WE-COLLAB

Co-funded by the Erasmus+ Programme of the European Union

PR5: Cognitive and emotional assessment of learners

Final conclusions of PR5 – Presenting the results from conducted experiments

SAPIENZA UNIVERSITÀ DI ROMA

BRAINSigns

Madrid, October 1st – 2nd 2024

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PR5: Introduction

We-Collab Objectives: What do you want to achieve by implementing the project?

1. "Challenge-based training" regarding the problem which occurs in the online environment of students' low engagement in online teaching and need to find the way how to include them more actively and reach their higher engagement.

2. *"'Designing in' engagement" through which behavioral data analysis and neurophysiological data analysis will be use to gather findings that enhance their engagement.*

3. "Learning analytics" and its use in order to upgrade learning approaches in online learning environment.

PR5: Objectives

To measure emotion and cognition from students' neurophysiological signals during learning experience and to integrate such information into a Multimodal Learning Analytics (MLA) system as a real element of innovation.

Emotion and cognition related to learning cannot only be inferred from behaviour, but they can be objectively measured by means of neurophysiological signals.

NEUROMETRICS:

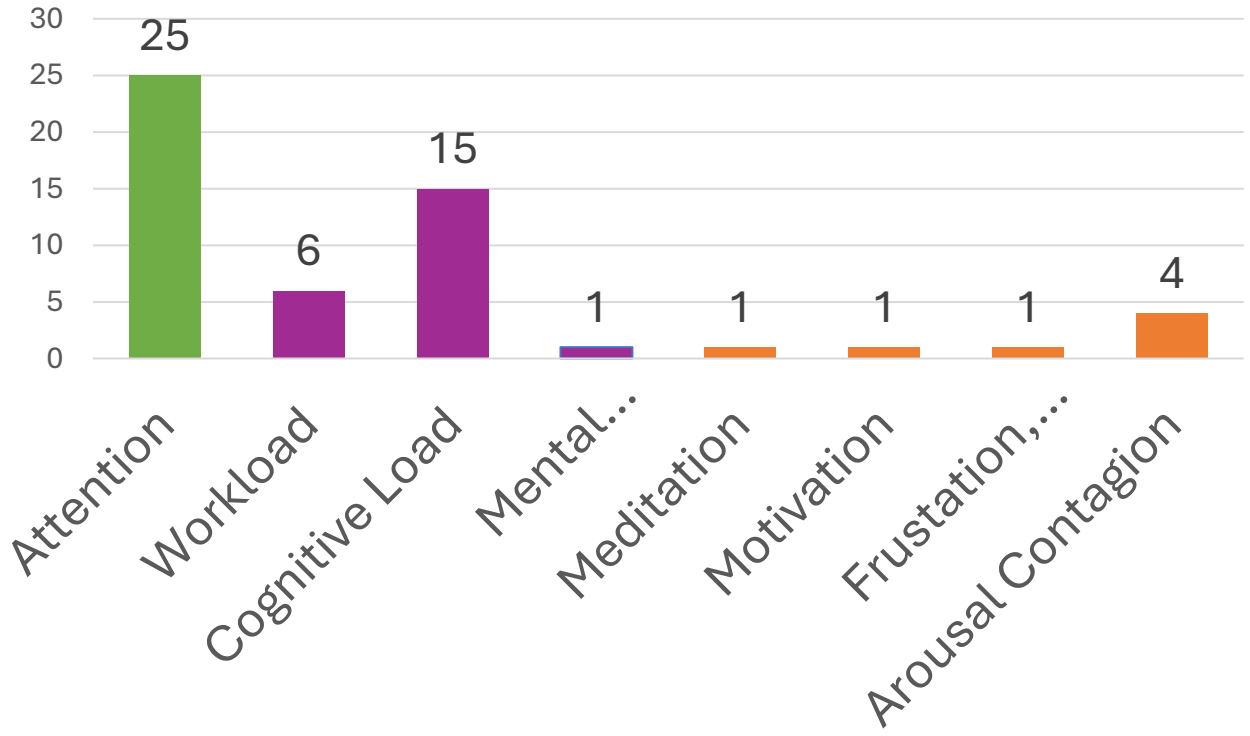
- Attention
- Cognitive effort
- Emotional engagement

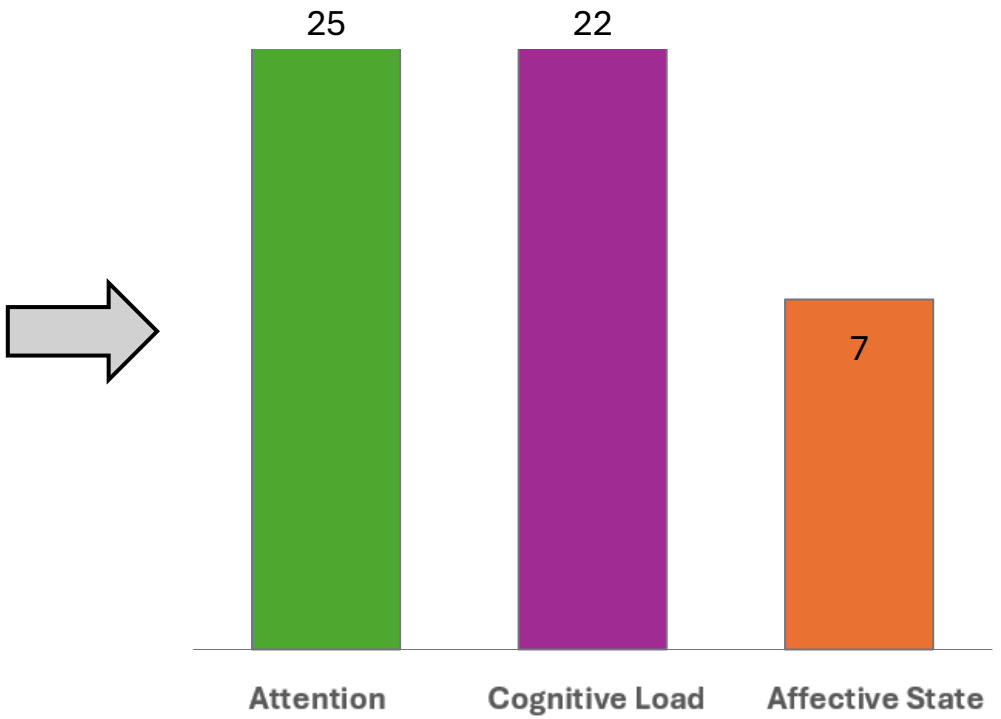
NEUROPHYSIOLOGICAL SIGNALS: EEG (Brain), PPG (Heart), EDA (Skin sweating)

PR5 – Preliminary work

Literature review on neurophysiological assessment in education and learning (T1.1 & T1.2)

1. MENTAL STATES of interest

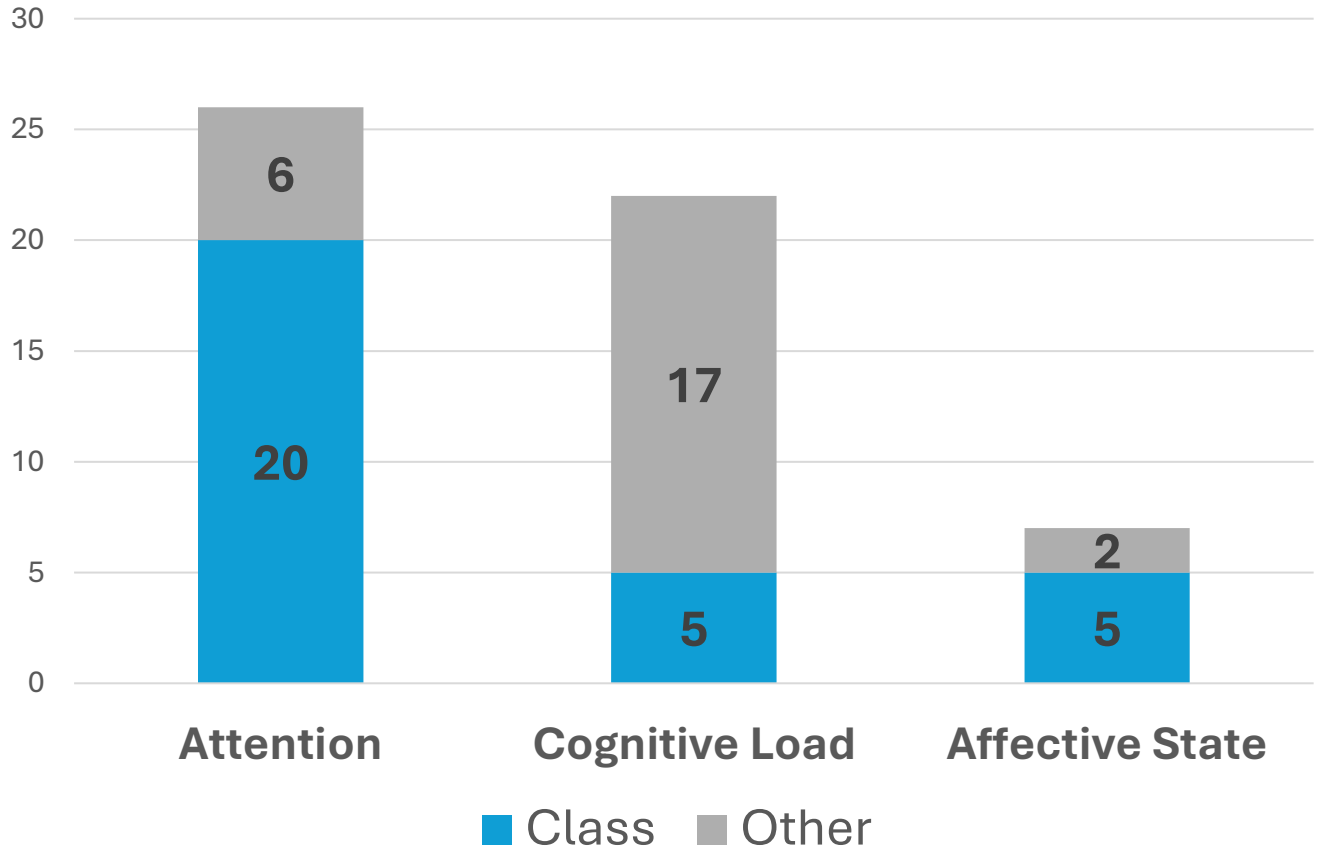




PR5 – Preliminary work

Literature review on neurophysiological assessment in education and learning (T1.1 & T1.2)

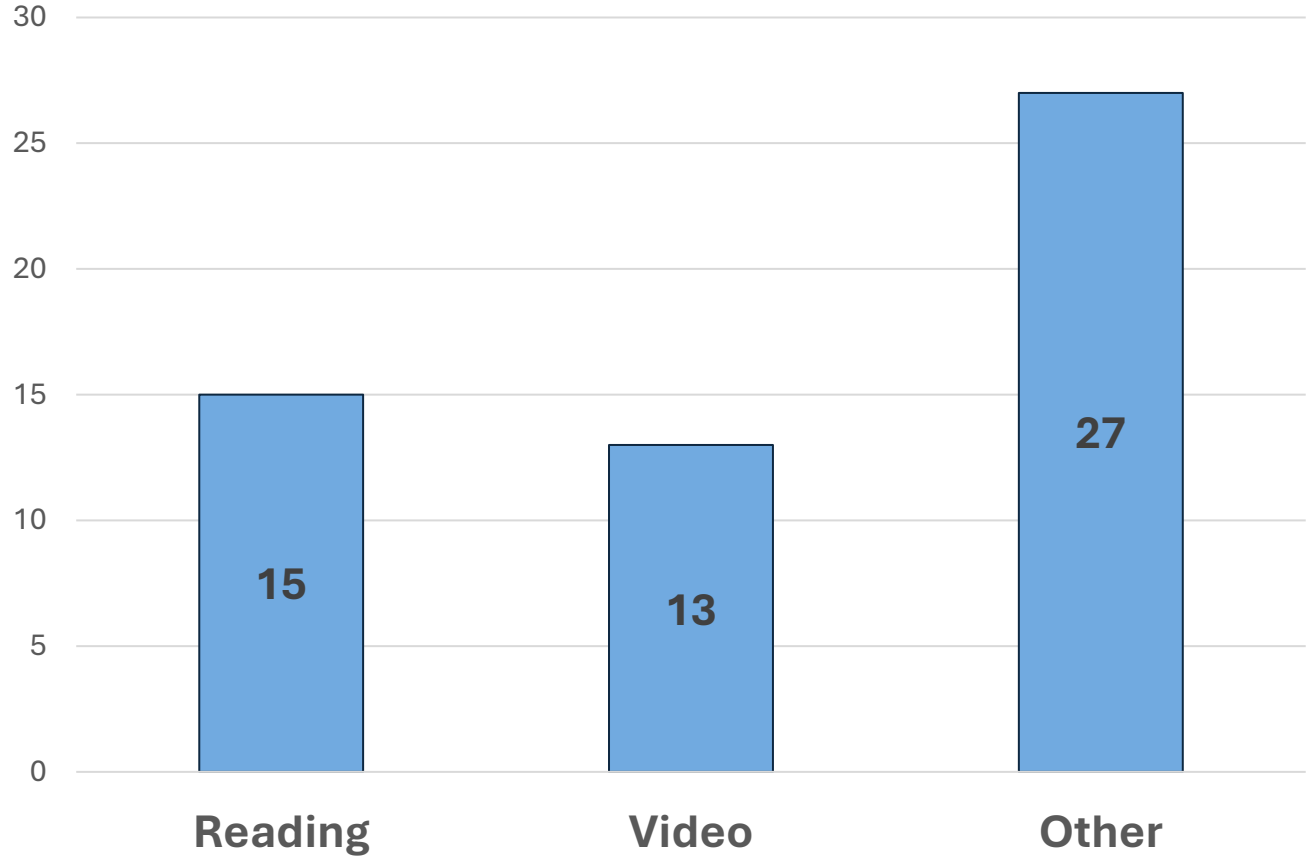
2. ENVIRONMENT



PR5 – Preliminary work

Literature review on neurophysiological assessment in education and learning (T1.1 & T1.2)

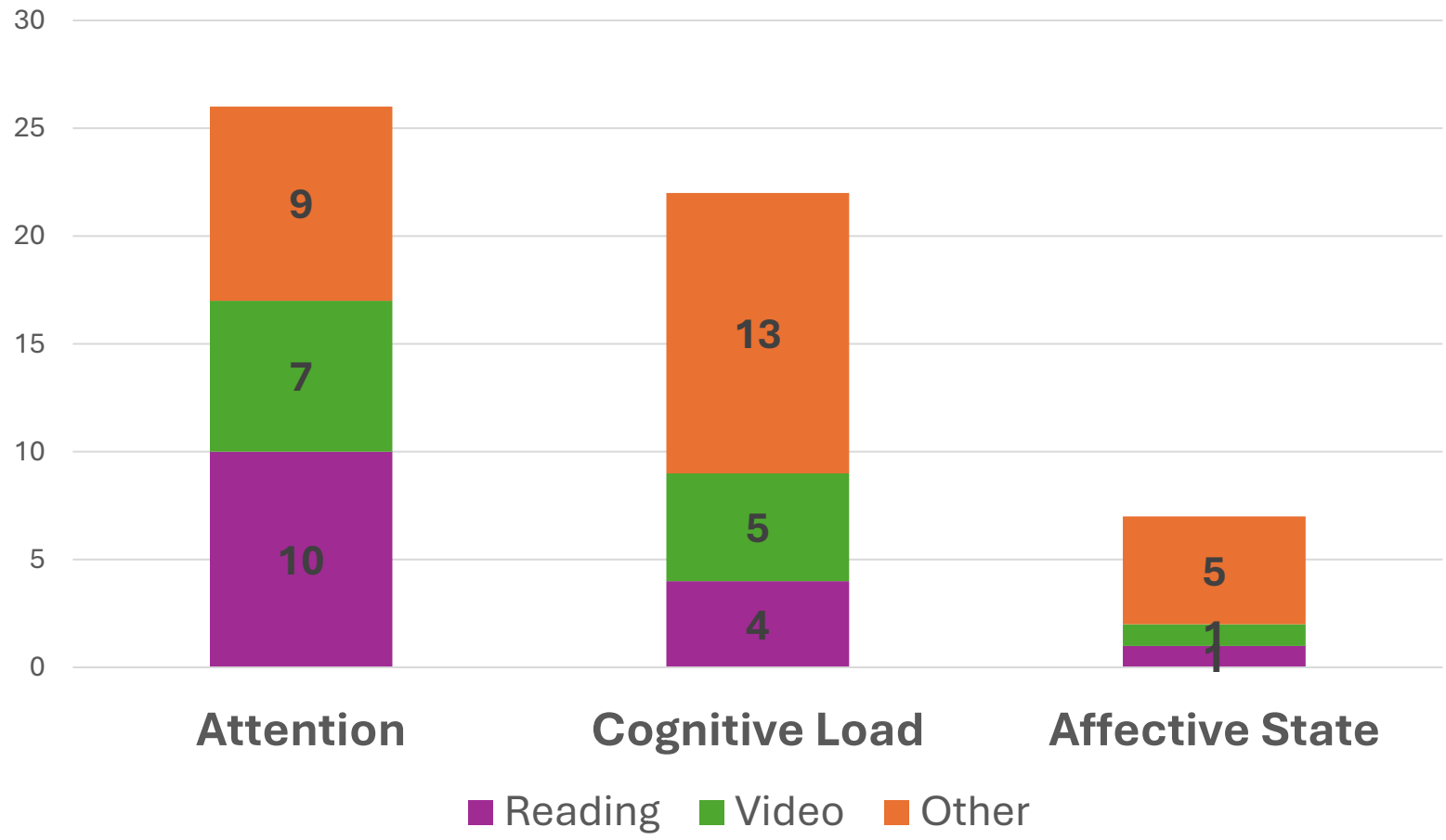
3. TYPE of TASKS



PR5 – Preliminary work

Literature review on neurophysiological assessment in education and learning (T1.1 & T1.2)

3. TYPE of TASKS & MENTAL STATES



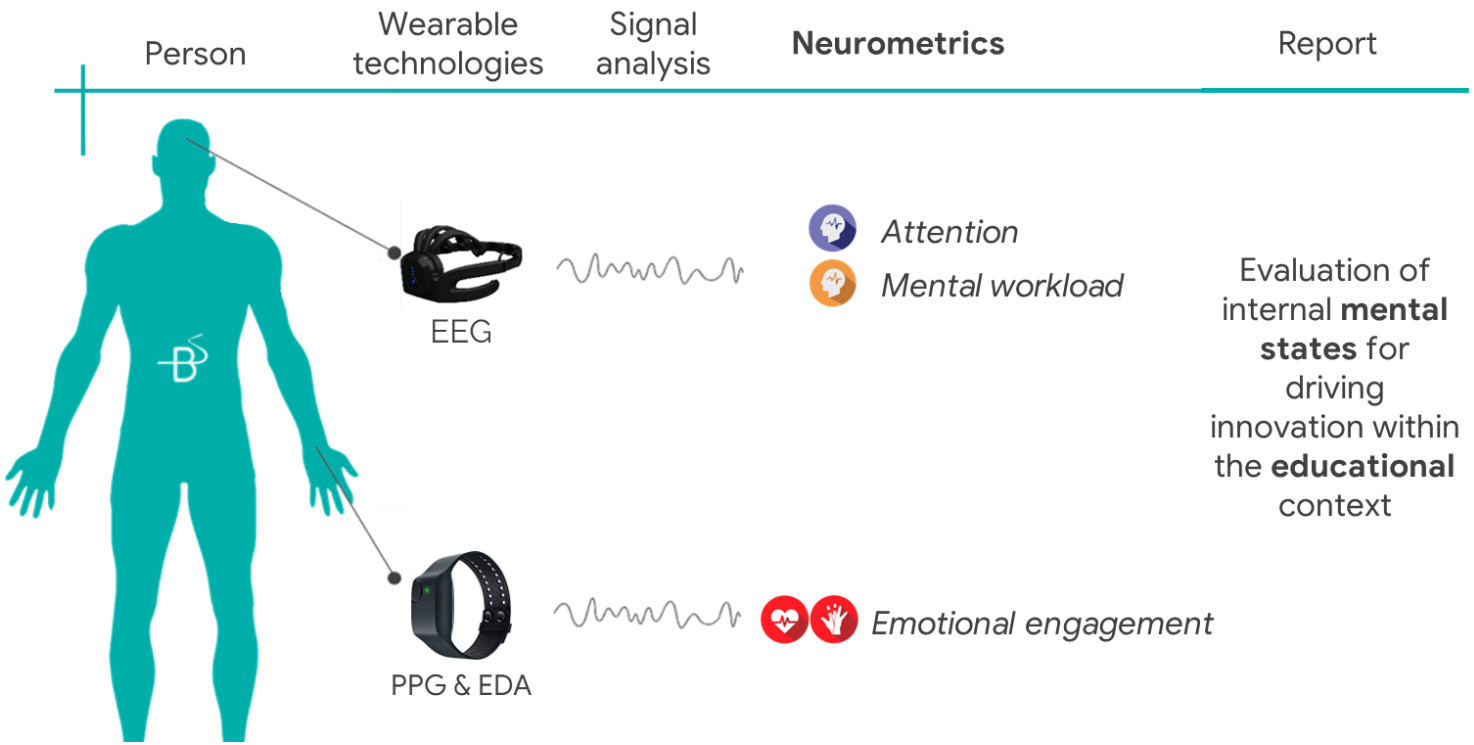
PR5: Summary

Measure emotion and cognition from students' neurophysiological signals during learning experience

Attention measured by means of brain activity

Cognitive effort measured by means of brain activity

Emotional engagement measured by means of EDA



PR5 – Preliminary activity @ CBS

5 participants (students)

- 3 males
- 2 females

Copenhagen Business School

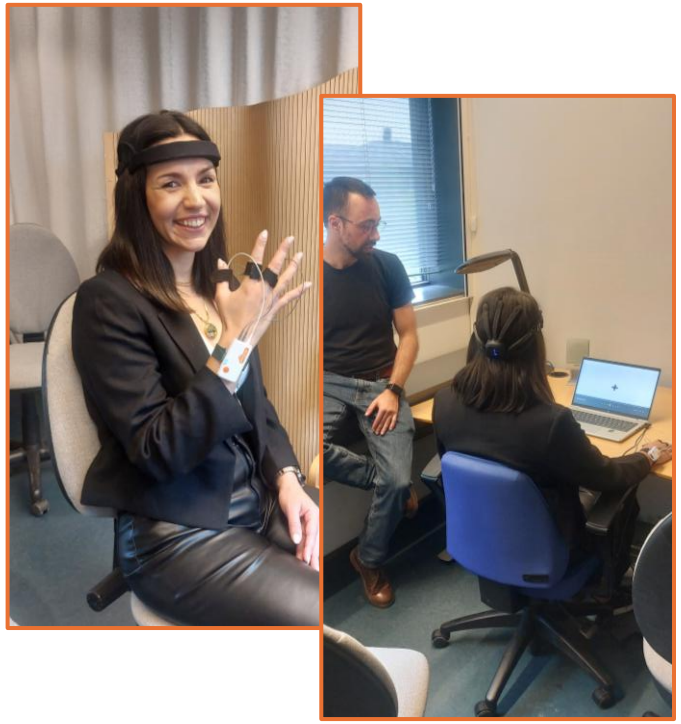
09/05/2024

2 VIDEOS:

- Same topic: Politeness and communication
- Same teacher
- Different length: LONG = 11’ 30’’ & SHORT = 5’ 20’’

➢ BASELINE: 76” beginning, 86” end

➢ FINAL QUESTIONNAIRE of 10 questions



PR5 – Preliminary activity @ CBS

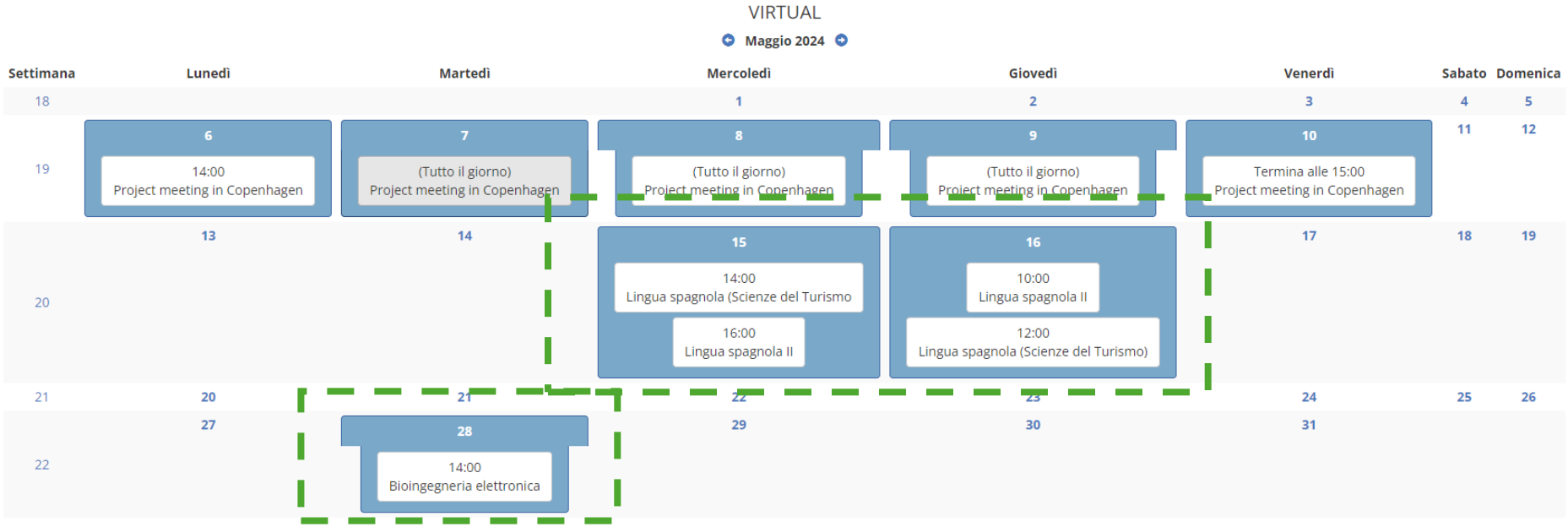
- ✓ More corrected answers were given after the LONG video.

- ➢ For almost all the neurometrics, except the visual attention, the behaviour in the first 3 minutes was similar (similar information), then the narrative impacted on the user's experience.
- ➢ In general, the LONG video, even by requiring more workload and attention, produced better performance → more effective narrative and harmony between topics?
- ➢ LONG video = more workload and attention, but also more appreciation
- ➢ Tables require less workload but more attention on both the videos.
- ➢ Duration is not necessarily a problem, even if there is a "boring" effect (emotion) → the key is the compromise between duration and amount of information
- ➢ Higher emotion and appreciation at the conclusion of the LONG video → Participatory examples help!

PR5 – Data collection @Sapienza

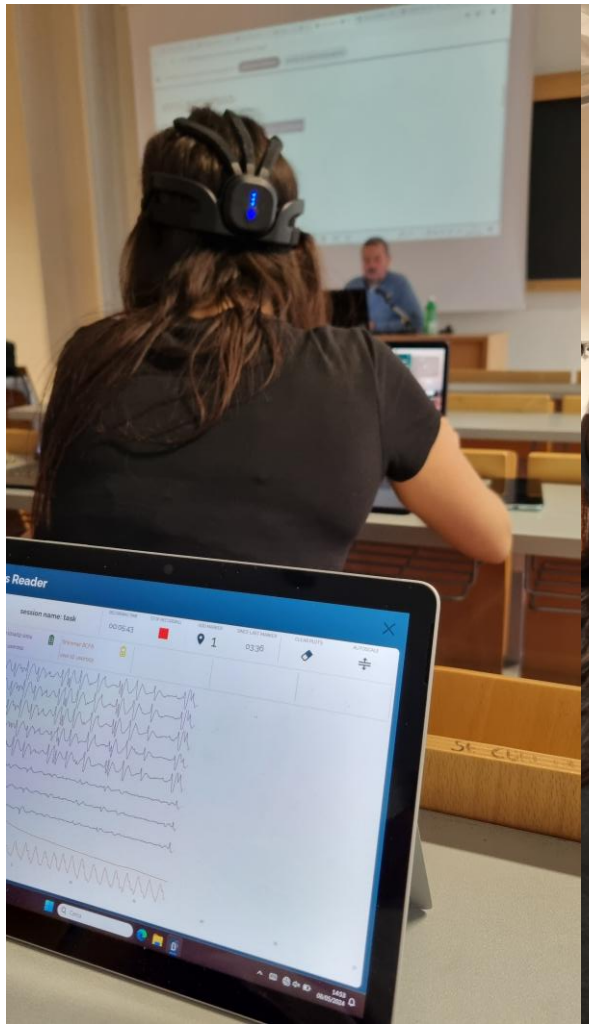
Comparison of *Presence* vs *Remote* conditions (same teacher)
30-minutes-long lessons. Sample size:

- 6 students attended 4 lessons within *Lingua Spagnola* course (Prof. Fernando Martinez).
- 3 students attended 1 lesson within *Bioingegneria* course (Prof. Gianluca Di Flumeri).



PR5 – Data collection @Sapienza

IN PRESENCE



REMOTE

PR5 – Data collection @Sapienza

Neurophysiological parameters analysis performed on EEG signals:

- **Mental workload** is linked to the amount of cognitive resources allocated on the task
- **Distraction** is linked to the difference between workload and attention (high difference means that students are *mindwandering*).
- **Stress** is linked to the overall 'comfort perception' of the students.

Autonomic parameters analysis performed on PPG and EDA signals:

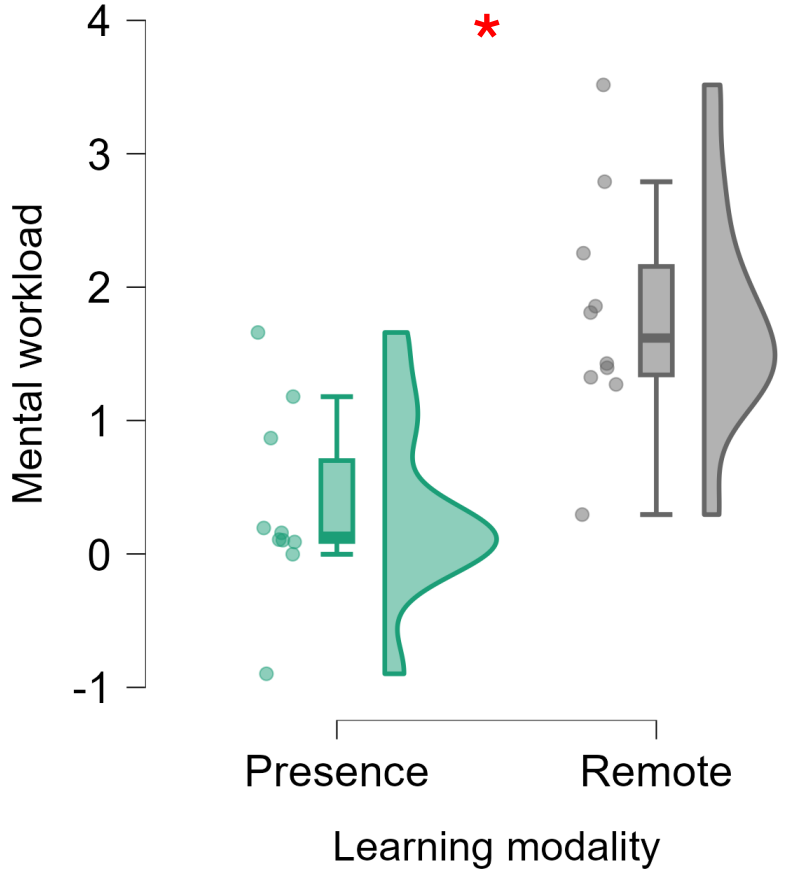
- Skin Conductance Level (**SCL**) is an EDA-derived parameter representing the state of **arousal** along the learning experience
- Emotional Index (**EI**) is a combination of SCL and Heart Rate (HR) parameters representing the **emotional state** of the students experienced along the learning modalities

The results will be presented:

- By visualizing the Neuro-Indicators variations **overtime**
- Neuro-Indicators mean values along the ***Presence*** and ***Remote*** learning modalities.

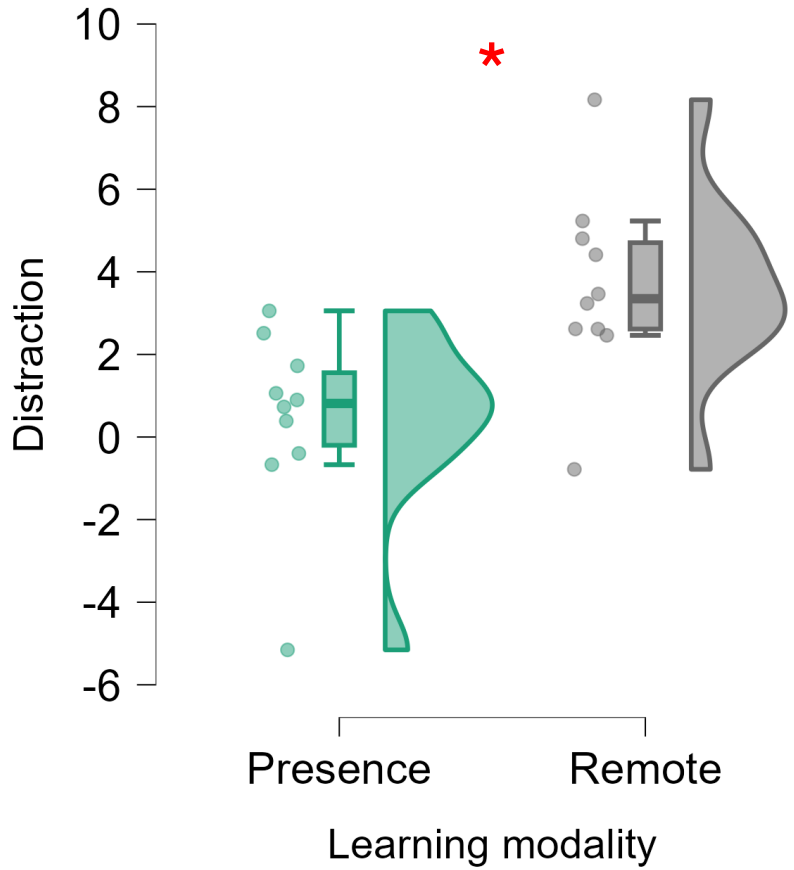
Neurophysiological parameters (EEG analysis)

Mental workload



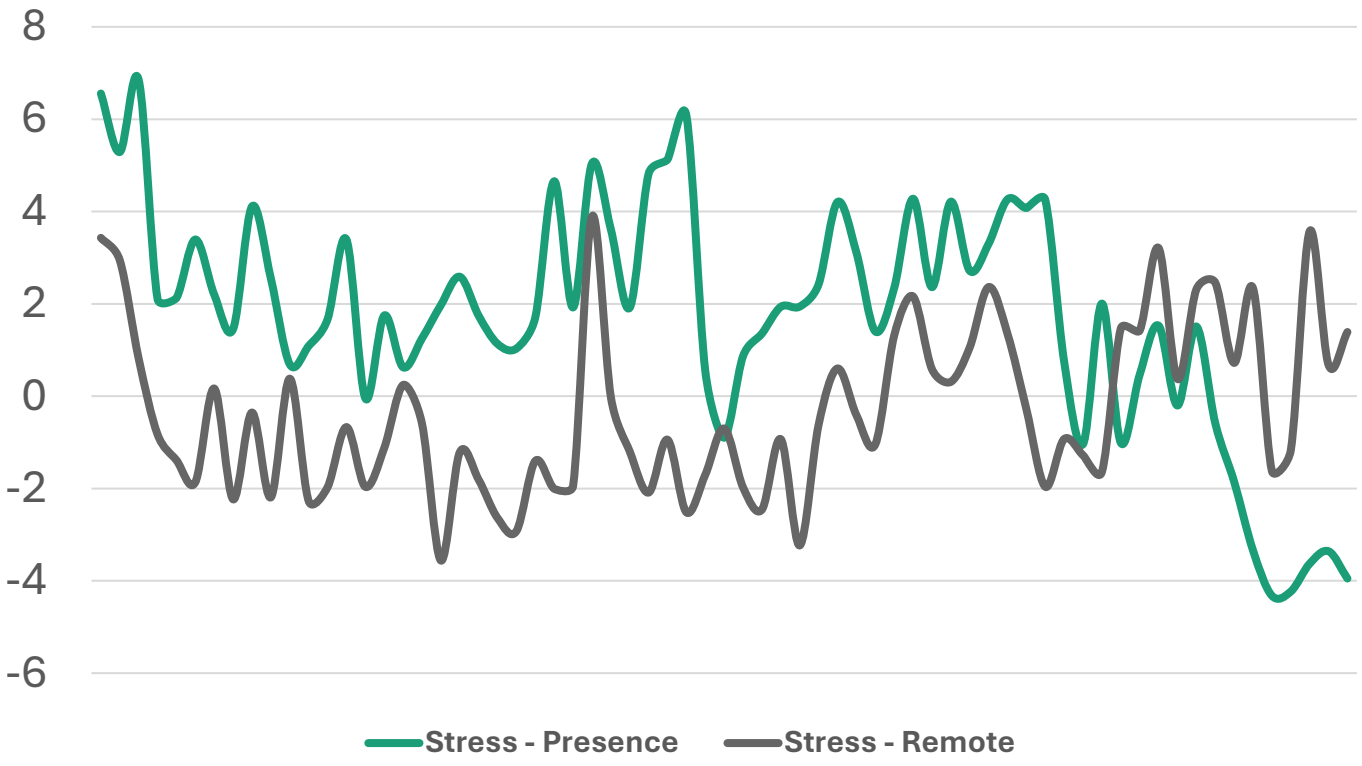
Significantly higher workload by remote → Higher difficulty? More engagement?

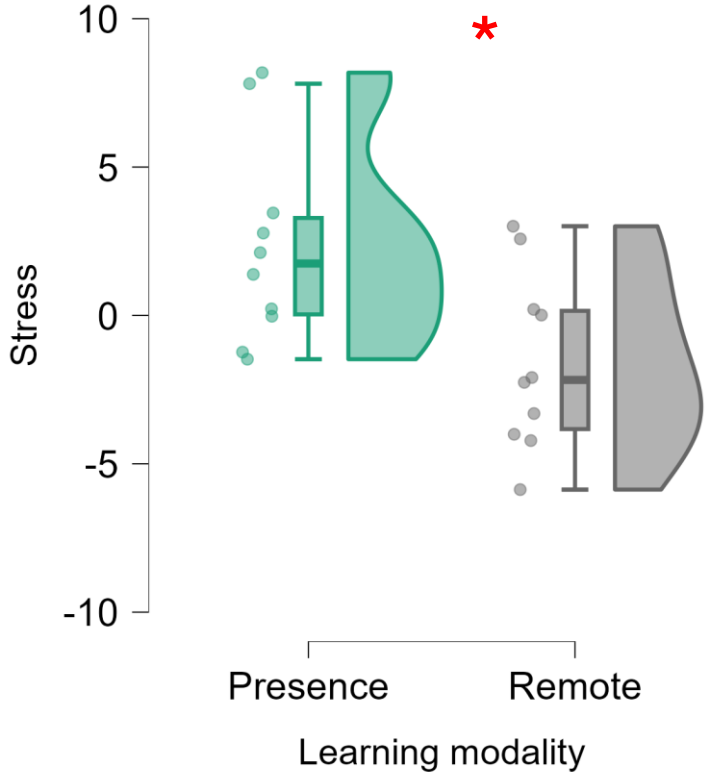
Distraction



Significantly higher distraction by remote → Less attention, the higher workload was due to the difficulty and not to the engagement.

Stress

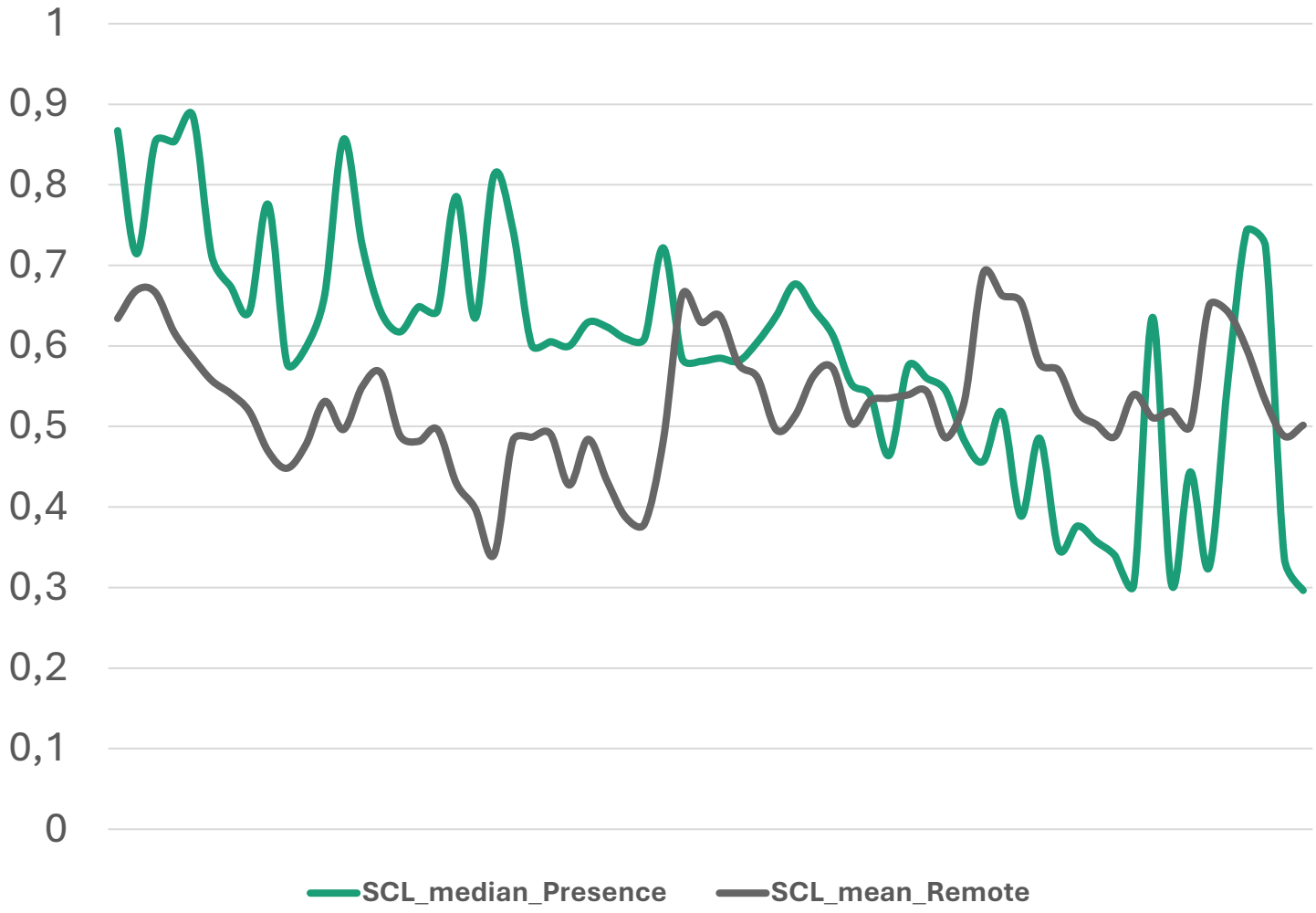


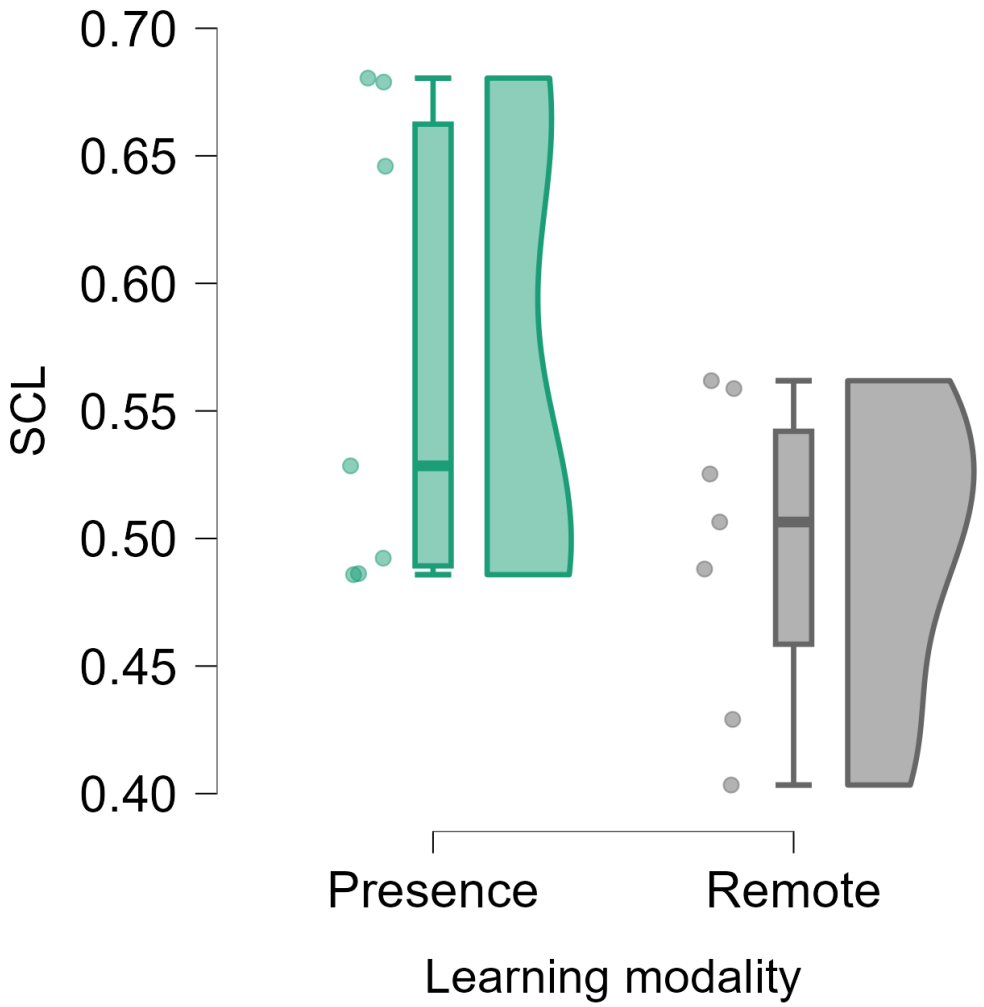


Significantly higher stress in presence, especially at the beginning.

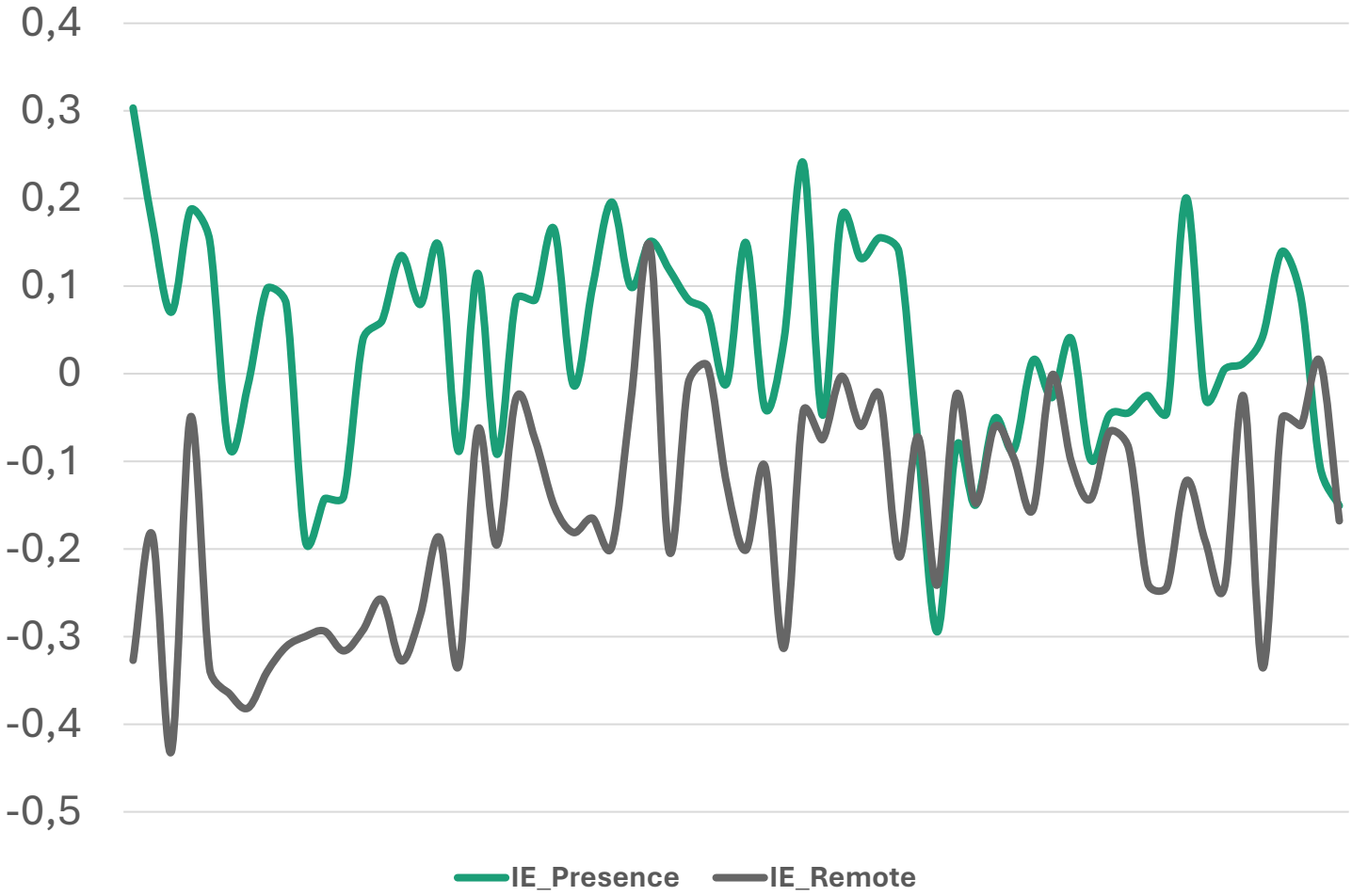
Autonomic parameters (EDA and PPG analysis)

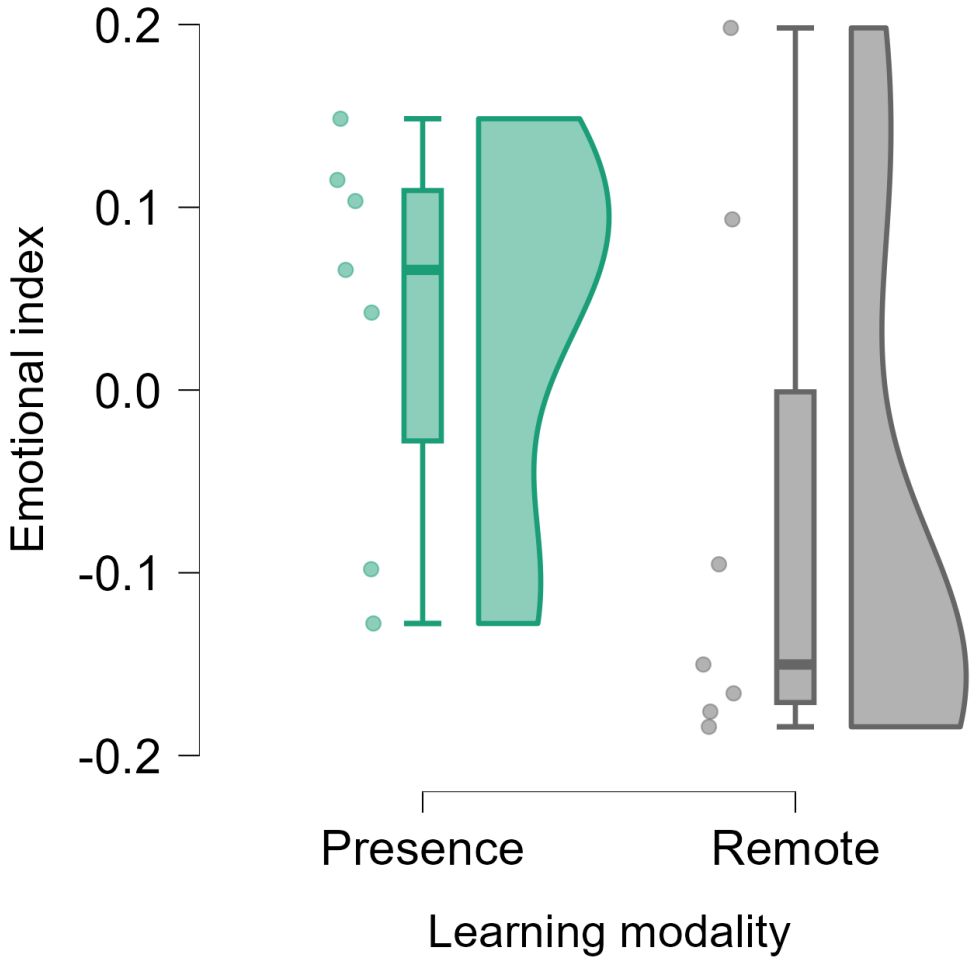
Arousal


1
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
SCL_median_Presence
SCL_mean_Remote


SCL
0.70
0.65
0.60
0.55
0.50
0.45
0.40
Presence
Remote
Learning modality

Emotional index overall



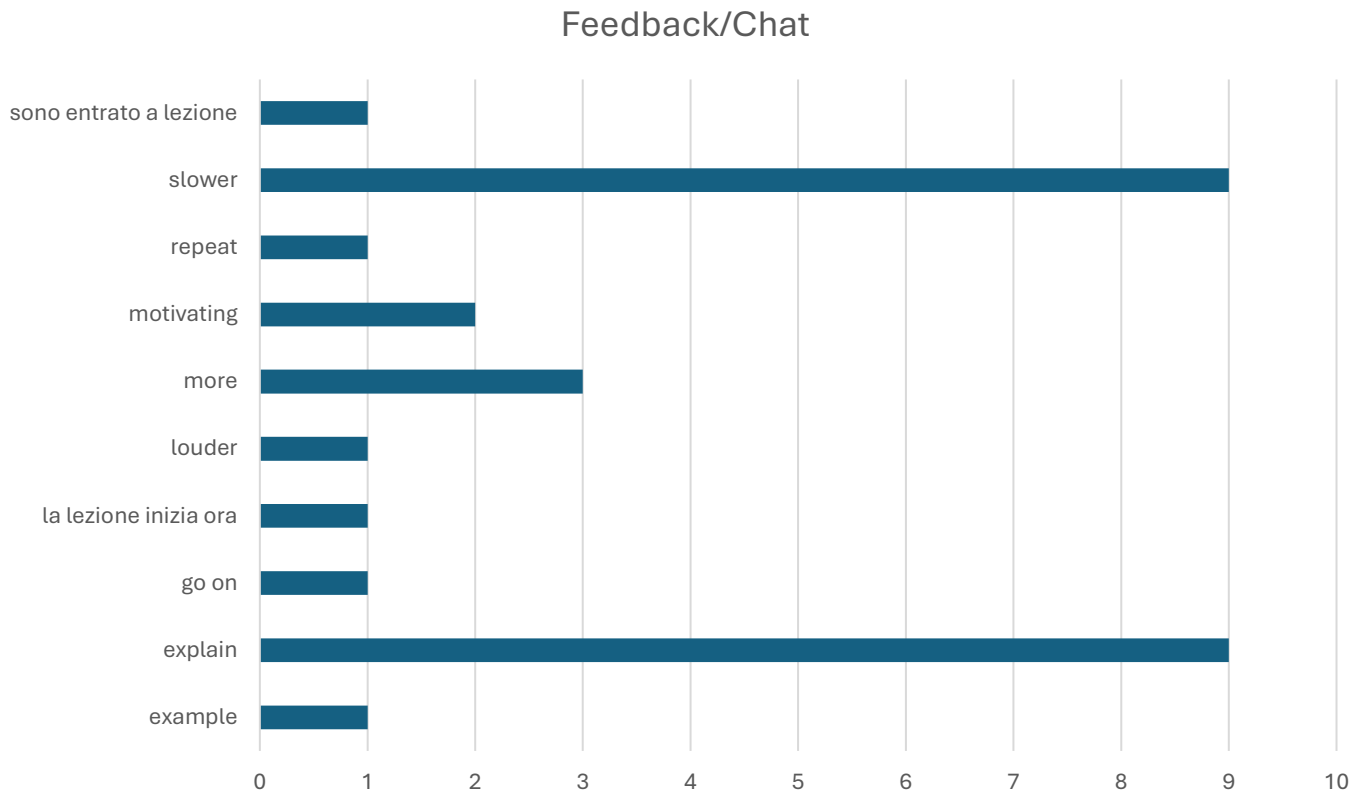


WECOLLAB Feedback App

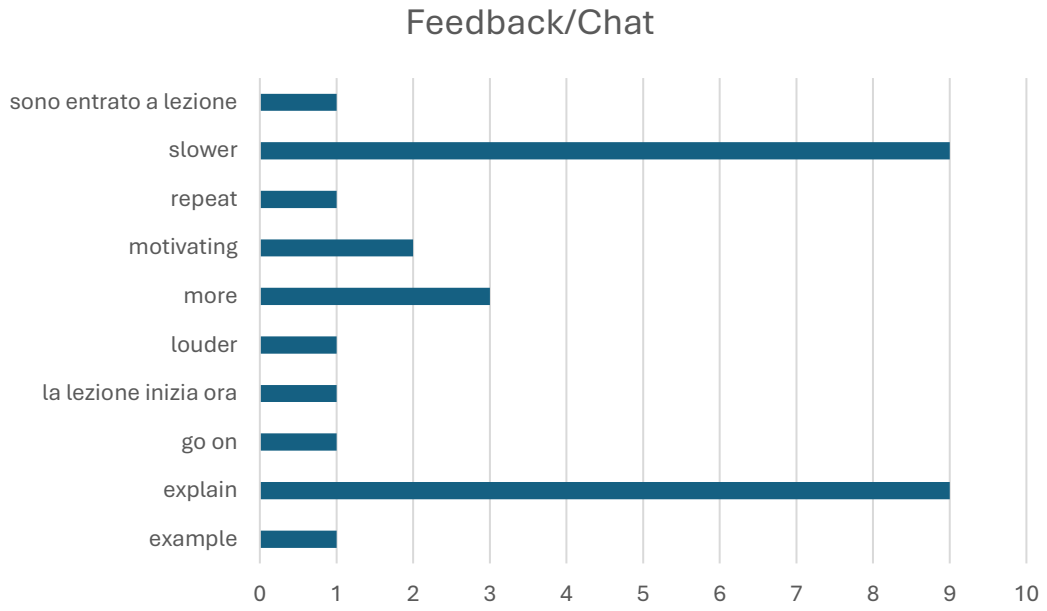
PR5 – WECOLLAB Feedback App

The feedbacks are a useful source of information. The most frequent feedbacks have been:

(1) Slower (2) Explain → Difficulty in follow the teacher



PR5 – WECOLLAB Feedback App



The granularity of the feedbacks is random and sparse → correlation with other measures (e.g. NeuroIndexes) is impossible

	A	B	C	D	E	F
4	2024-05-15T12:40:16.0848Z	gues	reaction	more		
5	2024-05-15T12:40:06.3812Z	stefa	chat	la lezione inizia ora		
6	2024-05-15T12:39:41.6414Z	marc	reaction	slower		
7	2024-05-15T12:39:41.3455Z	marc	reaction	slower		
8	2024-05-15T12:39:32.8146Z	gues	reaction	motivating		
9	2024-05-15T12:39:29.9556Z	gues	reaction	motivating		
10	2024-05-15T12:39:27.9130Z	marc	reaction	more		
11	2024-05-15T12:39:26.4997Z	gues	reaction	explain		
12	2024-05-15T12:39:26.0165Z	gues	reaction	slower		
13	2024-05-15T12:39:24.9016Z	gues	reaction	explain		
14	2024-05-15T12:39:22.6869Z	marc	reaction	explain		
15	2024-05-15T12:39:21.9962Z	marc	reaction	slower		
16	2024-05-15T12:39:21.0657Z	marc	reaction	explain		
17	2024-05-15T12:39:20.5119Z	marc	reaction	explain		
18	2024-05-15T12:39:19.2479Z	gues	reaction	explain		
19	2024-05-15T12:39:18.4370Z	lorer	reaction	explain		
20	2024-05-15T12:39:17.6978Z	gues	reaction	explain		
21	2024-05-15T12:35:35.2477Z	ferna	reaction	slower		
22	2024-05-15T12:33:44.4904Z	stefa	reaction	louder		
23	2024-05-15T12:33:03.3508Z	stefa	reaction	repeat		
24	2024-05-15T12:23:03.7314Z	stefa	reaction	explain		
25	2024-05-15T12:23:01.3405Z	stefa	reaction	slower		
26	2024-05-15T12:22:46.6898Z	stefa	chat	sono entrato a lezione		
27	2024-05-15T12:22:13.9314Z	stefa	reaction	slower		
28	2024-05-15T12:22:13.1925Z	stefa	reaction	slower		
29	2024-05-15T12:22:05.2081Z	stefa	reaction	slower		
30	2024-05-15T12:22:03.5991Z	stefa	reaction	go on		
31						

PR5 – WECOLLAB Feedback App

DEBRIEFING with students

Main limitations to the application use:

- Students are used to employ tablet/laptop for taking notes and following the lesson, the use of an additional device (mobile phone) is demanding
- They have the mobile phone there, but for ‘emergencies’ (calls, messages, WhatsApp) → if they have an application open, they cannot use their phone anymore
- If using the Webapp directly on the laptop, is difficult then to take notes
- In the end, they prefer to intervene during the lessons instead of using the app

THE USE OF THE APP IS NOT SEAMLESS SO FAR, AND THE COST IS HIGHER THAN THE BENEFITS

Conclusions

PR5 – Conclusions

1. Neurotechnologies are a powerful tool to get objective information about the students' experience
2. The advantage of this information is to be available online and eventually synchronous with specific events
3. They can be translated into relevant KPIs, i.e. learning analytics, to be applied at different levels of education: evaluation of materials and contents, of education modalities, of lessons design, etc.
4. It is still difficult to integrate them with other analytics (e.g. Feedback App), to understand how to integrate them in a different way

WE-COLLAB

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Thank you for your attention

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