



INSPIRING PRACTICE |  WINNER |  DOMINICAN REPUBLIC, 2021

## #ENVIRONMENT

# Young Dominicans transform energy from opening doors into electricity

Teacher supports the development of a solution for generating clean energy that passively captures energy from everyday actions

### TEACHER

Lázaro Pérez Acosta

### SCHOOL

Liceo Científico Dr Miguel Canela Lázaro

### STEM AREAS

Science, Technology, Engineering, Mathematics

### PROJECT'S NAME

Integrated passive mechanical energy capture systems

### OTHER AREAS OF KNOWLEDGE

Languages (Portuguese, English, Spanish, native languages, etc.), Social Sciences or Sociology

To open and to close doors. A commonplace act that happens numerous times a day, especially in large businesses and institutions. It was noticing this daily phenomenon that four students and teacher Lázaro Pérez Acosta from Liceo Científico Dr. Miguel Canela Lázaro, located in the Hermanas Mirabal province - the Dominican Republic, decided to develop a device capable of capturing the mechanical energy of this daily movement, transforming it into electricity.

## A STEM school: "from" and "for" the community!

The Liceo Científico, which has Project-Based Learning as its curriculum structure and the STEM focus, is a center of academic excellence, designed as a pilot experience to meet the demands of local civil society for quality education for the youth.

Created in 2012, as a partnership between the Ministry of Education, municipal authorities, and organizations such as the Provincial Technical Department, the Center for Attention to Diversity, the Provincial Office for the Development of Women, and the Casa da Juventude, Liceo is co-managed by the Ministry of Education and the Provincial Technical Department. At school, community and global issues are assumed as triggers of projects of interest to students, bringing together interdisciplinary knowledge, ICTs, and soft skills in a perspective of integral education of students.

The students developed the project as an extracurricular activity, seeking solutions for energy generation that favor the environment, and inviting the teacher to support them. "This generation has a real concern for the future of the planet and this group wanted to contribute to the scientific debate on the subject, based on their investigations," argues Lázaro. "Even in a school that works from projects, this group wanted to go further, dedicating itself to an initiative of theirs, with our support," he adds.

As a starting point, the students started an extensive investigation, raising possibilities in the existing literature on storage and transformation of mechanical energy. Together, they concluded that it was possible to harness the mechanical energy generated by everyday movements. Based on the literature review, the group chose to develop two mechanisms: one that captures the energy generated by the rotating movement of opening and closing doors and a second capable of capturing the "up and down" movements and displacements when someone sits in a chair or changes its center of gravity, transforming, in both cases, mechanical energy into electrical energy. "Initially, we came to think of a third one, operated by water, but from the review itself, we understood that it was not the way to go at the time," explains Lázaro.

## Project learning: combining multiple skills

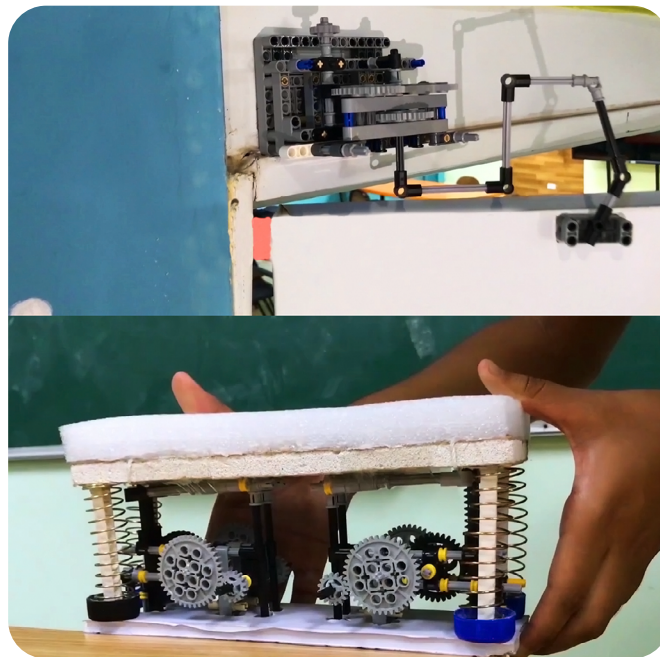
After designing and developing the necessary calculations, the students started prototyping, using kits of building blocks and recyclable materials available at the school, and studying, in addition to robotics, issues such as electromagnetism, the use of servo motors, gear trains, and the use of software for plotting of 3D models for making parts in more sophisticated versions of the prototype. In addition to STEM knowledge, students also strengthened their writing skills, writing the project and proposals for partnerships, and artistic skills, for designing and setting the devices. To this end, the group had support not only from schoolteachers in highly interdisciplinary work, but also from the local university, both to discuss issues of object efficiency, with more rigorous tests and measurements that required more sophisticated equipment, and to better substantiate the proposal itself.

The pickup devices were tested with a direct connection to the mains and in charging modules (batteries) and proved to be quite efficient. "However, from the tests the group realized that the efficiency of the device of the doors, taking advantage of the opening angle of 45th to 60th was much superior, and chose to validate this as a solution", argues the teacher. To work and test the idea at scale, the group established partnerships with local institutions and businesses, managing to conduct the tests in the anteroom of large establishments and a bank in the region. "This knowledge, of establishing partnerships, presenting the proposal, discussing it publicly was also developed throughout the process," explains Lázaro.



### Eureka Moment!

"When we apply the scientific method, in any area, we are subject to our hypothesis not being fulfilled. As the parts of the initial prototype were very delicate, any deviation in the positioning of the gears could lock the system. I felt relieved and celebrated, together with the students, that our projections were correct. The proposal worked!" explains the teacher.



Prototype developed by students

All work was partially developed at a distance, with face-to-face meetings taking advantage of the days of the week when the class was at school, given the distance requirements imposed by the pandemic. “I told them that I was there as a kind of consultant, a mediator for their actions. The work agreed for the week was conducted by them and we discussed the results together and decided on the next steps,” explains Lázaro, praising the willingness and focus of its students. As the project was an extra activity, no formal evaluation methodology was used, but the teacher is certain that the students have grown a lot as scientists. “With this authorial activity and from all the experience of the contest, the group grew a lot! They designed the experience, made and applied questionnaires, created experiments, learned to follow and apply a methodology, in addition to developing a strong sense of responsibility with the collective and dedication to the proposal,” he explains.

For Lázaro, the school’s experience in managing projects and opportunities such as Solve for Tomorrow are concrete ways to improve education quality. “As a teacher, I am having the opportunity to experience what we believe and what is already proven to work in the educational process: a structure for them to develop with autonomy, protagonism, and curriculum knowledge applied to their realities,” he adds. With Samsung’s support, students still managed to structure a business model for the solution.

## Learn more

Access the teacher’s report in the Project Gallery.



## Focus on practice!

Take a look at the teacher's guidelines on how to encourage and guide students in building a clean energy system from everyday actions.



### Empathy



The teacher explains that it is essential that both in regular curricular activities and in extra-class initiatives, students have a central role in the pedagogical process and can actively participate not only in defining the project's questions but in the way they will answer them.



### Definition



For Lázaro, the work of literature review is essential: the scientific method requires students to be able to structure a hypothesis that will be discussed and tested based on a coherent methodology. He explains that there are many ways to store mechanical energy and defining the path to what they wanted to do was essential to the success of the initiative.



### Ideation



For the teacher, it is particularly important to take advantage of the existing resources in the school for the experiments and initial tests of the model. He indicates working from robotics kits, when they exist, but **not forgetting recyclable or discarded materials**, such as old computers. For him, it is from the ideation and initial tests that the best way forward is defined, including financially exempting the construction of the prototype.



## Prototype



With the experiments conducted, it is important to develop prototypes based on reality and available materials and seek partnerships to qualify them. With the support of the university and the school, the group was able to design the systems and print them using 3D printers. The prototypes consist of structures, initially in modular blocks and then printed, to capture the mechanical energy (pulleys, gears) connected by wires to a set of mini-generators.



## Test



The teacher recommends that periodic and open conversations be held with students throughout the process. For him, the evaluation is also a strategy of engagement and mobilization, supporting them to see how much they have evolved, what they need to develop better and establish practical and concrete paths for this.