

# Empowering Students Through Hands-On Geosensing: A Transformative Approach in Geography Education

Natalie C. Ceperley (natalie.ceperley@giub.unibe.ch), Peter Leiser, Bettina Schaefli



**Mission:** Redefine the traditional "field" course to a learning-by-doing course on site

## Pedagogical Framework 2022 & 2024

7 (+1 presentations) course days (1 in May to launch ; 5 in August for workshop), 3 instructors (scientist, technician, ~~assistant~~); 11 students (MA geography, diverse competencies in terms of science and technical, various timelines for master research)

motivation of students & instructors, support from geography institute & (FIL-university)

constructive alignment, self-directed learning, collaborative workshop

scientific questions; micro electronic sensors; communication of data & results

+ design thinking

literature, presentations, observations, independent learning, ilias platform (forum, ~~etherboard~~, learning resource), feedback rounds, peer-feedback, troubleshooting, field installation, visualization, inner- and intra- group exchange

+ scavenger hunt

participation, presentation, ~~proposal~~

scientific questions, measuring devices, data sets, evaluation of learning

learning journals

technical competence, knowledge, familiarity, ~~raspberry pi~~, python, field work, scientific maturity, scientific process from question to collection to data to answer to communication, exposure to proposal, good collaborators

better scientists and teachers

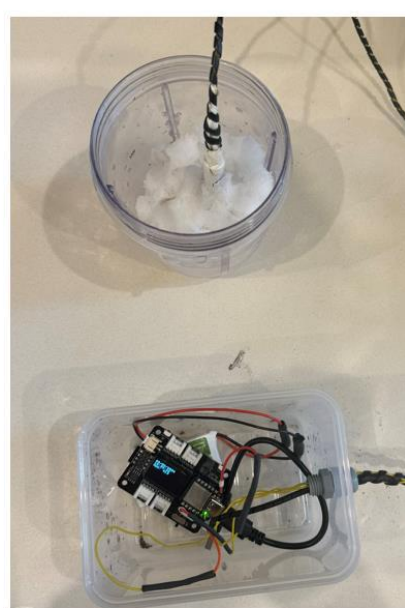
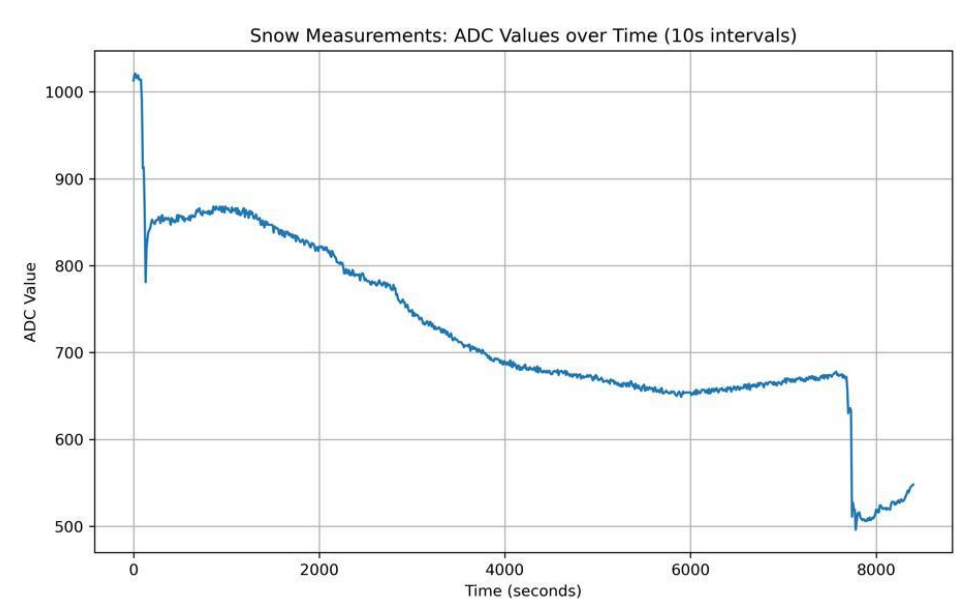
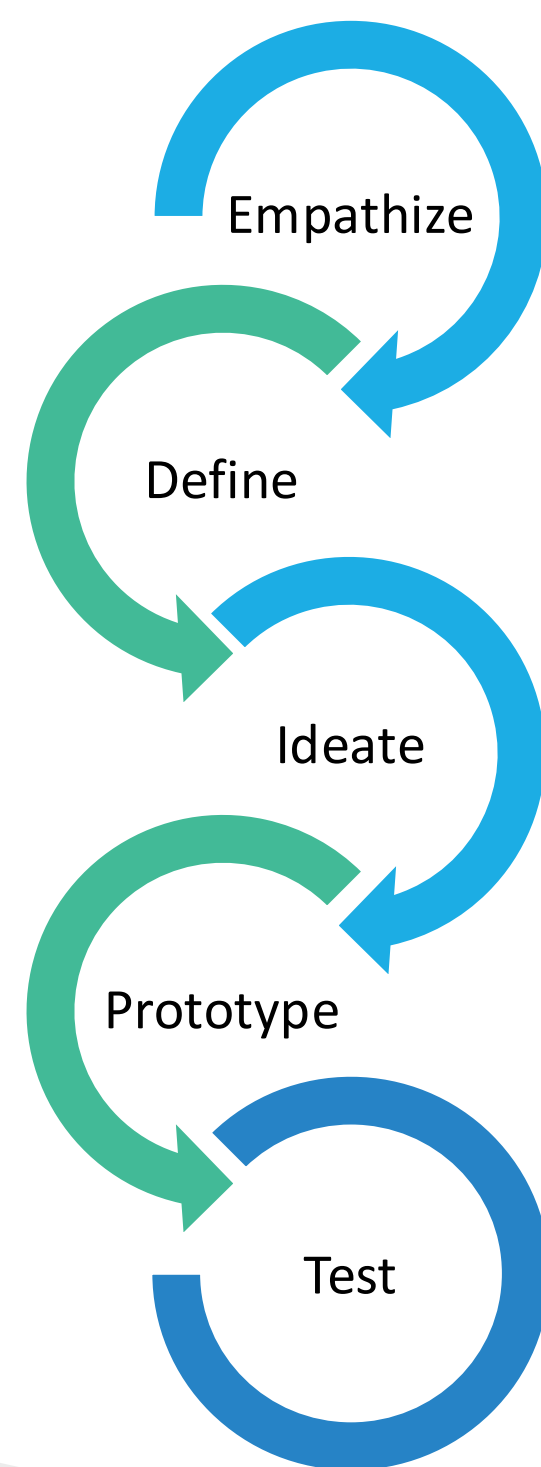
## Self-Directed Learning (April – August)

- Goal 1: Foundation in Arduino
- Goal 2: Generate & Share ideas
- Tool: Ilias (online learning platform) with Seeduino book
  - Learning Journals (Metacognition, Track progress)
  - Forum (Exchange, Troubleshoot, Brainstrom)
  - Library (Examples of Sensors in Literature & Web)



## Workshop: Format

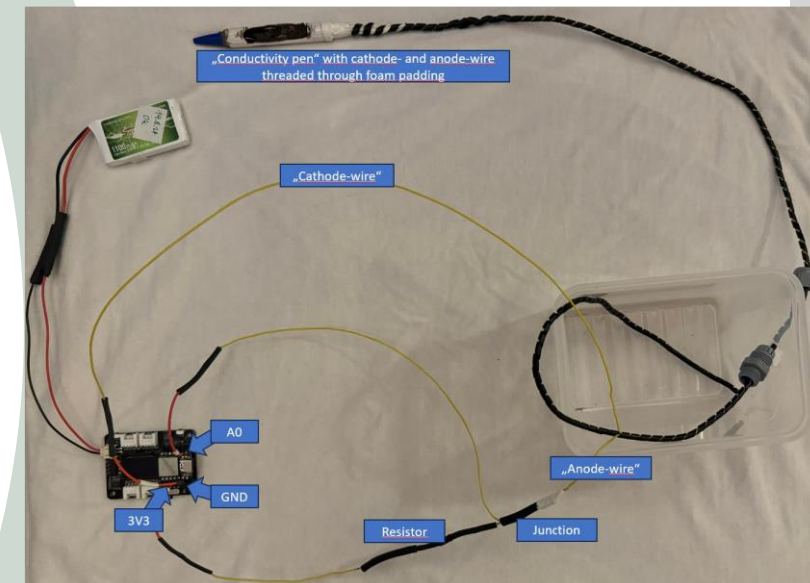
- Course Layout: 6 cycles of "feedback rounds" linked to 6 Themes & Design Thinking Steps



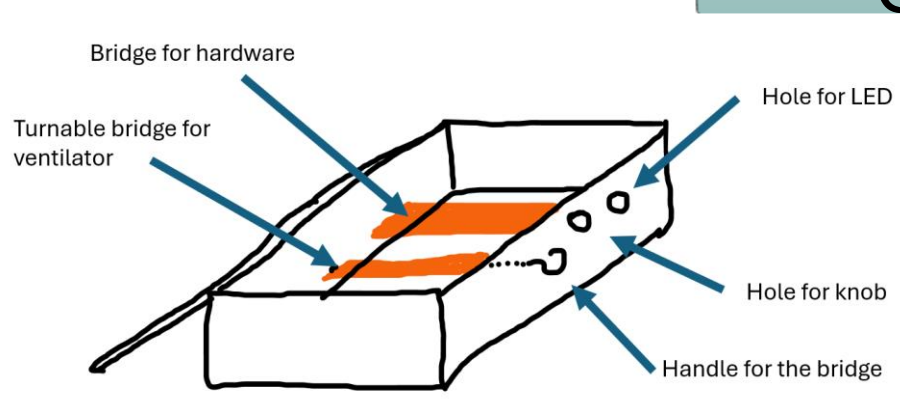
Scientific Questions

How does the CO2 concentration change over time in a closed environment over vegetated soil and bare soil?

Sensors



Data Analysis Communicate

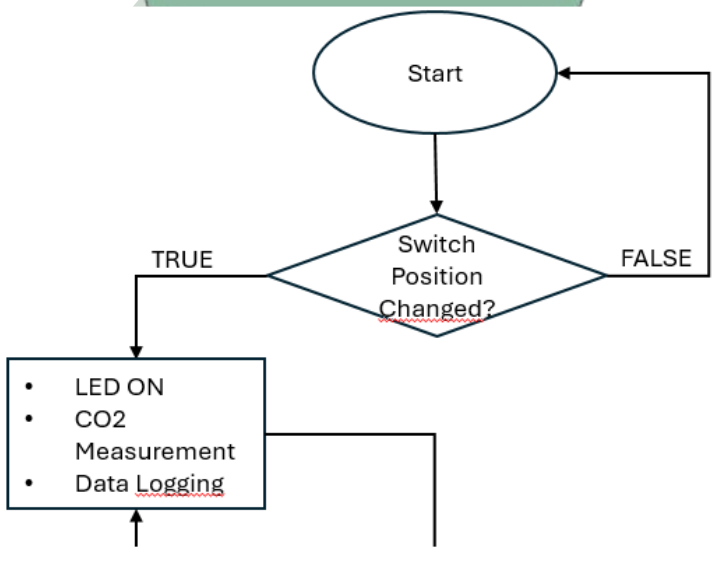


Casing, Hardware



Troubleshoot

Software, Libraries



1. What 3 things did you learn this summer?

2. What 2 questions do you have for your class mates?

3. What is your number 1 goal for this workshop week?

## Check-points:

1. Learning Journal entries complete after each self learning module, each day of workshop and after course (also to give open-ended feedback)
2. Informal check-in at the start and end of each group workday.
3. Group Feedback at course start, transition to workshop, and end

## Lessons from 2 years

- Trade-off between structure and unstructured / input and self-led activity must be integrated.
- Switch from technical learning to creative learning is hard for students.
- Structure design thinking with clear steps, tools, handouts and time limits.
- Stop 15 minutes early for group reflection; the morning and afternoon check-ins are important during open-ended days.
- Be careful that the grade reflects the creative process and the resulting product.
- Learning Journals are great, but the format could be improved in Ilias (i.e., export function).

## Feedback (+)

- Enthusiastic, I would recommend it!
- Learning journal to track own progress
- Open => creativity (biggest learning!)
- Arduino! Don't feel intimidated = dive in!
- Group work was nice because we could define the roles/ choice of more division or equal learning
- Self-study phase especially good
- Hands-on learning aligned with my strengths.
- Liked starting with a concrete exercise

## Feedback (-)

- Dragging at times: too much participant initiative, pedagogical methods, and discussions
- Too much uncertainty, give us more concrete examples
- Tell us more about the learning journal and specific goals (i.e. photos, sketches, deadlines)
- Solicit less general feedback
- It was hard to solve problems (need lots of input)

## Ideas for Future (2026)

- Recruit more students – cross listed in multiple master programs (perhaps with Enlight network? )
- Find students who will use it to prepare their master projects
- Expand summer learning to include calculation of storage and energy requirements, monitoring power levels, adding SD card and writing data to it, improving clock function (some of this could replace the casing lecture)
- Expand teaching to include communicating with LORA
- Add a pressure sensor to our kit
- Add more examples of different date stamps and a game to learn to import them quickly
- Discuss official rules, permissions, equipment labels, and desiccant to casing lecture
- Teach troubleshooting with role playing scenarios to figure out
- Bring in the 3D printer (new to us!)
- Have access to more "maker" equipment, i.e., craft material
- Have more concrete guidelines for manuals and intermediate tasks in class to assemble its contents (i.e., diagrams)

## Acknowledgements

- 2022 Support from the "Förderung Innovative Lehre (FIL)" via the Vice Rectorate of Teaching at the University of Bern
- Participants from 2 years, Linus Fässler (Assistant year 1)