GOVERNO DO ESTADO SÃO PAULO
Secretaria da Educação

TITLE: PEDALS CLEAN ENERGY AND HEALTH: SMARTPHONE AND TABLETS CHARGER

STUDENTS: Kethellyn de Souza Freitas; Eduardo H Lima

TEACHERS: Cesar Hipolito Pinto

APPLICATION SCHEDULE:

SUMMARY

This study explores scientific concepts through the manufacture of a charger for smartphones and tablets in a state school located on the outskirts of the city of Sorocaba, in the interior of the State of São Paulo, in a region of social vulnerability. Its application took place in the shift of regular classes addressing skills of the National Common Curriculum Base - BNCC. The project includes Objective 4, belonging to the set of Sustainable Development Goals (SDGs) of the 2030 Agenda of the United Nations (UN), which deals with the promotion of quality education, ensuring inclusive and equitable and quality education, and promoting lifelong learning opportunities for all through various educational actions. It refers to the study and construction of an electronic equipment charger powered by a dynamo attached to a bicycle. In addition to the design and validation of the prototype loader, this work involves the testing and characterization of dynamo power, the design and construction of specialized test equipment, as well as the development of a handlebar-mounted case for the smartphone. The use of clean energy makes the project sustainable, besides providing health benefits through the practice of physical exercises. Still under development, the circuit is expected to meet the charging requirements of the smartphone at bicycle speeds ranging from 3 to 4 m/s of speed, inserting the school into the scientific community and providing the dissemination of scientific knowledge with actions of autonomy and protagonism.

Keywords: sustainable; energy; dynamo; Agenda 30; Education.

INTRODUCTION

The use of the internet in education is a significant learning tool in all educational cycles. The COVID-19 pandemic brought an increase in the use of mobile phones and tablets by students in public schools for academic purposes, since school demands required the use of such equipment for the development of online pedagogical activities, due to the social distancing imposed by the daily activities. Many of these demands were added to the daily school, making electronic equipment as effective strategies in the teaching-learning process.

> Technologies can help us, but fundamentally educating is learning how to manage a set of information and make it meaningful to each of us, that is, knowledge. (MORAN,2001, p.21)

Today's smartphones offer a variety of apps for study and research, as well as phone, camera and video functions which in turn are valuable learning tools. Starting from the need to keep such equipment loaded for its constant use, there was the proposal the creation of sustainable strategies developed by high school students of a state school located on the outskirts of the city of Sorocaba, in the state of São Paulo, Brazil. Aiming at the manufacture of a real consumer product and not just a proof of concept, using low cost materials and maintaining certain design considerations, as well as ergonomic and economic factors for the development of the smartphone charger was the objective of this project, the present Academic project features a functional prototype of a smartphone charger whose power supply is a dynamo coupled to a standard bike.

Some products are currently on the market and are designed to power portable electronic devices such as smartphones. However, they all have certain limitations, which this design overcomes. The existing products are bulky, have an excess of cable and some of them can not charge devices at speeds below 5m/s. The charger developed in this project is an ergonomic and simple to use product, capable of

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charging the smartphone with energy at speeds below 5 m/s and has a price comparable to that of existing products on the market.

A case is mounted on the handlebars of the bike, facilitating the student's access to the resource even while pedaling, continuing their research or video lessons. The dimensions and charging requirements of smartphones vary from model to model, and this charger adapts to any Android and IOS model.

JUSTIFICATION

Build a charger for smartphones and tablets using a bicycle and low cost materials, being a sustainable device, generating clean energy and enabling health benefits by practicing physical exercises. Such equipment will be available for frequent use in the school unit, being easily accessible and handling, not preventing the use of the electronic device while charging.

PROBLEM ISSUE

How to charge smartphones and tablets using clean energy?

DEVELOPMENT

The Common National Curriculum Base (BNCC), a document that regulates and consolidates the curriculum proposal for elementary school, presents as general learning objectives:

> Exercise intellectual curiosity and resort to the proper approach of the sciences, including research, reflection, critical analysis, imagination and creativity, to investigate causes, elaborate and test hypotheses, formulate

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> and solve problems and invent solutions based on the knowledge of the different areas. (BRAZIL, 2017, p.9).

As for high school, in the area of Nature Sciences and its Technologies, BNCC points out:

> Given the diversity of uses and the dissemination of scientific and technological knowledge in contemporary society, it is essential for students to appropriate specific languages in the area of Nature Sciences and their Technologies. Learning such languages, through their codes, symbols, nomenclatures and textual genres, is part of the process of scientific literacy necessary for every citizen. (BRAZIL, 2017, p.551).

Based on this theoretical framework and the need to add experimental practice to the regular classes of bncc disciplines, this project took shape. After the formation of a group of students, theoretical classes focused on the theme were held in the shift, so that there were no interfacings in the school routine. After the theory, the assembly of the loader was carried out in stages, always joining theory to practice, effectively contextualizing the maker culture.

> In the educational context, the maker culture seeks to explore practical activities in the classroom, enabling the creation and resolution of problems when constructing prototypes and other objects that aim to develop different skills. (PAULA; OLIVEIRA; MARTINS, 2019).

To start making the charger, the students handled the materials used, researching the functions and functions of each one. They designed the bike support holder and customized it, creating an identity for the project.

As a power supply of the charger, an AC dynamo (from hooverboard motor) was used to the rear wheel of the bicycle, as shown in Figure 01. Nominally valued at 34 Volts, 350 Watts, and dynamo cost between R$ 200.00 and R$ 400.00. These dynamo models can function as an energy source, but may have some disadvantages, such as significant losses in the wheel/generator interface and are not reliable in wet weather because the generator wheel slides, according to Heine and Oehler (2005), as can be seen in picture 02.

With the cyclic energy, the rider may be concerned about the performance, efficiency and amount of energy required to ride a bike. Many bike manufacturers design lighter frames and lower friction components to meet the performance needs of cyclists, so it's important to investigate the effects of using a dynamo to provide power to charge a smartphone.

To design the smartphone charger, familiarization with power source is required. Facilitating dynamo testing, a device rotates the bicycle wheel n a stationary assembly in the laboratory, allowing controlled testing conditions. Picture 3 shows the facilitating test device of all preliminary data collection for this work, and it helped to determine the electrical limitations of the system, such as maximum consumption power and current intensity as a function of human effort.

The bike was mounted on a system of tassels and latlocks made of wood (support designed by the students). The power generation system is coupled to the rear wheel forming a system and interconnected pulleys (pictures 3 and 4), where its rotation axis has the three-phase terminal that connects to the rectifier, made with 6 np 4007 diodes, two capacitors of 1000microF 80V, a green LED and a resistor of 1000 ohms. Its rectified output delivering variable voltage is connected to a voltage regulator that low voltage for 5 volts that meets the demands of cell phone chargers.

After testing the AC dynamo at different speeds and loads, the three variables considered relevant to characterize the system as an energy source were electric current, voltage and power.

The device in the charging phase is in its own case that is fixed on the handlebars of the bicycle, so it can still be used by the user of the system.

Table 1: Charging current required by different models of devices.

Apparatus	*Current A*	*Voltage V*
Iphone	0,61 A	5
Samsung S8	0,87 A	5
Samsung A32	1,13 A	5
Motorola	0,40 A	5
Samsung M32	1,09 A	5

The electrical frequency depends on the wheel speed, number of dynamo pole pairs, and wheel diameter. For each hub/wheel combination, the number of pole pairs and wheel diameter remain constant, so the only variable is wheel speed. Both the voltage and output power of the system depend on the type of load that is connected, according to Liu and Teng (2006)." Tables 2 and 3 show the test results.

The circuit input section converts the HUB AC voltage into DC, provides circuit protection, and reduces voltage ripple. Figure 5 shows the different components in the input protection section. The AC hub input is first rectified to DC for the DC/DC converter. According to Liu and Teng (2006), a rectifier bridge composed of 6 diodes and a capacitor performs this task. SBR diodes are chosen due to their high reliability and low direct voltage drop, which is a desired factor, since the peak input voltage should be maximized to accommodate more speeds.

As Explained by Lopez and Gonzalez (2004), after the input stage the power must be converted from a rectified and smoothed the variation of the DC level to a regulated output of 5 V or 3.6 - 4.2 V for charging the phone or battery respectively. There are several options for voltage regulation, however, since the input voltage may be higher or lower than the output voltage, figure 5.

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RESULTS AND DISCUSSION

Building a charger for smartphones and tablets using low-cost materials and enabling an improvement in quality of life through physical activity and sustainable practices requires a prior study of everything that involves this subject. For this, theoretical research was carried out instigating the scientific curiosity student, proving the protagonism and engagement to the project.

> Physics is a science that studies the different forms of interactions between matter and energy. Because it is characterized as an experimental science, it can be simulated in most cases, either virtually, through several simulator tools, or through real experiences, on a smaller scale that can reproduce the phenomena to be studied. In addition, bringing physical concepts closer to students' reality makes the subject meaningful in order to facilitate learning. This means that Physics is practical and can be checked in the day-to-day life of students. (PINTO; SPIDER, 2018).

The pandemic moment in which we live, by itself, is an immense challenge. Develop and adapt the proposed content to minimize unconsolidated skills that caused lag in learning, provoke scientific curiosity in students so that they may be interested in the subject, instigating another look at the reality that surrounds it and its daily experience, are factors that enrich pedagogical practice. The use of active methodologies, such as the maker culture, were essential for the good progress of the process, as well as the integration of the student throughout the trajectory.

> The maker movement is related to the practice in which the student is the protagonist of the process of building his knowledge, exploring subjects of interest and satisfaction. (PAULA; OLIVEIRA; MARTINS, 2019).

Attracting the community to the school, seeking its participation and the valorization of students and their guardians, through their effective participation in the development of the project that has a scientific and sustainable character is important for the good progress of the project, because it will take place through research and development of high-tech and low-cost systems, bringing to the community of the school environment the idea that the school is an active organism that produces technology in a sustainable way, enabling and opportunistic youth protagonism .

TESTINGS

Still in progress, once the system is assembled and ready for use, this generator will be able to produce about 72 watts of power (05-12 V to 2-6 A) with a speed of about 4 to 5 m/s, pedaling ride. The System is fully capable of charging a common cell phone, but also illuminate comfortable with 9W LED lamp, as shown in the table below.

Table 2: System-generated energy production and result.

Initial Charge	74%
Final Load	75%
Output voltage	5.03 volts
Output current	0.6 A
System speed	6,7 m/s
Pedal time	5 min

Table 3: System-generated power production and results, redmi note 7.

Initial Charge	90%
Final Load	93%
Output voltage	4,7 volts
Output current	0.3 A
System speed	4 m/s

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Pedal time	5 min
Distance traveled	1200 m

FINAL CONSIDERATIONS

Once we succeed in the construction of the power generation system associated with adequate and efficient energy capture for the purpose of charging mobile phones and tablets, a goal of capacity expansion with more robust generation system will be established and can supply a greater number of devices, bringing experience from a research and development center to the school unit.

The project impacts society in a positive way, inserting the school to the scientific community, providing the dissemination of knowledge with actions of autonomy and protagonism, through student replicability. The stimulation of literacy and scientific literacy with the help of active learning methodologies, allows the manufacture of low-cost smartphone and tablet chargers in the school unit, containing the bicycle and all the materials necessary for its operation. By contemplating Objective 4, belonging to the set of Sustainable Development Goals (SDGs) of the 2030 Agenda of the United Nations (UN), which deals with the promotion of quality education, its development and implementation process has become an instrument of emancipation and empowerment, raising awareness and awareness of all who may be involved, directly or indirectly, transcending the boundaries of the school community.

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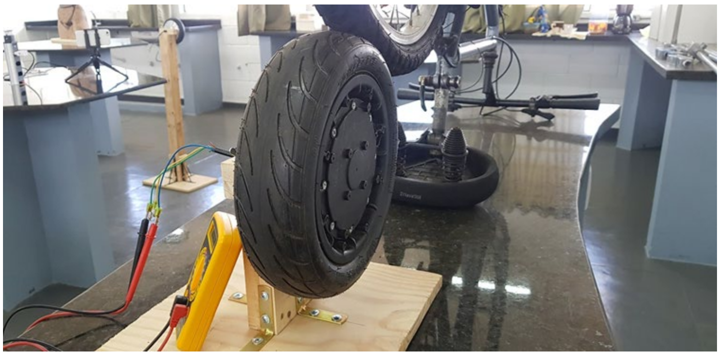
APPENDAGES

Figure 1: Motogenerator coupled to the rear bicycle wheel.



Source: César Hipólito Pinto

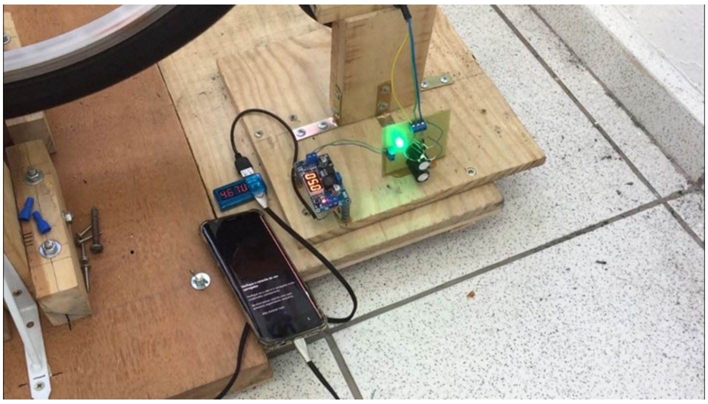
Figure 2: Coupling where sliding generator wheel may occur in case of friction loss.

Source: César Hipólito Pinto

Figure 3: Student testing system and how much it can generate energy in 5 minutes of pedaling.

Source: César Hipólito Pinto

Figure 4: coupling system and tassels for assembly of power generation systems.



Source: César Hipólito Pinto

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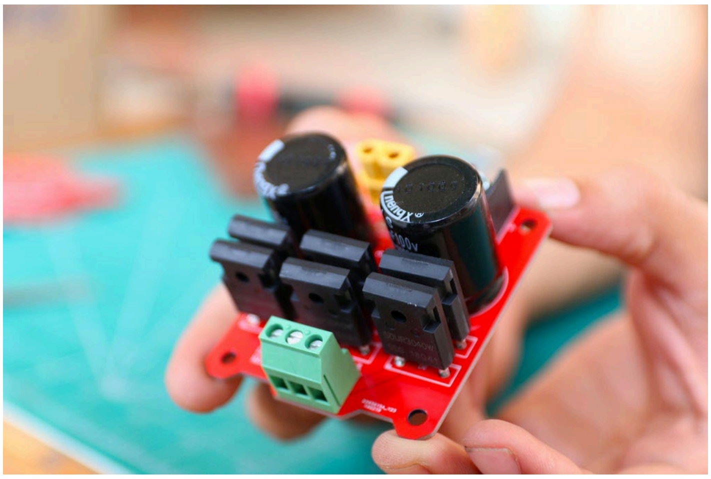
Figure 5: Rectifier circuit and voltage regulator.



Source: César Hipólito Pinto

Figure 6: Unifilar diagram of the rectifier bridge of the clean energy b icicleta.

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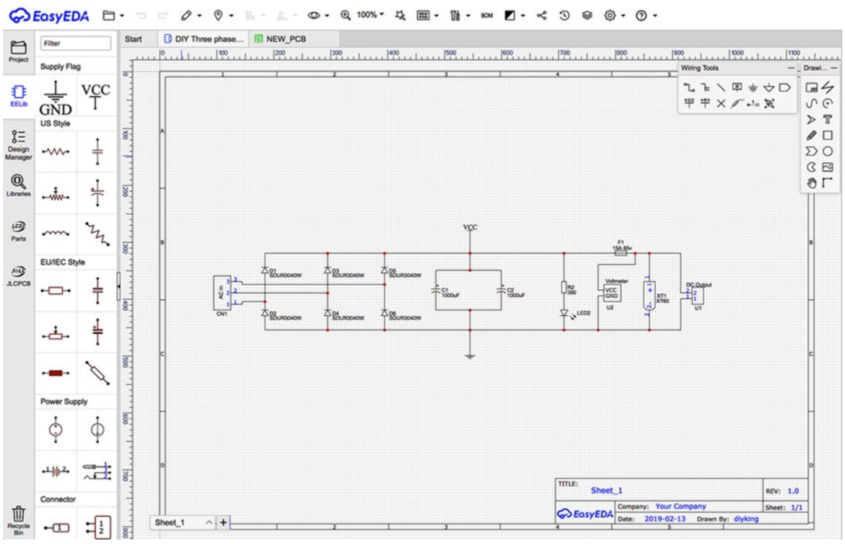

Source: César Hipólito Pinto