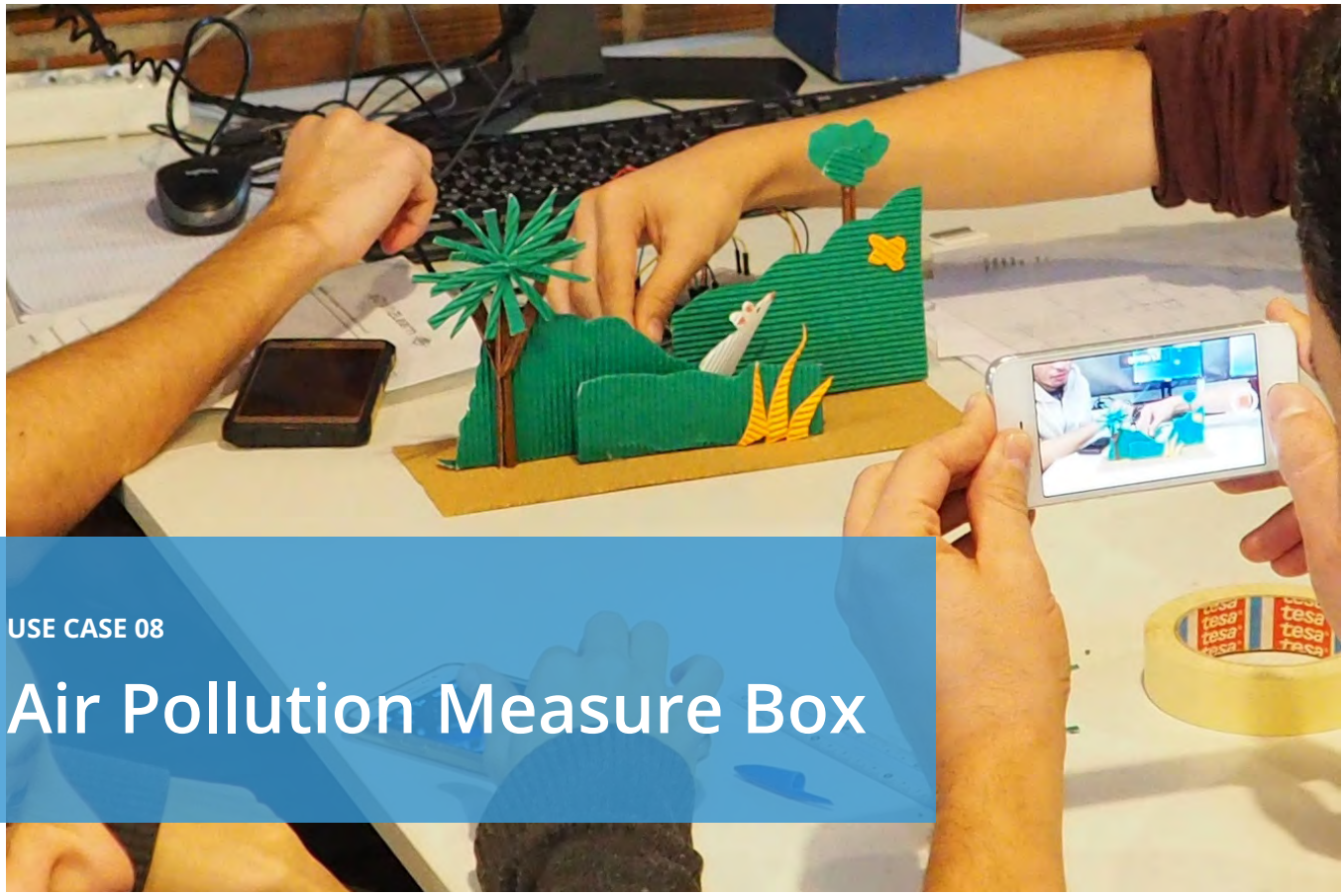

USE CASE 08

Air Pollution Measure Box

Age & Level

Anna, Austria
Teacher for Biology, Maths & Physics
39 years old

Anna, 39 years old, is a second-grade student teacher for Biology, Maths and Physics in Austria. The new system of 'Neue Mittelschule' is meeting very much her personal way of teaching. A personal attitude of her being as teacher is to enable and empower students and connecting theoretical knowledge with practice. Thus, she is balancing her teaching a lot with different teaching methods and pedagogical approaches. She also tries to foster team work amongst the students since she is convinced that this is a core skill for the next generation. She tries hard to integrate the obligatory curriculum plan with the student projects, and is getting better at this every year.

Primary Actor and Main Goal

Anna lives on the countryside in the mountains. Since ozone pollution is higher in the mountains, she plans to raise the awareness of her students towards air pollution. Last year she had everyone collaborate on the same project, but this year she wants the students to be freer to come up with their own ideas. She decides that all projects need to incorporate some specific technical components, and that they need to bring awareness of the invisible concept of air pollution.

From previous projects she knows that most of her 14-year-old students only have very basic skills in electronic or even programming, but all of them are very capable to handle different programmes. Some of them did amazing crafting the year before. As for herself, she has to confess that her abilities in programming or crafting is limited thus she is aware that she would need very clear and detailed instructions to get started on a project. Some time ago she talked to her colleague Mike who teaches IT in the class and he was willing to collaborate in case she finds an appropriate project that fits also to the IT curriculum. Together, they agreed all students would need to technically incorporate at least one sensor input, and any type of output. Apart from that, the students would be free to innovate.

Topic and Content

Searching on the internet, she discovers the eCraft2Learn platform and decides it's the perfect tool for her students since it supports team work. It provides her a frame for how to plan for her current as well as future student project assignments.

Reading on the instructions, she understands that she will need to provide prior to the project, some theoretical background knowledge to air pollution but since these fit well with the current school year curriculum she continues reading the other teachers experiences that have been shared on the eCraft-2Learn platform.

Description of Environment and Possible Pre-conditions

Anna and Mike start by looking through the electronics and tools inventory from last year, to sort out all broken components. This takes longer than expected, and Anna decides that next year she will do this as soon as the term has ended.

After they have spent some time researching what materials and tools to purchase for the pollution theme, Anna calculates the related costs for materials needed. After making sure the cost falls within the yearly budget, Anna pays a visit to the local electronics store in the outskirts of the town. She spends the following days sorting components into compartments boxes, and makes sure to label all components and resistor values. She learned this from last year, as all components and resistors quickly became a mess.

Mike makes sure to update the computer rooms software with the latest version of the Arduino IDE. He also makes sure all students have access to the eCraft2Learn platform that has been installed in the classroom.

Preparatory Work

wo weeks later Anna starts with the educational content preparations. She decides to give some first initial input before starting the project in order to allow the students to gain a broad context of pollution, talking about atmospheric ozone, carbon dioxide emission, methane gas, and other substances that affects air quality.

Starting out, she wants all students to follow instructions to connect an Oxygen(O2) gas sensor, to read the values with an Arduino. This ensures individual assessment. For the project, she and Mike then give them the exercise to use incoming sensor values, from a gas sensor of their choice, to control an LED, a motor, a Piezo, or any other component. This, along with an explanation of what their code did, was the minimum technical solution and deliverable they needed to implement in order to pass Mike's IT class learning goals.

Anna, on the other hand, was more interested in the biological pollution aspect, as well as the introduction of mathematical concepts such as < (smaller than), and >(bigger than) being used in the conditional statements. Other than that, she is also interested in how well they are able to collaborate and execute a project in groups, and plans to have the students keep a log of what they are doing. She later finds this type of activity tracking is partially integrated into the eCraft2Learn system.

She books the IT room and the crafting room in accordance with Mike, gets the o.k. from the headmaster and organizes the needed materials (Arduino boards, jumper wires, breadboards, gas sensors, and various other electronic components).

Description of Activity

Anna gives her students the task to learn about air pollution. She splits her students into eight small groups, and ask them students to list causes, solutions, and to locate what gases are polluting the environment, and how. The students are told to work in groups to visualize the findings in one poster, and are then paired with another group to present their findings. The paired groups are then instructed that they now work together, and that they are supposed to create an interactive system that can detect one or more types of air pollution, and then carry out one or more actions(outputs). The teams brainstorm, present their ideas, and are given feedback on them based on relevance, usability, and feasibility. The concepts students have created are;

• A sensor box that opens a window when CO2 levels are too high
• A fart (methane gas) sensor that makes a Piezo beep as a threshold is reached
• An Ozone map (built to represent ozone levels in different areas around the school)
• "Bach's air" - a portable instrument made out of sensors. The different inputs are transformed into tones for different instruments or music loops.

Anna and Mike meet the teams one by one, to help them iterate their ideas, and to understand what tools and materials they will need to complete the projects. After a few days, the 4 teams meet in the drafting room. Anna and Mike have brought the materials each group needs, meaning the practical part of the project has begun. Students take on different roles in the teams, and to ensure everyone are actively involved, they meet with the teams and have them describe their work. every week. The teams are encouraged to solve the problems they stumble upon on their own, and during the weekly support meetings they mainly get hints and links to relevant resources. They can also book Mike for an hour to help out with the soldering of the circuits.

Most groups have similar problem, such as dealing with gas sensor warm-up time, and setting appropriate threshold values. Some groups want to build their electronics into boxes, and get help from the wood crafting teacher. Anna and Mike decide to plan for her to be on board for the projects next year.

After five weeks it is time for final presentations. The students are asked to give a background description based on their initial research, demonstrate their prototype, and to talk about what they've learned throughout the process. One group of students are not finished, and their prototype is only half done. They are asked to present their project later, and are told they cannot get the top grade for their project.

Other Stakeholders and their Possible Interests

As the wood craft teacher is contacted by the students to help them build cases for their electronics, she starts to imagine ways to incorporate these types of projects in her curricular activities. She starts to think about complex mechanical structures, as well as product design angles.

After discussing her thoughts with Mike and Anna, she decides that a laser cutter and an Ultimaker 3D printer should be purchased for next year. They also agree to collaborate more the following year, and have at least three cross curricular student projects that can be executed in a similar way.

To ensure their hours can be scheduled in synch to make this happen, they talk to the school principal. The principal is positive to this development, and encourages the teachers to present this at the next teacher meetup so that it can inspire other subject teachers to do the same.

Success and Condition

One week after the project is over, the last student group is able to demonstrate their prototype and get their grade. They are asked to write a post mortem to reflect on what they could have done different to deliver on time. In the end, all four teams were able to conduct research, create concepts, realize their ideas, and present their project and share what they learned to the class.

Failure and Conditions

Anna and Mike learned that their schedules needed to be more in synch, that they lacked the time, knowledge, materials and tools to build the electronics into physical objects. It was hard to keep track of the students' individual contributions to the teams, and this was something they wanted to improve for the following year.

Extensions

Some students started tinkering after school, and would create interesting devices at home.

Variation

The brief given to the students could be made more defined or open depending on the topic. The themes and topics could be varied as well.