

STEAMing English: Should I breathe or should I no?

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Summary: This article provides an example of a project-based learning centered on the theme of air pollution. The project was carried out in a primary school with students from 12 to 13 years old in English foreign language lessons, using the STEAM approach. The primary objective was for the students to research the causes and effects of air pollution in their community and hence become more engaged in community issues, apply scientific research to issues meaningful to them, and learn to protect themselves from air pollutants.

Keywords: STEAM, air pollution, research, experimenting, peer learning

Introduction

I have been working as an English language teacher for 17 years at a primary school located in a rural area of Tuzla in Bosnia and Herzegovina. My students, aged 6 to 14, learn English as their first foreign language. The Tuzla region is known for a large coal power plant and a long history of coal mining, with heavy reliance on coal as the main source of heating in winter. As the city is situated in a valley surrounded by mountains air pollution is a serious local problem.

In October 2022, I completed a MOOC (Massive Open Online Course) called *STEM Out of The Box: A STEM approach to non-STEM subjects* (Molina et al., 2022). The final assignment was designing a learning scenario which I then implemented in my English language classroom. According to the World Health Organization, Tuzla is one of the most polluted cities in Europe (SRNA, 2018), so the objective was for my students to learn about the causes and effects of air pollution and how to protect themselves. The project was implemented in the 8th grade with 12- and 13-year-old students. Although this topic is not a part of our standard English language curriculum, teachers may make alterations to the content of their classes, allowing me to develop this project-based unit in which students outlined their hypothesis, implemented a two-week field experiment, and presented their results.

Project-based learning through STEAM

STEAM is an educational approach to learning and teaching which combines Science, Technology, Engineering, the Arts, and Math, at the same time allowing learners to develop and improve 21st-century skills: critical thinking, communication, collaboration, and creativity. In recent years, I have been incorporating STEAM in my English lessons to introduce my students to STEAM-targeted language. According to Mason (2020), this would involve things like vocabulary and readings on different STEAM projects.

The project activities involved several phases:

- Science and Technology: researching air pollution, consulting a physician, and presenting findings;
- Experimentation: demonstrating air pollution through scientific experiments;
- Engineering: building alternative power production models;
- The Arts: fostering creativity through song rewriting;
- Math: calculating CO₂ absorption by trees;
- Public presentation: showcasing project results at the Tuzla Center for Ecology and Energy and on local and national TV.

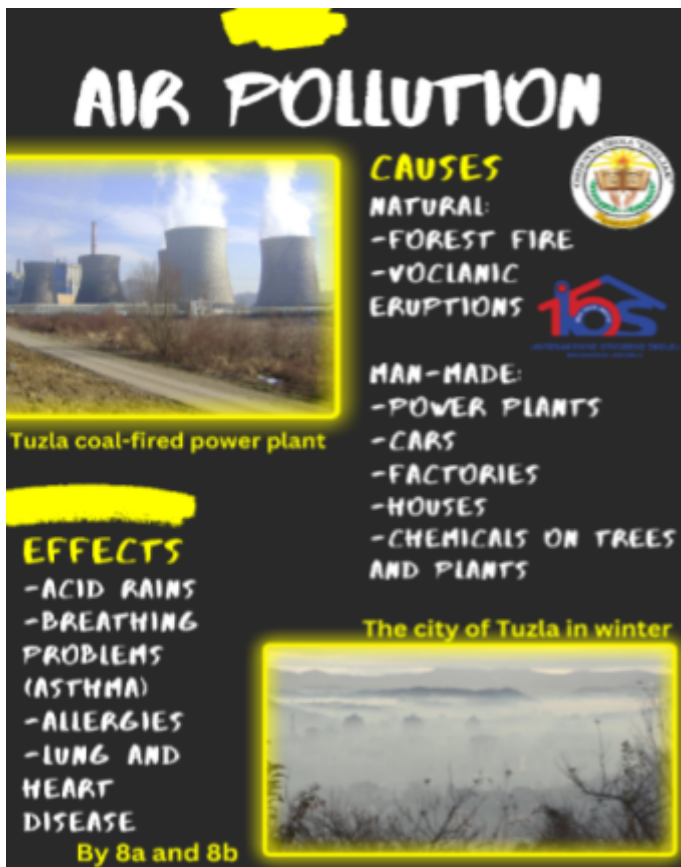


Figure 1: Class poster on causes and effects of air pollution

Science and Technology

First, during the introductory lesson, we discussed the causes and effects of air pollution. My students were able to identify a few causes (e.g., cars, houses, and the power

plant) and effects (e.g., coughing, heavy breathing, and sore eyes). I then played an educational video *Air Pollution for Kids* (Learn Bright, 2021) to teach my students new information about air pollution. During this lesson, I also presented Canva, a digital tool my students hadn't used before, but continued to use during the project (and later on in other school subjects when making presentations). Students then listed what they knew from our discussion and what they learned from the video, which resulted in a single class poster on causes and effects of air pollution (see Figure 1).

Next, we brainstormed a list of topics to research, including fine particulate matter (PM2.5), the number of children affected by air pollution in Tuzla and globally, and types of diseases caused by air pollution. The students were instructed to prepare presentations, paying careful attention to sources and using data provided by different health institutions. They formed groups of two to four and had two weeks to collaborate and research one topic to prepare presentations.

Before the actual presentations, I used an image of the body organ system displayed via projector to pre-teach medical terms such as lungs, bloodstream, respiratory, and cardiovascular system, etc. A peer feedback form (see Table 1) was then distributed. Volunteer students read the elements to be assessed, and translated them into their first language(s) (L1). When students presented their findings, their classmates were captivated by the material. Their presentations taught us that PM 2.5 are very small particles found in the polluted air which can get into our

bloodstream, affecting our lungs and heart, that children are at greater risk as they usually breathe through the mouth rather than their nose which results in greater amount of inhaled pollutants, and that polluted air frequently causes or aggravates cardiovascular diseases, chronic obstructive pulmonary diseases, asthma, lung cancer, stroke, allergies, etc. Because of the advanced English words related to health and science, I scaffolded throughout the presentations using L1 as necessary. Nevertheless, it was clear that visual aids made it easier for the students to acquire new items more quickly. The presenters

	Excellent 5	Very good 4	Good 3
My classmates understood their topic and prepared well.			
My classmates' talk was clear.			
My classmates' presentation was interesting.			
The balance of text and images in the presentation was excellent.			
I understood my classmates.			
I've got all the information about the topic.			

Table 1: Peer assessment form



Image 1: Zoom meeting with a physician

were assessed through a simple checklist. I opted for peer rather than teacher assessment in order to provide a more comfortable learning environment for students and to offer them a diverse range of perspectives on their work, beyond the teacher's viewpoint.

After the presentations, a class Zoom meeting was arranged with Lejla Alidžanović-Nurkanović (see Image 1), a physician at the University Clinical Center Tuzla so that she could verify my students' findings. Speaking in English, Dr. Alidžanović-Nurkanović not only confirmed the information students had gathered, but also explained that the number of ill people, especially children, considerably increases in winter owing to poor air quality. She communicated with the students using level-appropriate language with short, simple sentences, avoiding medical terminology (choosing 'lungs' instead of 'pulmonary', 'heart' instead of cardio') and pointing to the body part or system being talked about. She provided valuable recommendations on how to protect oneself such as using available applications to monitor air quality, remaining inside when the air quality is hazardous, reducing outside physical activity, wearing appropriate masks, and using air purifiers inside. During this meeting, several students with high proficiency in English acted as translators for their classmates.

Experiments: Hypothesis, observation, result

To continue the learning process and provide better understanding of air pollution severity during the winter, we conducted a scientific experiment. In this experiment, the students constructed air pollution catchers by applying petroleum jelly to white paper plates and placing them in various locations around the school and their homes for observation over a two-week period. This activity encouraged engagement in the scientific method by hypothesizing outcomes, observing the catchers, and ultimately recording their findings to either prove or disprove their hypotheses. The language of STEAM is centered on the scientific method and problem-solving, which involves observing, questioning, predicting, experimenting, and discussing (Miralimovna, 2022).

Although the majority suggested placing the catchers above their front doors, some suggested using contrasting locations near the school grounds to see if differing test environments would result in different findings. Given the school's rural location, a forest (Figure 2) was selected as a *healthy test environment*, with the students designing protective covers for the catcher. Conversely, the school coal boiler room (Figure 3) was identified as an *unhealthy test environment*. Depending on the location, the students



Figure 2: Poster authored by Miran Anđelić, a student in the author's class of air pollution catchers in the forest

gave different hypotheses such as *I expect the catcher above my front door to remain pretty clean in two weeks period, I assume the catcher in school boiler room will be very dirty in a short period of time, and If I put my catcher in the forest, it will stay clean during the observation period.* At the end of the two-week period, students presented the findings. The class's hypothesis that the air we breathe is very dirty was proven true. The contrast in results between the clean (forest) and dirty (school boiler room) test environment was striking (see Figures 2 and 3). Although PM 2.5 particles cannot be seen by the naked eye, the changes on the school boiler room catcher were quite visible.

I also introduced a practical demonstration of temperature inversion, a natural phenomenon common during the city's winters. Under normal conditions, temperature decreases with an increase in altitude; however, under certain conditions, the situation becomes reversed and the temperature starts increasing with altitude rather than decreasing. As the cold air stays down (blue water in our experiment), and warm air goes up (red water), it creates "a trap" for air pollutants (invisible layer between the two colors) (see Image 2) near the ground and prevents the dispersal of smog. This experiment demonstrated to students that it is not just the human factor causing or contributing to air pollution. Additionally, it helped us learn or practice vocabulary concerning everyday household items (jar, tube, funnel, wood skewer, and kettle) and cooking-related verbs (pour, stir, and boil).



Figure 3: Poster authored by Danijel Galušić, a student in the author's class of an air pollution catcher in school boiler room

Engineering and power production

Wanting to broaden my students' understanding of alternatives to coal-fueled power production methods, I collaborated with my colleague Sanela Džinić, who teaches Technical Culture. The subject guides students to apply knowledge in technology in everyday life. During her lessons, students made models of solar-powered houses, windmills, and hydro-electric plants. These activities provided an opportunity for students to engage in various construction processes and learn about power production. Their models were successful in generating electricity. Again, collaborating in pairs or groups, the students prepared and gave short presentations to their classmates,

A Practical Demonstration of Temperature Inversion

To demonstrate normal weather conditions, pour blue-colored cold water into a jar, then place a tube at the bottom of the cold-water jar and slowly pour red-colored hot water into the cold one through the tube. You will see that the two colors mix.

To demonstrate temperature inversion, pour red-colored hot water into the jar. Again, place the tube at the bottom of hot water jar and slowly pour the blue-colored cold water into the hot one. You will see that cold water stays down, and red goes up. There is an invisible layer between the two that doesn't let them mix.



Figure : Poster authored by Edis Kamberović, a student in the author’s class which includes calculations of the number of trees needed to absorb CO₂ produced by the power plant Tuzla

naming different parts of their models in English (solar panels, wind turbines and blades, transformers, generators, etc.).

Math in English

Another colleague, Mersida Muminović Muminhodžić, who teaches math, also lent her expertise by providing a formula for calculating the number of trees needed to absorb the CO₂ emissions from the Tuzla coal-burning power plant. First, students needed to learn that in one year, this plant emits 2,471,215 tons of CO₂, and one average tree can absorb 21 kg per year. Next, using the formula, and the data that an average 12–15m tree takes 3m x 3m of space and the size of Tuzla canton (a country’s territorial division) is 2,649 km², my students were able to calculate that 39% of the canton should be covered in trees

to absorb CO₂ produced by the power plant alone (see Figure 4). This task helped students go beyond the typical expectations of their learning because students study numbers in primary school in their English lessons, but they don’t normally do any calculations. However, in this activity, they have managed to explain mathematical calculations in the L2.

The arts and creative writing

Although many of the activities in this STEAM project involved either writing or speaking English, creative writing emerged as a favorite amongst the students. As I used the song *Should I stay or should I go* (The Clash, 1982) to title our project *Should I breathe or should I no*, the students were encouraged to showcase their creativity in rewriting the original song to reflect the theme of air pollution. See Table 2 for some students’ examples:

Rewriting songs can help students develop a contextual lens by analyzing the original song’s lyrics, themes, and messages and then adapting them to fit the context of their topic. This process fosters critical and creative thinking about how the song’s content can be reinterpreted to convey their message about a real-world problem, in our case air pollution.

Public presentations of project results

Upon completing the project activities, students visited the Center for Energy and Ecology in Tuzla. The purpose of the visit was to meet with high school and university students working on the project *Youth for Clean Air* and exchange the information gathered and results obtained in the projects. The meeting enabled my students to share

Original song	Students' version
Darling, ... It's always tease tease tease You're happy when I'm on my knees...	Earth, ... It's always pollution, pollution You're happy when I'm not finding a solution...
This indecision's buggin' me I can't breathe, I can't be free	This indecision's buggin' me If you don't want me, set me free
Exactly whom I'm supposed to be Don't you know which clothes even fit me?	Exactly, what am I supposed to do Don't you know you need me too?
Should I stay or should I go now? If I go, there will be trouble And if I stay it will be double...	Should I breathe or should I stop now? If I breathe there will be trouble If I don't it will be double...

Table 2: Creative re-writing of a popular song

their knowledge, practice public speaking skills, and learn more about our hosts' activities in advocating for changes with local community members, industry representatives, and government officials. Finally, one local and one national TV station visited the school to report on our project results, which additionally highlighted the significance of my students' work.

Conclusion

With the above-mentioned activities, I successfully integrated all five STEAM areas in my teaching scenario while simultaneously enabling my students to improve 21st-century skills: critical thinking, communication,

collaboration, and creativity. The students studied air pollution and its effects on human lives, developing their skills in stating hypotheses and conducting scientific experiments as well as their critical thinking skills by gathering and analyzing data and evidence to test those hypotheses. The students used technology to do their research and prepare their presentations, and some lessons were given in the form of a video or a video meeting. The students also presented their findings to their classmates and to peers at the Center for Energy and Ecology Tuzla and two TV stations, which provided them with additional opportunities to improve communication skills and feel the impact of their work on the

larger community. Making models of renewable and green power production, the students engaged in some engineering processes and managed to produce electricity themselves. They also worked in small groups, which developed teamwork and their collaboration skills. My students expressed their artistic sides in their creative presentations, but most important (for a language teacher) in creative writing. Finally, they sharpened their mathematical skills by using English in their calculations. The students' writing and speaking using STEAM-related vocabulary was my biggest reward. Overall, these STEAM activities have provided a well-rounded learning experience.

References

- Learn Bright. (2021, March 30). *Air Pollution for Kids | Learn about the Causes and Effects of Air Pollution* [Video]. YouTube. <https://www.youtube.com/watch?v=Yjtgu2CxtEk>
- Mason, K. (2020). Picking up STEAM: The role of languages and linguistics. *The STEAM Journal*, 4(2). <https://doi.org/10.5642/steam.20200402.02>
- Miralimovna, M. Y. (2022). Integrating Steam in English language classrooms (K1-K2). *International Journal on Integrated Education*, 5(2), 140-144. <https://journals.researchparks.org/index.php/IJIE/article/view/2735>
- Molina, M., Milenkovic, J., Kane P. (2022). *STEM Out of The Box: A STEM Approach to Non-STEM Subjects* [MOOC]. European Schoolnet Academy. <https://www.europeanschoolnetacademy.eu/courses/coursev1:Scientix+STEMOutOfTheBox+2022/about>
- SRNA (2018, October 31). *WHO: Tuzla among 10 most polluted places in Europe*. N1. <https://n1info.ba/english/news/a294262-who-tuzla-among-10-most-polluted-places-in-europe/>
- The Clash. (1982). Should I Stay or Should I Go? [Song]. On *Combat Rock*. CBS Records.

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