

Didattica **BLENDED** per  
l'insegnamento della **matematica** in **Università**  
durante la pandemia da COVID-19

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(previously DICAM, University of Trento, Italy)



**Almath Verona Seminar**

1 Dicembre 2020

Joint work with **Saray Busto** and **Michael Dumbser**

# Context and key assumptions

- **Online** lectures **mandatory** by law (DPCM 7 of August) and guaranteed by UniTN for the entire academic year
- **Benefit of in presence lectures:**
  - **Synchronous blackboard lectures**, **gestures** and facial **expressions** of profs  
→ efficient and **highly appreciated** means of teaching
  - Teaching of mathematics: dynamic **creative process**  
→ requires the **physical presence** to **fine-tune the lecture**
  - Possibility of **interaction** between students and with the profs

**Questionnaires** on the pure online teaching phase of the spring 2020 **confirm** these hypothesis

- **Time & Budget constraints**

## Simple but efficient **technological** and **logistic concept** for blended teaching of Mathematics

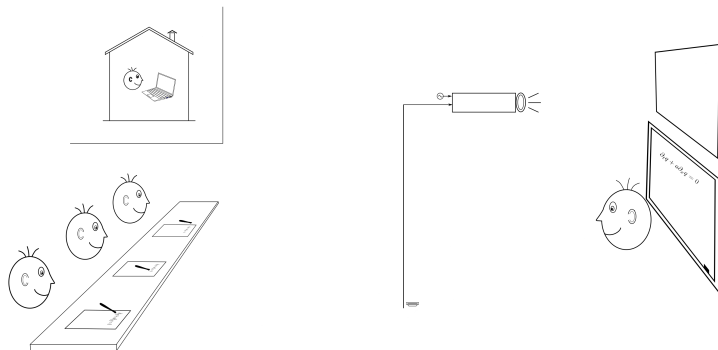
- ✓ Context      ✓ Hardware & software      ✓ Logistics
  - ✓ COVID related organization
  - ✓ Questionnaires on students & professors perception
- ⇒ **Tested and implemented** at the Dep. of Civil, Environmental and Mechanical Engineering (DICAM), **University of Trento**, Italy
- ⇒ 50 courses and 18 lecture halls

**GOAL: traditional blackboard lectures** with

- **reduced** number of students **present** in the lecture hall
- **high quality low-bandwidth **online streaming****  
& good **bidirectional communication**

# Equipment & Setup

Lecture hall **basic equipment**: **blackboard** & **projector**

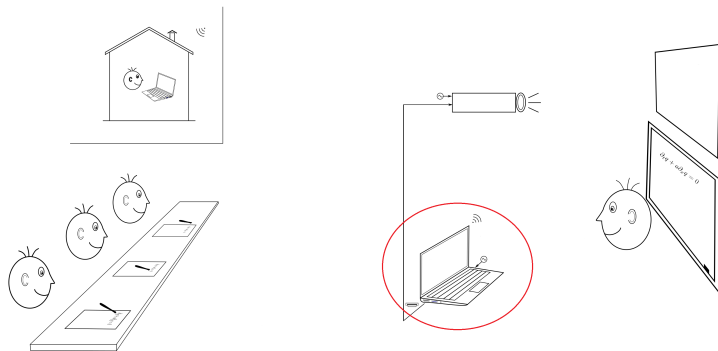




# Equipment & Setup

**Personal laptop** → crucial **hub** for **acquisition** and **distribution** of audio and video **streams**:

- i) Preferred computer environment and operating system for each prof
- ii) COVID related sanitary reasons & iii) Time constraints

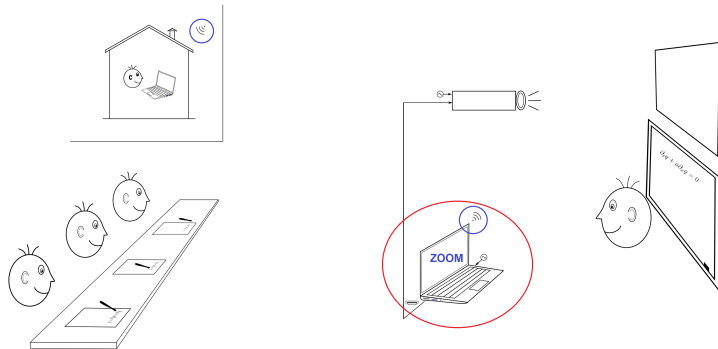


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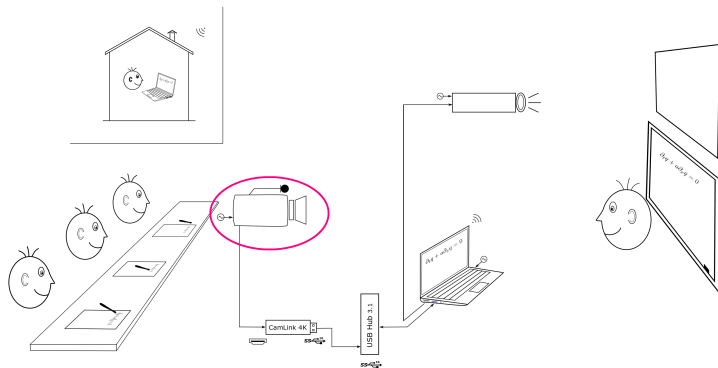
**ZOOM** videoconferencing tool:

total **bandwidth** required in **download** by the online students: only **~ 700 kbps** fully adequate even for low bandwidth ADSL and 4G connections



# Equipment & Setup

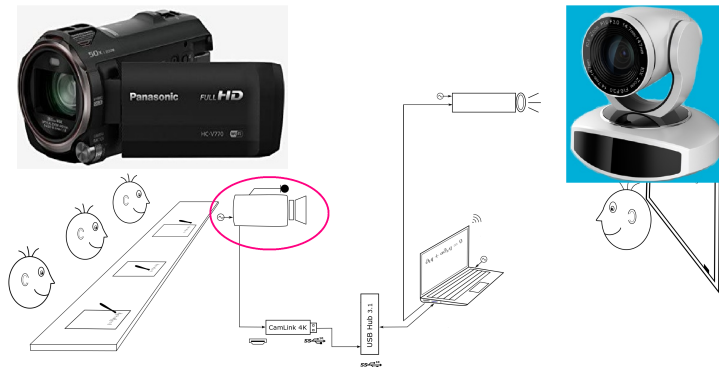
Full high (**FULL-HD**) definition **camcorder**



Panasonic HC-V770 camcorder, 410€ (or PTZ Minrray UV540)  
Panasonic HC-V180 camcorder, 190€

# Equipment & Setup

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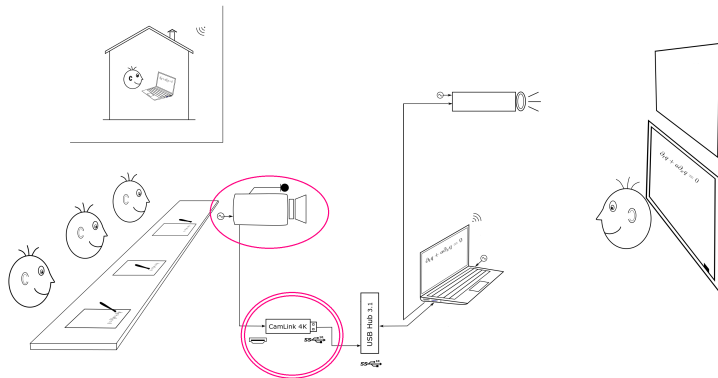
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**4K HDMI to USB Camlink** converter

→ **synchronous** transmission of **high quality video signal**  
from the camcorder to the computer



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Elgato Camlink 4k HDMI to USB converter, 130€

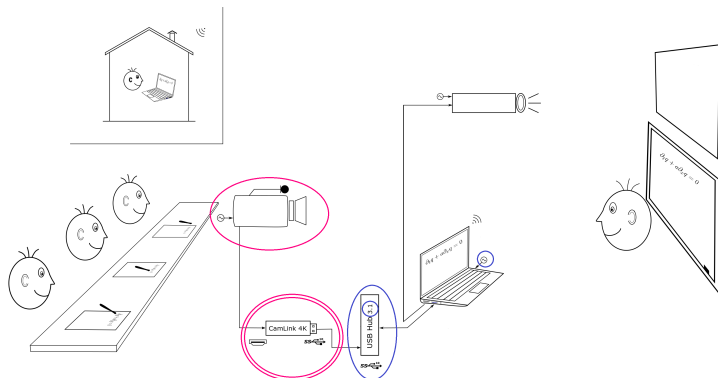
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**N.B. Power supply** is needed

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Elgato Camlink 4k HDMI to USB converter, 130€ & Anker USB hub 3.1, 13€

# Setup: high quality video streaming

→ **N.B.** Very useful trick!

**Context.** Visual information **streamed** via ZOOM: it is crucial the transmission in **optimal quality** of **static content of blackboard**

**Problem.** ZOOM automatically **reduces the video quality** to  $640 \times 360p \times 60\text{fps}$ , due to COVID-19 internet bandwidth restrictions for all meetings with **three or more** people simultaneously connected

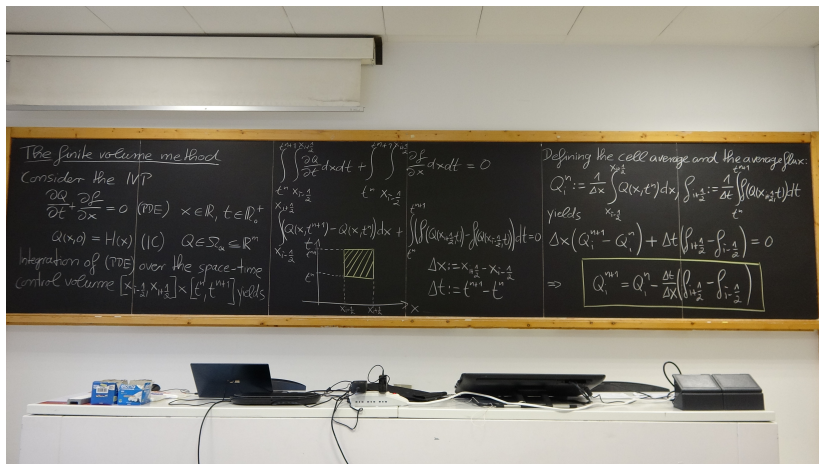
**Solution for stream at full HD resolution** ( $1920 \times 1080p$ ):

- i) Use a third party **video capturing software** to capture the signal coming from the video cameras (e.g. [VLC](#), [OBS](#), [Quicktime](#))
- ii) Use the **share screen feature** of ZOOM to transmit it

Reasonable **compromise**: **reduced framerate** 25fps

# Setup: high quality video streaming

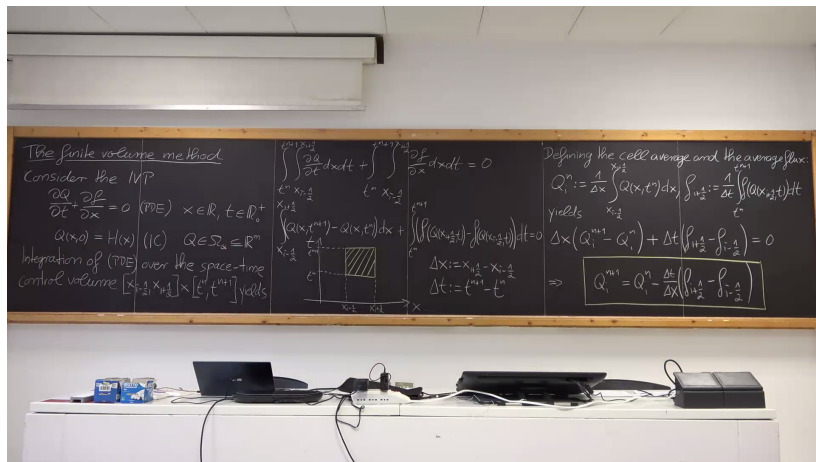
## Photograph of the blackboard - reference





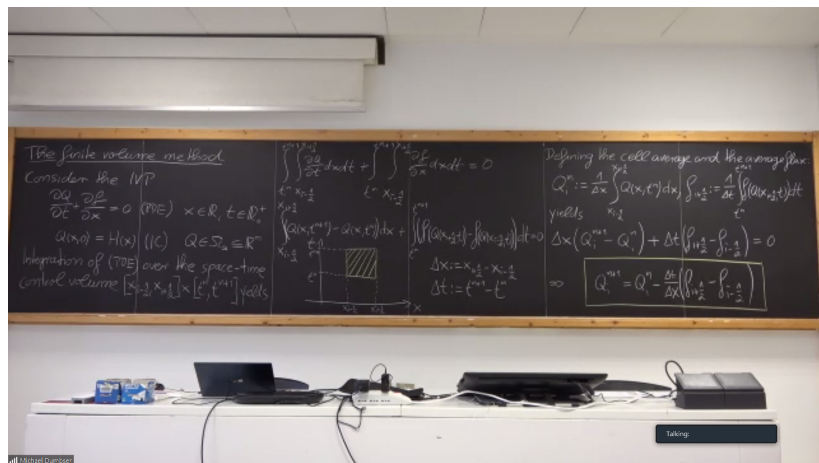
# Setup: high quality video streaming

Screenshot video received by ZOOM client - **our screensharing method**



# Setup: high quality video streaming

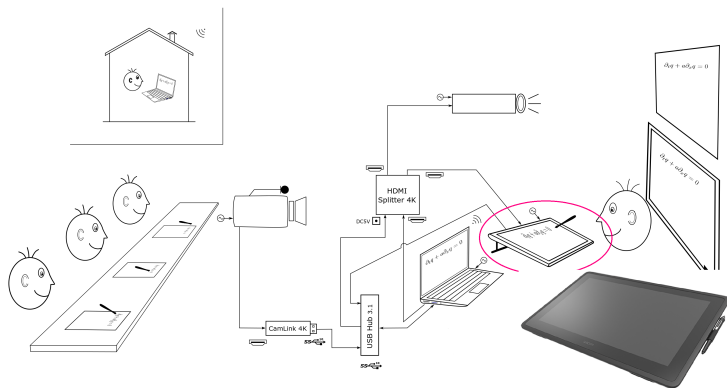
Screenshot video received by ZOOM client - **standard ZOOM stream**



# Equipment & Setup

**Graphics tablet** and **digital pen system** (rubber grip HD 22 inch graphics tablet not hand sensible) + **whiteboard software** (e.g. [OpenBoard](#))

**Communication.** Input HDMI signal that duplicated the laptop screen and Output USB signal for the recording of the handwriting

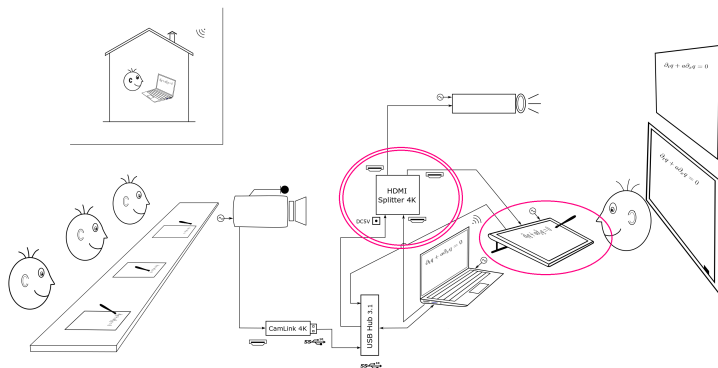


Wacom Cintiq 22 graphics tablet, 577€

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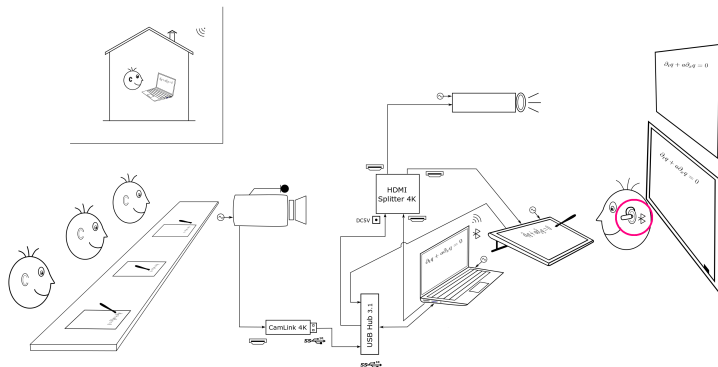
**Communication.** Input HDMI signal that duplicated the laptop screen and Output USB signal for the recording of the handwriting



Wacom Cintiq 22 graphics tablet, 577€ & 4k HDMI splitter Ablewe, 15€

# Equipment & Setup

**Ear microphone.** To properly capture the **speech with high quality** when the professor is turned towards the blackboard

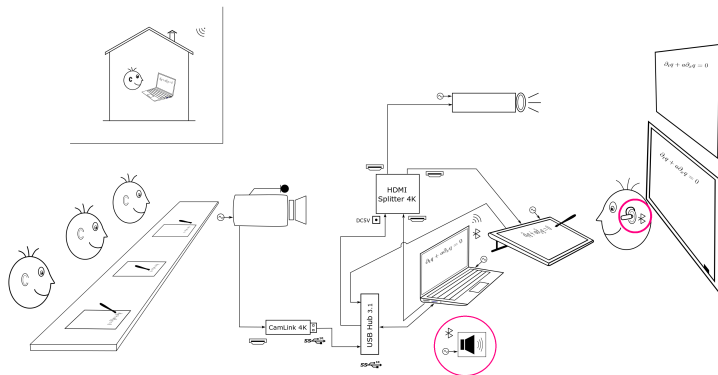


Jabra talk 25 bluetooth ear microphone, 25€

# Equipment & Setup

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**Airlink or speakerphone.** To facilitate **bidirectional communication**

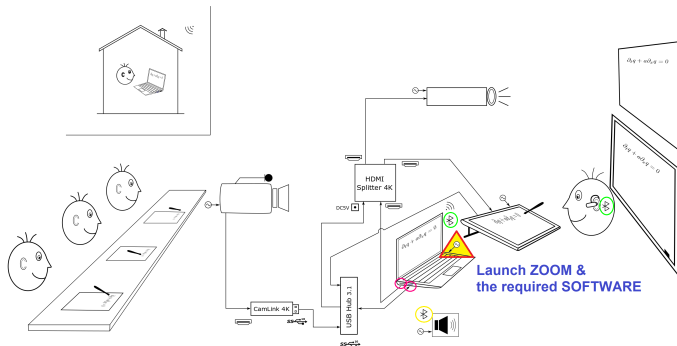


Jabra talk 25 bluetooth ear microphone, 25€

BT DW 20BR Klark Teknik bluetooth airlink, 95€ or Jabra speak 810, 470€

# Lecture setup - multiple choices

- 0) Plug in the PC! It really matters!
- i) Connect to the **standard hardware** of the lecture halls (1 **HDMI** and 1 **USB/A 3.0** port) → large set of adapters available
- ii) Connect to the audio system via bluetooth
- iii) Use a **video capturing software** (VLC) or any **third party software** (OpenBoard, Power Point ...) and share the screen via **ZOOM**



We organized a series of **special training sessions**:

- **Professors** (in presence) were informed and trained to use the necessary hardware and software
- Hundreds of **students** (online) got a preview of how the blended teaching would be
- **Master students** were formed to be able to help as **tutor** during the semester (**hired** with 'contratti 150 ore')

**Continuous technical support:**

- First weeks: **top-down** supporting service  
a person of our staff present in each lecture room to facilitate the setup
- During the rest of the semester: **bottom-up** or **on-demand**  
if necessary profs request the intervention of technical staff/tutors always present in the building

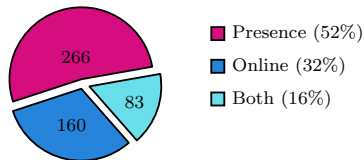


# Covid related organization

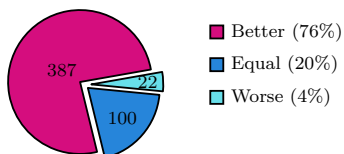
- Survey: free **choice** to attend lectures in person (82%) or online (18%)
- Weekly **rotation** principle to respect the **50% of nominal capacity** of lecture halls for in presence students and equity
- Survey: free **choice** to give blended lectures (70%) or pure online (30%)
- **Reduce pressure on public transport** system:
  - **Timetable re-organized** in morning and afternoon blocks
  - Master students start with a **shift** of 15 minutes
- Entrance **controlled** electronically via a **smartphone app**
- Same lecture hall only for at most two different groups of students (**sanitized** in the break)
- **Fully equipped but empty room** available as **strategic reserve** in case of disinfection measures or in technical difficulties

# Evaluation of the concept and of its implementation

**509 interviewed students: 96% satisfied!**

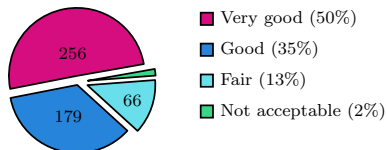


(a) Attended modality

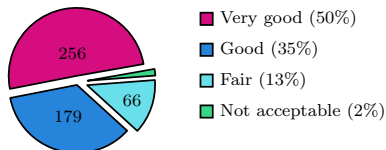


(b) Blended vs. online

## Video quality



## Audio quality



After 5 weeks of courses

## ⇒ **Important aspects from students PoV**

- More and easier **interaction with profs** (61%)
- More and easier **interaction with colleagues** (57%)
- The use of **blackboard** improves learning effectiveness (52%)
- Seeing **professor mimic and expression**  
makes more engaging the lectures (48%)
- Possibility to continue also being sick or in quarantine (81%)
- Availability of **recorded lectures** (64%)

## ⇒ **Profs PoV** (which were free to choose between blended 70%, or online 30%)

- Clear **preference for blended** teaching vs pure online teaching
- Some are willing to **maintain** several concepts here introduced even when traditional teaching will be again possible

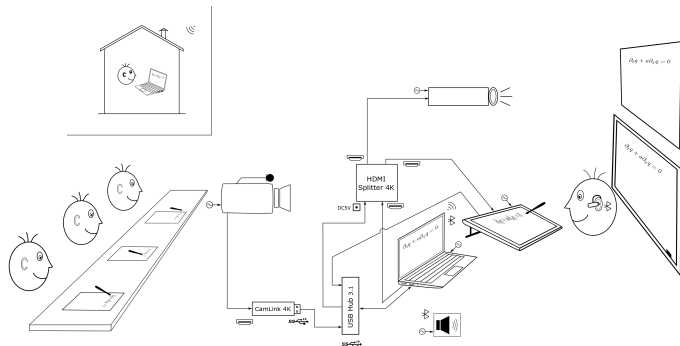
## Regole:

- **Controllo preciso** di stanza/postazione via webcam all'inizio
- **Telecamera con inquadratura completa** (viso, mani, cell)
- **Microfono acceso**
- **Sottogruppi** di max 25 persone
- Tempo massimo disconnessione concesso 90 sec
- **Registrazione** dell'esame
- Controllo calligrafia alla consegna
- Nessuno può lasciare zoom prima della fine dell'esame

## Esperienza personale:

- **Tempo** per controlli iniziali precisi e **tutor** per dividere in sottogruppi poco numerosi
- Quando l'esame è controllato con cura e si chiede il completo rispetto delle regole copiare è difficile tanto quanto in aula

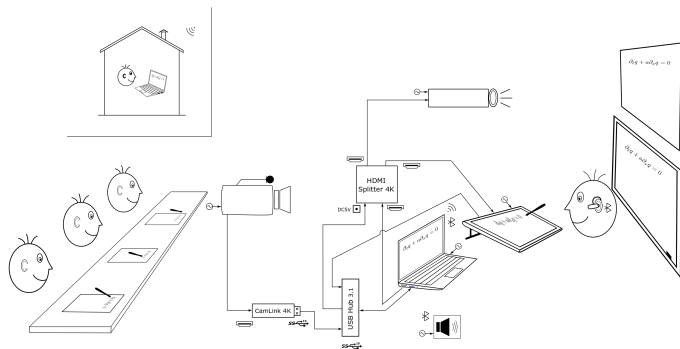
# Blended teaching!



**Total required budget per lecture hall  $\sim$  1700€**

S. Busto, M. Dumbser, E. Gaburro. [A simple but efficient concept of blended teaching of mathematics for engineering students during the COVID-19 pandemic](#), submitted to *Teaching mathematics and its applications*, 2020.

## Grazie per l'attenzione!



Total required budget per lecture hall ~ 1700€

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