

A hands-on STEM project on the drought in Spain: The impact on scientific and green skills of Dutch high school students

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Abstract. Dutch high school students often question the relevance of learning physics. Addressing this, a STEM project was initiated, challenging students to use their physics knowledge to tackle Spain's drought issues. The project aimed to enhance skills in problem-solving, technical design, automation, scientific literacy, and awareness of career opportunities in physics, providing a real-world context to demonstrate the subject's relevance and the significance of climate change. The impact was evaluated by comparing students without participation, those who only completed the preparatory project, and those who also engaged in hands-on activities in Spain, showcasing the value of applying physics in real-world scenarios.

Introduction

During their final year at high school, physics students have to carry out a technical automation project. At the Martinuscollege (a high school), we have chosen to link this topic to an actual problem in the world, namely the drought in Spain. Students were challenged to design and build (technical automation) solutions to tackle the problem. This year, some of the students had the opportunity to go to Spain to witness the problems in real life and to help locals with small problems related to the drought.

As a physics teacher, my role extends beyond teaching physics; it involves enhancing students' scientific skills, fostering and understanding of climate issues (referred to as Green competences [1]), and providing guidance on study and career choices. While the significance of physics, along with scientific and green skills, is evident to educators, it often remains obscure to students. This STEM project was designed to highlight the importance of these skills. Its aim is to increase scientific and green competences of students, particularly in areas such as problem solving, technical design, automation, scientific literacy, climate awareness and sustainability. Additionally, the project aims to present students with career possibilities in physics and technical disciplines, and elevate students' optimism regarding future climate prospects.

To evaluate and improve the project for the future, the research question addressed in this study is: "How does participating in this STEM project impact the students' scientific skills, career awareness and understanding of the impact of climate change?". The results of this practitioner inquiry (research conducted by teachers [2]) on how to improve the impact of this project will be shown during the presentation.

Description of the project

The project was introduced to the students (22 students) by giving them newspaper articles about the drought in Spain. During a class discussion, the main problems were identified from the articles and prioritised. The group was divided into 6 "engineering consultancies", each with a CEO. The CEOs choose the problem their firm would solve. The first assignment was to do research on the impact and magnitude of the problem and whether there are any known solutions. The second assignment was to identify the main problem for their specific subject that had to be solved and to suggest solutions for this problem. The third assignment was to build a solution with the aid of technical automation. The whole project was designed as a design cycle (identify the

problem, define design rules, make prototypes, test and evaluate). The students worked for three weeks on these assignments and had to present their solutions to each other and to the school board.

Some of the students ultimately went to Spain for the “hands-on” phase of this project. In preparation, students made a website and gave interviews to local broadcasting companies and newspapers. In the Spanish region of Álora, they visited water reservoirs for hydroelectric power and spoke to locals to collect their problems related to drought. The students worked in small groups following the 6 CliPs STE(A)M cycle (this cycle resembles the design cycle but also focuses on presenting, promoting and sharing the results to stakeholders, social media and YouTube). This trip was partially organised by Ponton and 6 CliPs, and facilitated by a grant from Erasmus+. At the end of this five-day trip, the students presented their solution to the locals.

Impact of project on students’ skills, awareness of career opportunities and climate impact

The main aim of this project was to enhance students’ understanding of the importance of physics education in combination with an increase in scientific and green skills, awareness of career opportunities and awareness of climate change. In this practitioner inquiry, three groups were identified: a control group of a different class (15 students), the group that did the project at school but did not visit Spain (12 students) and the group that visited Spain (10 students). To compare the three groups, a questionnaire with Likert scales and essay questions will be given to the students to investigate the effect of the project. The essay questions address the impact and the causes of the drought, the complications that arise when trying to solve the effects of the drought and possibilities for future careers in the (applied) sciences. The essay questions will be analysed with rubrics to reveal whether the students had an increased understanding of climate change (including green skills), career opportunities, scientific literacy, scientific skills and a change in attitude towards future climate prospects.

The achieved outcomes

Hypothesised is that the students that did the follow up trip to Spain show significantly increased skills and awareness of the issues and career opportunities compared to the students that did not go to Spain. The same goes for the group that stayed at home compared to the students who did not participate in the project, though to a lesser extent. The smallest increase is expected for the group that did not participate in this project.

Results are not yet available because the trip took place from February 18th until 22th. During the presentation the results will be presented using effect sizes (due to the small group of students) and a comparison of personal testimonials from different groups.

References

- [1] G. Bianchi, U. Pisiotis, M. Cabrera Giraldez, *GreenComp The European sustainability competence framework* (No. JRC128040). Joint Research Centre (Seville site) 2022.
- [2] M. Cochran-Smith and S. L. Lytle, *Inquiry as stance: Practitioner research for the next generation*. Teachers College Press, 2015.