PROAMBIENTE
innovation & environment

In collaboration with:

IMM BOLOGNA UNIT

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

CHANGE CO_2Lab

2022-1-IT01-KA220-VET-000087732

CUP: G31B22002160006

Co2 monitoring in scHools for digitAl aNd Green compEtences

A didactical pathway on indoor air quality

THE PROJECT

KA220-VET: Cooperation partnerships in vocational, education and training

CHANGE CO_2Lab

Co2 monitoring in scHools for digitAl aNd Green compEtences

Erasmus+

OFFICIAL STARTING DATE: November 1st, 2022.
OFFICIAL ENDING DATE: October 31st, 2024.

***PARTNERSHIP*:**

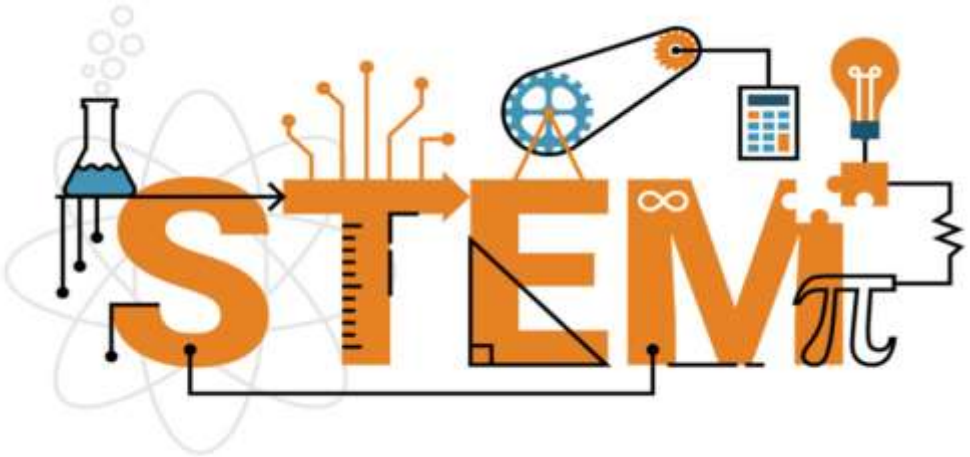
- **COORDINATOR:** PROAMBIENTE S.C.R.L. (IT)
  - **AFFILIATED ENTITY:** CNR-IMM + CNR Library.

- **PARTNER 1:** IIS «BELLUZZI – FIORAVANTI» (IT)
- **PARTNER 2:** CIPFP «VALLE DE ELDA» (SP)
- **PARTNER 3:** LICEUL TEHNOLOGIC «MIRSA» (RO)
- **PARTNER 4:** PROFESIONALNA GIMNAZIA PO ELEKTRONIKA «JOHN ATANASOFF» (BG)

TOTAL BUDGET: LUMP SUM 250 K€.

THE TARGET

Development of a **didactic pathway** addressed to teachers and students of secondary schools, in order to provide **STEM skills and competences** on a specific topic: **Indoor Air Quality (IAQ)**.



«**MAKING**» activities → VET graduates will acquire skills and competences functional to match the incoming labour market demand:

- "90% of future jobs will require digital skills" – *Digital Education Action Plan*, 2021).

Pathway centered on **IAQ** → Raising awareness on the importance of adopting **good practices** to improve the living conditions in enclosed environments (classroom):

- "Europe market size of IAQ monitoring solutions will exhibit a huge growth in the 2021-2027 period, with a Compound Annual Growth Rate of 7.3%" – *Fortune Business Insights*, 2024

CO_2 measurement as an INDICATOR of Indoor Air Quality and comfort

- High values of indoor CO2 concentration indicate crowdy spaces and insufficient ventilation → MONITORING DEMAND.

- CO_2 measurement technique is simple and basic.

- Availability of efficient low-cost sensors, to be used as didactic tools.

THE PATHWAY: LEARNING MODULES

1. Theory

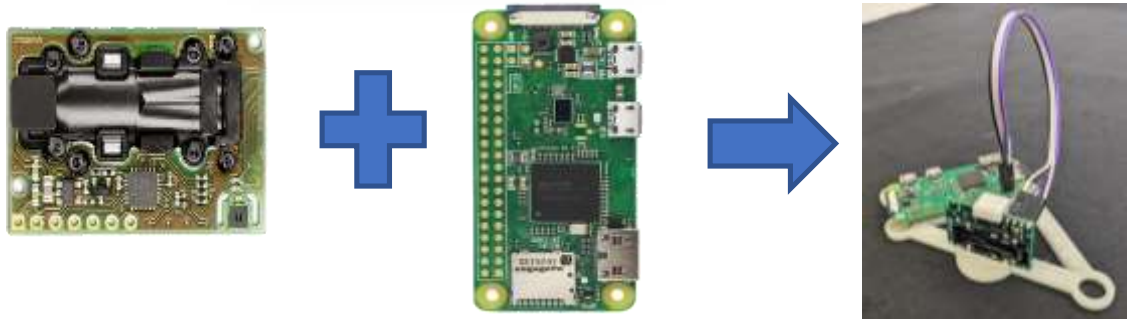
FRONTAL LESSON CONCERNING VARIOUS TOPICS:

- CO2 concentration Outdoor & Indoor
- CO2 measurement techniques
- IAQ & Health
- Low-cost sensors
- ……..

2. Assembly & Experiments

GUIDED ASSEMBLY OF A DIDACTIC TOOL: A CO_2 MONITORING STATION

- Low-cost CO2 sensor
- Raspberry Pi Zero SBC
- Plastic support



3. Continuous monitoring

PRACTICAL ACTIVITY IN CHARGE OF THE STUDENTS:
Continuous CO2 monitoring in the classroom (or in other relevant indoor space within the school)

4. Output

PRACTICAL ACTIVITY IN CHARGE OF THE STUDENTS:

- Report on the pathway (comments, suggestions, questionnaires…..)
- Participation to open/dissemination events

THE PATHWAY: WHAT WE PROVIDE

- Powerpoint slides (multilingual)
- Videos and tutorials on the CO2 monitoring station assembly
- CO2 monitoring station Kit (~ 20/each partner school)
- Web-App for the visualization of CO2 monitoring data (real-time or history)
- Web platform (repository) for CO2 monitoring data collection and storage in «OPEN ACCESS» format.
- Tutorials on Python programming language
- Support on the continuous monitoring activity (guidelines)

MATERIAL USED TO TRAIN TEACHERS OF THE PARTNER SCHOOLS IN TWO «**TRAINING OF TEACHERS**» DEDICATED EVENTS (IN PERSON):

1) Bologna (Italy), October 5-6, 2022

2) Mirsa (Romania), October 30-31, 2023

«E+ CHANGE» PROJECT: THE NUMBERS

Once the teachers have been trained on the "CHANGE" didactic material, this was presented to their students through dedicated lessons.

Going into detail:

- **16 teachers** of partner schools held the "CHANGE" lessons in the school years covered by the project (2022/2023 and 2023/2024).
- during the first school year (2022/2023), **226 students** of partner schools (26 from Italy, 100 from Spain, 50 from Romania and 50 from Bulgaria) completed the "CHANGE" pathway.
- during the second school year (2023/2024), **240 students** of partner schools (85 from Italy, 60 from Spain, 45 from Romania and 50 from Bulgaria) completed the "CHANGE" pathway.

IIS Belluzzi-Fioravanti

Liceul Tehnologic Mirsa

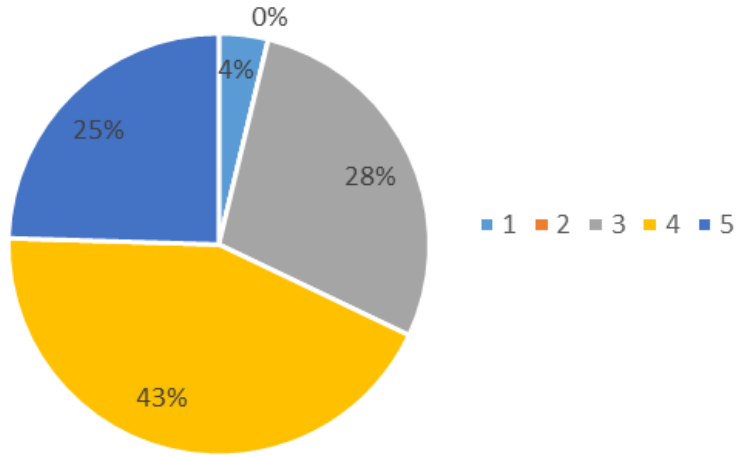
CIPFP Valle de Elda

“John Atanasoff” Vocational school of Electronics

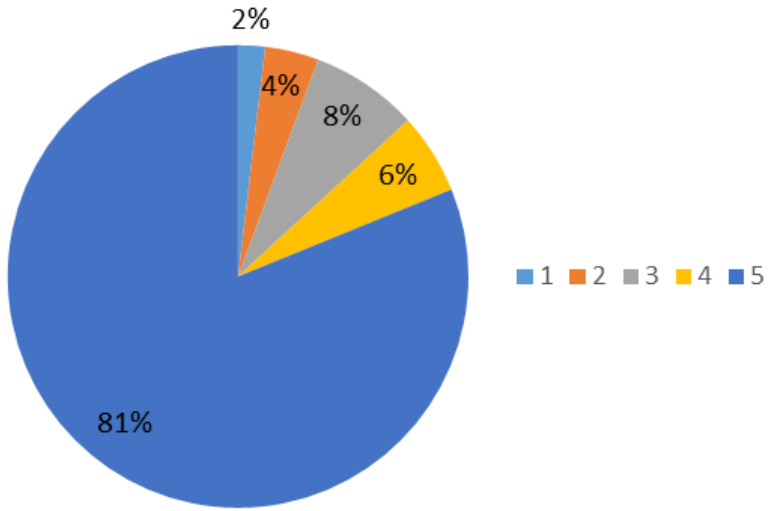
EXAMPLES OF OUTPUT

1. QUESTIONNAIRES FOR STUDENTS AND TEACHERS

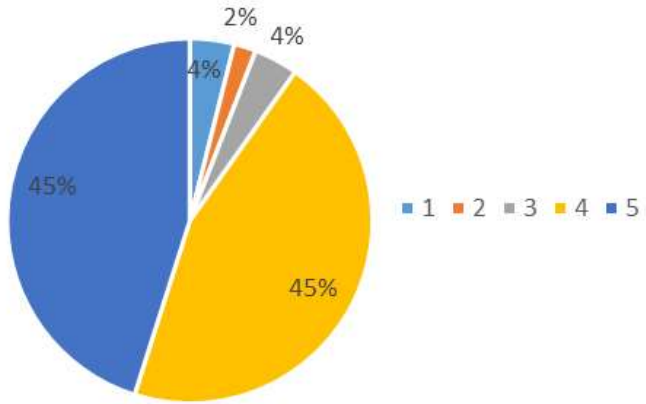
Do you think that the CHANGE Pathway can have a positive impact on your professional development (1 to 5)?



What is your personal engagement in the project (1 to 5)?

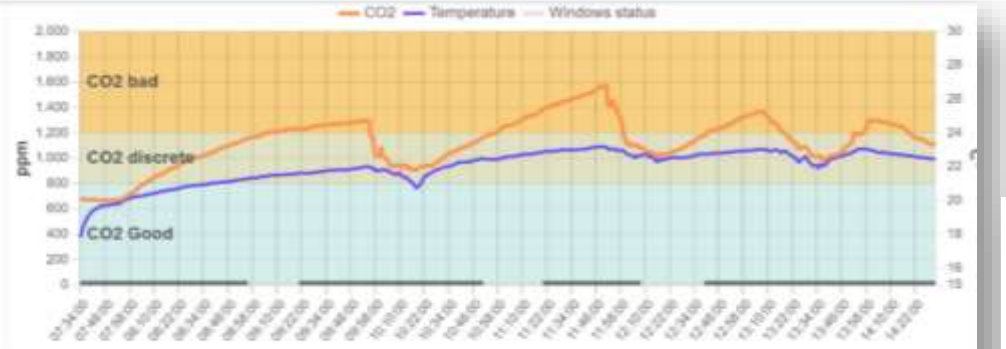


What was the level of your interest in the treated topics (1 to 5)?



2. REPORTS BY THE STUDENTS

12/11



- 7:58 **entrata** in classe (aumento CO2)
- 8:58 **aperture** finestre (Co2 sale)
- 9:55 CO2 diminuisce
- 10.00 sono visibili vari **picchi** a causa di qualcuno che durante l'intervallo si è avvicinato alla centralina
- 10:51 **apertura** finestre (C02 sale)
- 11.19 **chiusura** finestre
- 11:51 sono visibili **vari picchi** a causa di qualcuno che durante l'intervallo si è avvicinato alla centralina.
- 12:07 **apertura** finestre
- 13:04 CO2 **diminuisce** ma presenti picchi
- 13:38 CO2 **aumenta** la classe sta per uscire
- 14:00 CO2 **diminuisce** lentamente
- 14:22 la centralina **smette di monitorare**, viene **staccata la corrente** nella scuola.

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Event log to be used in CO_2 monitoring experiments
Доклад за дейността при мониторинг на CO_2

Type of activity (вид дейност): Monitoring CO2
Info about workspace (информация за работната среда) - School environment
School and Class (училище и клас) - Professional High School in electronics „John Atanasov" – Stara Zagora
Room destination (номер на стаята) - 313
Room surface (площ на стаята) - 30 m^2
Room volume (обем на стаята) - 90 m^3
Number of windows (брой прозорци) - 2
Window opening surface (площ отваряеми прозорци) - (0,8 x 2) m^2
Position of monitoring stations (разположение на устройството) - On the teacher's desk, adjacent of an openable window
Position of HVAC (??? Отоплителни , вентилационни системи) - Radiator 3m^2 away
Average number of occupants (среден брой на хората) - 13
Average occupation time (school hours?)(учебни часове: начален час-краен час) - 8:00 – 13:50


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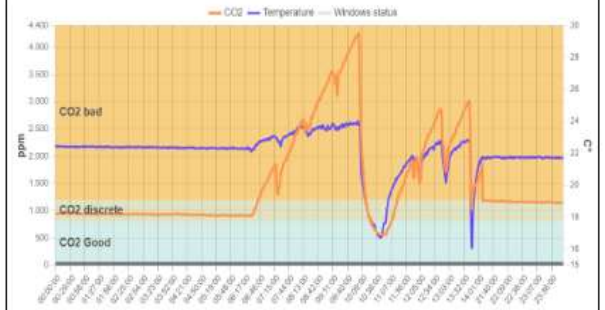
Event log to be used in CO_2 monitoring experiments 09.01.2024



Type of activity: Continous Monitoring

Info about workspace

School and Class : a IX-a A
Room destination : TEACHING ACTIVITES
Room surface: 100 m^2
Room volume : 330 m^3
Number of windows: 3
Window opening surface : 6 m^2 (all windows)
Position of monitoring stations : See map
Position of HVAC: No HVAC
Average number of occupants : 20
Average occupation time (school hours?)
6h / day

La CO_2

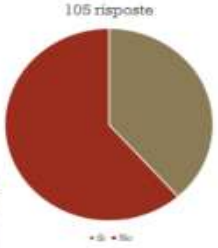
L'anidride carbonica è un gas serra che, ad elevate concentrazioni nei luoghi chiusi, può causare molteplici problematiche come **stordimento/mal di testa/difficoltà cognitive e di attenzione .**

Ecco perché si consiglia l'apertura delle finestre periodicamente durante la giornata scolastica.

SONDAGGIO

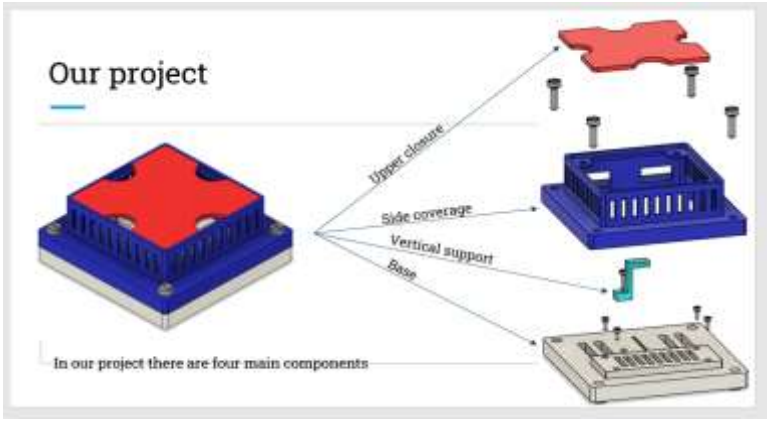
Abbiamo condotto un sondaggio tra i nostri compagni e le nostre famiglie

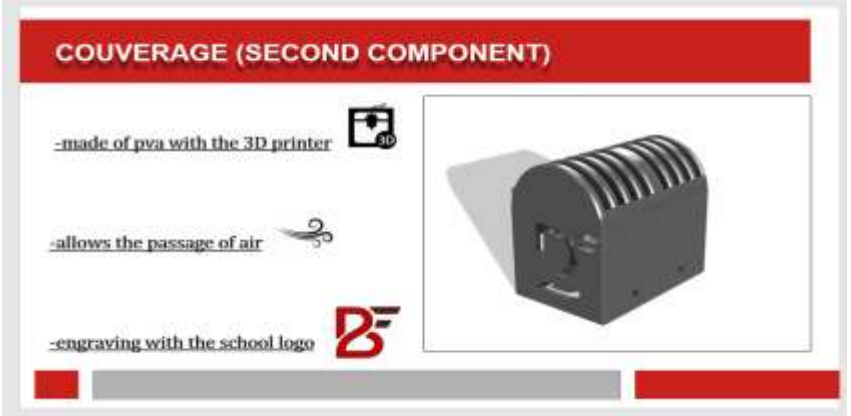
SI CONOSCE IL MASSIMO LIVELLO DI CO2 IN UN AMBIENTE CHIUSO?



3. CUSTOMIZED PRACTICAL ACTIVITIES

On March 5th, 2024, students of class 5AM (mechatronics) from IIS Belluzzi Fioravanti ("CHANGE" partner school) have presented their designs of the personalized CO2 sensor support.

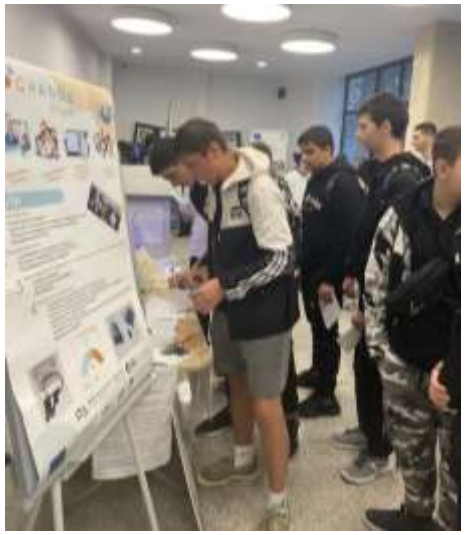




4. DISSEMINATION IN PUBLIC EVENTS

EU RESEARCHERS' NIGHT BOLOGNA (IT) & AVRIG (RO) 29/09/2023

FESTIVAL DELLA CULTURA TECNICA BOLOGNA (IT) – 16/10/2023



Regional panorama of vocational education and career guidance
Stara Zagora (BG) – 2023 & 2024

EL BAUL DEL ESTUDIANTE
ELDA (SP) – 24-25/04/2024

And many more…..

QUALITY OF AIR
Sibiu (RO) – 2024

FINAL CONSIDERATIONS

- The students acquired skills in performing monitoring activities with high scientific value → CITIZEN SCIENCE.
- The pathway increased the awareness of teachers and students on the imprtance of healthy living conditions in indoor spaces.
- An efficient implemetation of the pathway requires a strong sinergy and collaboration among teachers of STEM subjects (Physics, Chemistry, Mechanics, Electronics, Computer science,…..).
- According to the feedbacks received from the students, the «digital» features (Python coding, Web-App development, data processing,….) should become the most relevant part of the pathway.
- The pathway, currently centered on CO2 monitoring, can be tailored and improved for the monitoring of different compounds and pollutants.

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Research Area of Bologna
Bologna CNR Technopole
Via P. Gobetti 101, 40129 Bologna (BO), Italy

E-mail: info@consorzioproambiente.it
Phone: +39 051 639 9990
Website: www.consorzioproambiente.it

CONTACT PERSON: Enrico Cozzani
E-mail: e.cozzani@consorzioproambiente.it
Phone: +39 051 639 9978

@proambientelab
@ProambienteLab
@proambientelab
@proambientelab