is 0.5 W/m2K and the U value of the window is 1 W/m2K.

- the occupant (100W), the lights (36 W) and the laptop (100W) release an average of 200 W of heat flow.

- the outside temperature is 9°C in average during the day

- the window is facing north, so there are no solar gains

- the infiltration rate is 0.3 renovations per hour

- the temperature in the office is 20°C.

1 - How much are the losses through the envelope in W (Assume that there is heat gains and losses only through the external wall.)

82.5 ✔

2 - How much are the internal gains?

200 ✔

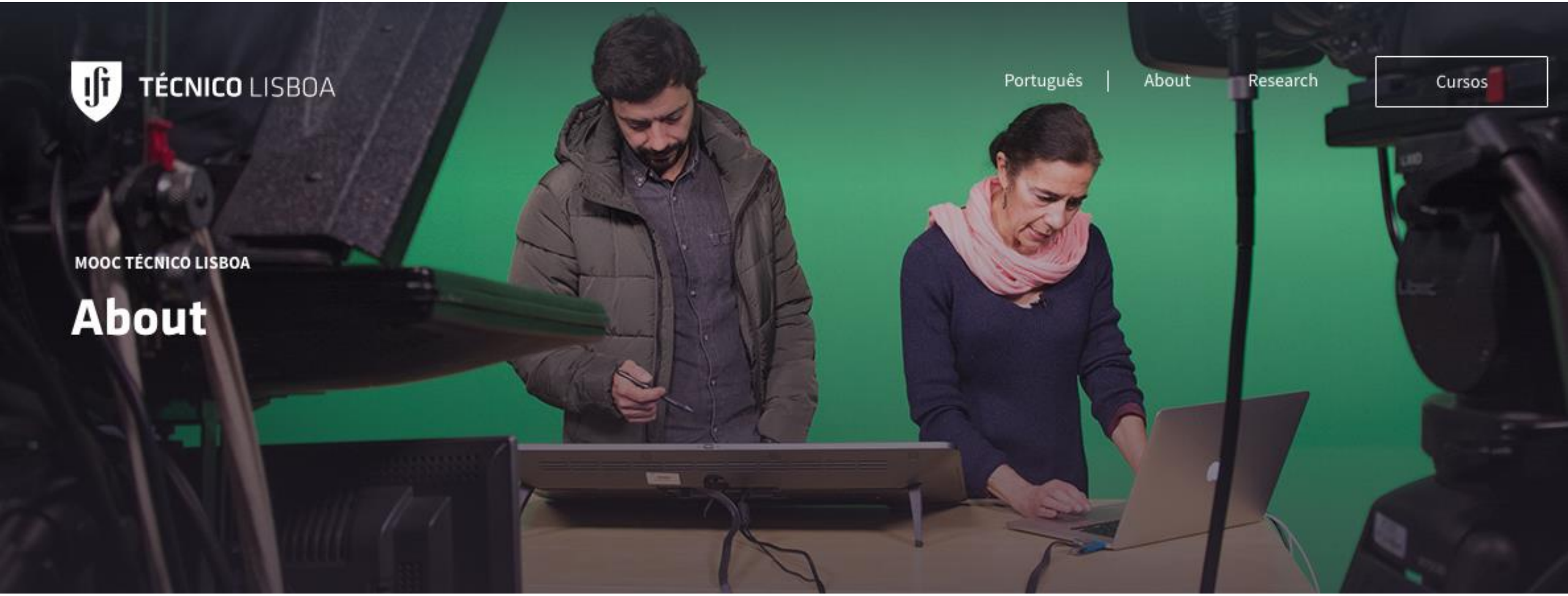
3 - How much are the solar gains?

0 ✔

How long does it take
(*Reference: Theory Class of 2 hours with 50 to 60 slides and Problems class of 2 hours with 2 to 3 exercises)*

- Divide the slides in 4 to 6 topics
  **(1 hour)**
- Divide the slide contents in more concise and direct slides
  **(2 hours)**
- Write a script for each slide
  **(4 hours)**
- Make sure you find a open source or make your own
  **(2 hours)**
- Interaction with production team to verify and improve contents
  **(8 hours)**
- Exercises
  **(3 hours)**
- Recording 4 to 6 videos
  **(4 hours)**
- Verify the contents of the 4 to 6 videos
  **(2 hours)**

# Results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# Results of esX @ MOOCS IST

506 bet-testers:

- 205 – part of a course
- 301 – alumni of IST & MOOClist

213 completed the course (certification, above 60%)

- 187 - part of the course
- 26 - alumni of IST & MOOClist
- ( 8.7% conversion rate)

# Results of esX @ MOOCS IST

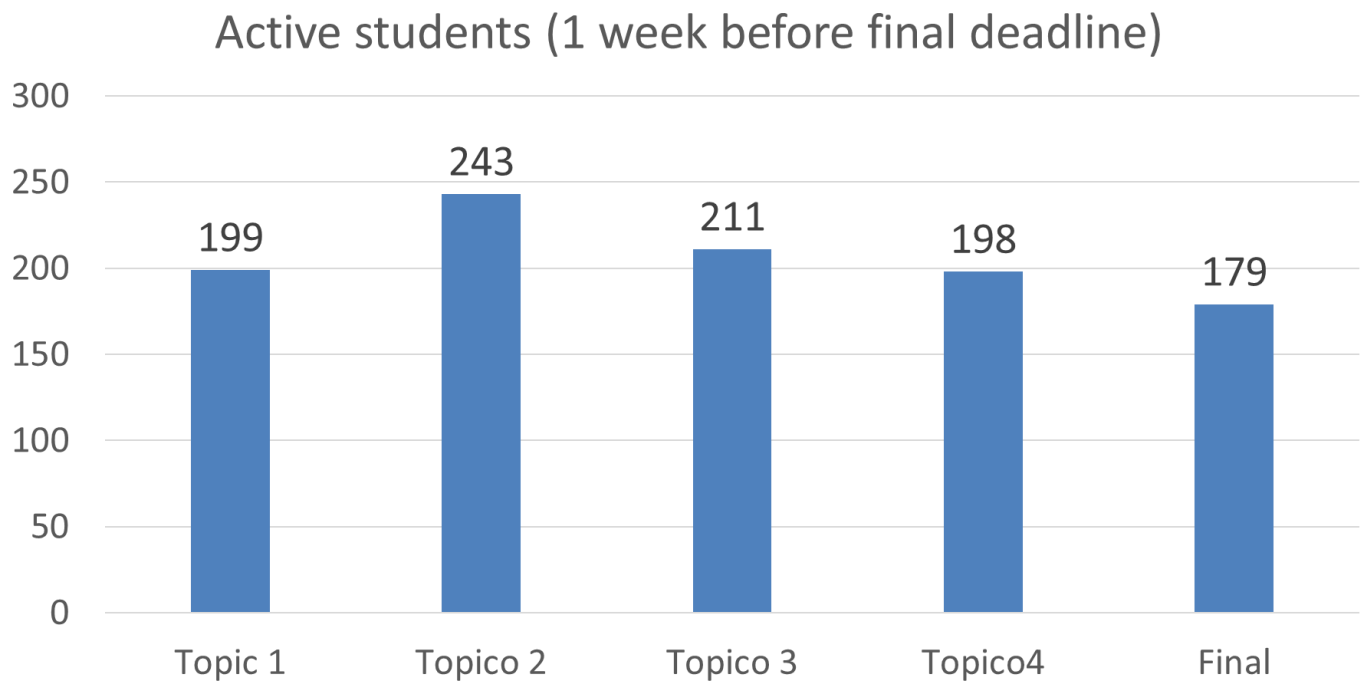
| Portugal | Spain | Portuguese speaking countries | Spanish Speaking countries | European countries | Rest of the world | Undefined |
|---|---|---|---|---|---|---|
| 79,6% | 1% | 3,7% (4 countries) | 1% (4 countries) | 4,9% | 2,7% | 1% |

| ≤18 | ≥60 | ≥30 & <60 | ≥18 & <30 | Undefined |
|---|---|---|---|---|
| 0.04% | 1.3% | 28.7% | 69.9% | 0.1% |

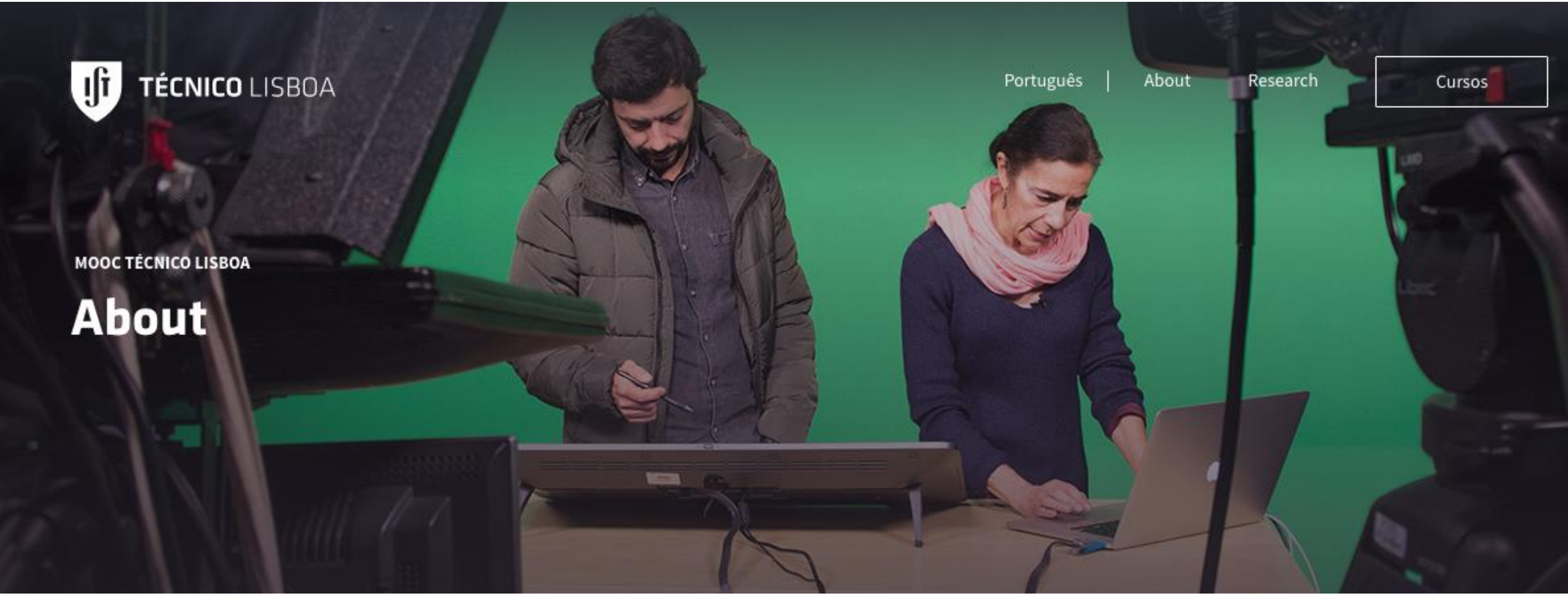
| Male | Female | Others |
|---|---|---|
| 81,9% | 17.7% | 0.2% |

| High-school | Bachelor | Master | PhD | undefined |
|---|---|---|---|---|
| 29,5% | 32% | 32% | 2.5% | 4% |

# Results of esX @ MOOCS IST



# Thank you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