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Renewable Energies as Experimental Practices in Physics Teaching of Youth and Adult Education

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Abstract *– Energy sources for electricity generation have been the focus of numerous researches, driven by the increase in environmental concerns, seeking to minimize the environmental impacts generated by fossil fuels. This paper presents renewable energies as experimental practices in teaching physics of Youth and Adult Education (YAE) modality at the Teacher Nelson Alves Ferreira State School, located in the city of Manaus/AM, showing the interdisciplinarity between the concepts applied to physics, the development of experimental practices involving renewable energies (solar, wind, hydroelectric and geothermal) and their application in the physics program content. It is observed that the teaching of physics at YAE is scarce, where the teacher finds the cause of the difficulties in the student's learning, in the education system that does not offer him the necessary conditions to prepare his classes, and the student, in turn, attributes unsatisfactory learning to the teacher, to the school, to the abstract content, to his disinterest with the discipline and sometimes to his professional work. Environmental education is increasingly becoming an instrument of social transformation for discussion in different areas and contexts, where interdisciplinarity is indispensable for the implementation of an intelligent process of curriculum construction in the classroom. The educator/student relationship is achieved by building knowledge, linking renewable energies to the teaching of physics.*

Keywords *– **Youth and Adult Education, Environmental Education, Physicsteaching, Renewable energy.***

I. INTRODUCTION

The general objective of this work is to present renewable energies as experimental practices in physics teaching of Youth and Adult Education (YAE) modality at theTeacher Nelson Alves Ferreira State School, located in the city of Manaus/AM, showing the interdisciplinarity between the concepts applied to physics, the development of experimental practices involving renewable energies (solar, wind, hydroelectric and geothermal) and their application in the physics program content. Teaching is a complex task that involves more than the specific knowledge of the teacher, it involves mastering the pedagogical field and this is constituted as the teacher experiences the teaching and learning processes in a relationship of collective construction in which it presents as a subject for formationand for forming [1]. The problems are presented by the difficulties of the teaching-learning process of physics at YAE, the lack of laboratory practices for carrying out the experiments, the scarcity of information involving environmental education, the lack of knowledge about fossil fuels and renewable energies. The construction of three-dimensional teaching models provides the teacher with an important tool that facilitates learning, complementing theoretical and practical content, often not found in textbooks. In addition to the visual aspect, such material allows manipulation and a better understanding of the content covered [2]. The solution of environmental problems, with sustainability, requires multiple actions in the educational area, ranging from the theoretical and conceptual position to its practice. This means, above all, it matters which education and sustainability project and for what purpose, and where each of us places ourselves in social processes and in favor of what [3]. This work allows the student, in addition to the acquisition of knowledge, to develop skills that allow new discoveries, applied to a constructive, perceptive, interactive and participatory methodological process. Renewable natural resources can be understood as those that are perpetuated naturally, for example, the sun, plants, soil and animal life; nonrenewable natural resources are

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those that do not perpetuate and are limited in quantity on the planet, for example, minerals and fossil fuels [4]. Questions related to physics practices are necessary to improve teaching and learning and to inspire future students who will come to the public educational institution. As the importance of knowing and understanding the students' difficulties in absorbing the contents applied in the classroom is verified, in the face of an outdated pedagogical practice, it provides a series of possibilities and studies to find suitable solutions for teaching physics, and a of them applied in this work, are the experimental practices involving renewable energies.

II. YOUTH AND ADULT EDUCATION

Youth and adult education (YAE), a new name for supplementary education, is characterized as a flexible pedagogical proposal that considers individual differences and students' informal knowledge, acquired from daily experiences and in the world of work. It is a different form of regular education in its structure, while its methodology, duration and structure itself [5]. In reality, the regulatory role of education is highlighted, since, under the imperative of maintaining social order, educational programs are part of the logic of providing the poorest with some forms of alleged social inclusion [6]. The motivation of YAE students in the search for education, in research, showed that the need to increase family income was the main reason that made students stop their studies and the demand of the job market makes these people who abandoned their studies return to school for better training and, consequently, higher remuneration [7]. Such problems are pointed out from the perspective of YAE coverage in the national territory, which is deficient and unequal, due to problems related to territorial criteria of distribution, income, gender, ethnicity or generation [8].

III. ENVIRONMENTAL EDUCATION

Everyone has the right to an ecologically balanced environment, a common use of the people and essential to a healthy quality of life, imposing on the public authorities and the community the duty to defend and preserve it for present and future generations [9]. The environment is related to life on Earth, encompassing all living and non-living elements, such as water, climate, vegetation, soil, air, animals, humans etc. Therefore, the importance of preserving the environment, so that an environmental imbalance does not occur and we suffer from such future impacts. Environmental education is understood as the processes through which the individual and the community build social values, knowledge, skills, attitudes and competences aimed at the conservation of the environment, a common use of the people, essential to a healthy quality of life and its sustainability [10]. Environmental education is an essential and permanent component of national education, and must be present, in an articulated manner, at all levels and modalities of the educational process, in a formal and non-formal character [11].

IV. PHYSICS TEACHING

Teaching physics means seeking scientific understanding of the natural and general behaviors of the world around us, from elementary particles to the universe as a whole, with the support of scientific method and logic, with mathematics as a natural language. The application of physics for human benefit has contributed in an invaluable way to the development of all modern technology [12]. The demarcation, constitution and definition of a specific research field, directed and dedicated to the systematic study of the phenomena arising from the interactions between teacher, students and knowledge about physics, reflects a process of definition, substitution and evolution from a training perspective physics teaching [13]. The use of teaching methodology by projects in physics teaching in science education is defended as a viable possibility of introducing concepts, notions and physical principles, especially at fundamental levels where, often, science teachers do not have specific training in physics, and yet, teaching by projects can be an alternative to diversify the evaluation of science learning aiming at achieving a more formative process, continued and aligned with public policies [14].

V. RENEWABLE ENERGY

Worldwide, the most used energy source for the production of electric energy comes from fossil and non-renewable sources such as oil, coal and natural gas. The large dependencies on non-renewable sources of energy have caused, in addition to the permanent concern with their depletion, the emission of toxic and polluting gases and particulate matter. Of the gases released into the atmosphere, the most worrisome from a global point of view are greenhouse gases, especially carbon dioxide [15]. Currently, natural and renewable resources have been the focus of numerous researches, driven by increasing concerns about the environment, due to ecological problems and global warming, generated by the use of fossil fuels. The correct use of renewable sources is an excellent way to replace “dirty energies” and avoid damage to the planet [16]. The use of energy always generates some kind of environmental impact, be it renewable or non-renewable, of small or large proportion.

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However, these impacts can be minimized when associated with integrated resource planning, as they aim at a more sustainable world, promoting political and economic measures [17].

VI. METHODS AND DISCUSSIONS

A very obvious finding is that there is an abyss in the training of teachers separating natural sciences from human sciences and that does not allow the necessary interdisciplinarity and consistent with the aim of integrating knowledge at all levels [18]. To prepare this work, it was necessary to apply a questionnaire, which involved the participation of 10 teachers and 80 students from YAE. The school surveyed (Fig. 1), has four high school classes focused on the YAE modality with a maximum capacity of 40 students per classroom. Statistical data were collected from the school's academic control and archive coordination. Table 1, shows the situation of students in the years 2015 to 2020, with the number of students enrolled, approved, failing and dropping out and detailed by year, where there is an overcrowding and a high rate of dropout students in 2019 (Fig. 2). Climate change, global warming and the greenhouse effect, were the main consequences generated by the environmental impacts caused by fires and pollution in the teaching and student conceptions (Fig. 3). The main greenhouse gases – CH_4(Methane), N_2O(Nitrous Oxide), CO_2(Carbon Dioxide) and O_3(Ozone) – absorb part of the energy radiated by the Earth, generating a greater amount of heat that is retained in the atmosphere, resulting in an increase in temperature. The Amazon is a hot and humid region, and yet, it has a hydrography that occupies 45% of the national territory, therefore, for the state of Amazonas, teachers and students pointed out that the main alternative sources are in solar energy (46%) and hydroelectric (34%) for electricity generation (Fig.4). The interdisciplinarity between physics teaching and renewable energies led to experimental practices to be taught in classrooms, where four practices involving solar, wind, hydroelectric and geothermal energies were carried out. Practice 1 (solar energy), aimed at adapting a photovoltaic plate, instead of batteries, in a remote control cart, the following materials were used: remote control cart; photovoltaic plates; wires; soldering iron; solder; multimeter; measuring tape, being applied in the study of kinematics (acceleration and speed) (Fig. 5). Practice 2 (wind energy), resulted in the construction of an wind turbine, the following materials were used: wind engine; computer cooler propellers; pipe; rechargable battery; protoboard; multimeter; resistors and capacitors, being applied in studies of resistor and capacitor associations (Fig. 6). Practice 3 (hydroelectric energy), aimed at the implementation of a hydroelectric plant, the following materials were used: tap, hydrogenerator, resistors, capacitors, diodes, LEDs, transformers, protoboard, wires and multimeter, being applied in the study of electrical circuits with diodes and LEDs, hydrogenerators and transformers (Fig. 7). Practice 4 (geothermal energy), resulted in the construction of a geothermal plant, the following materials were used: soda can; other cans; propeller; wind engine; alcohol; wires, phosphorus; protoboard; resistors; LEDs; rechargable battery; multimeter and oscilloscope, being applied in the study of calorimetry (sensitive heat and latent heat), temperature changes (Celsius, Fahrenheit and Kelvin), density and buoyancy (Fig. 8). Finally, a conceptual research was carried out for students and teachers regarding the practices developed in the classroom, where most participants found them excellent.

VII. FIGURES AND TABLES

Fig. 1: Teacher Nelson Alves Ferreira State School.

Table.1: General data of students

ANO	MATRÍCULAS	ESTUDANDO	APROVADOS	REPROVADOS	DESISTÊNCIAS
2015	124	-	88	6	30
2016	113	-	75	9	29
2017	121	-	83	2	36
2018	158	-	80	42	36
2019	181	-	90	3	88
2020	141	141	-	-	-
TOTAL	838	141	416	62	219

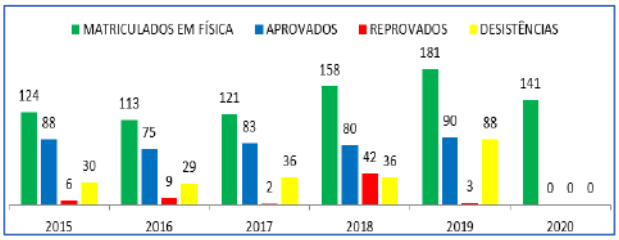

Fig. 2: Statistical data of students.

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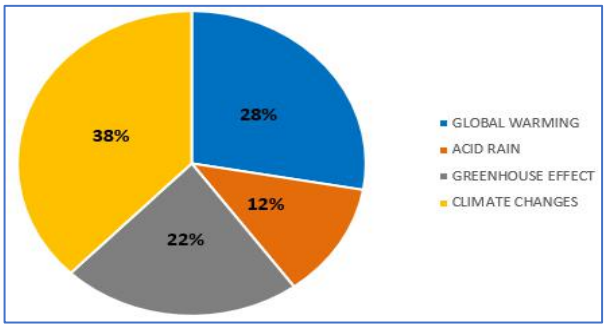

Fig. 3: Consequences of environmental impacts to teachers and students conceptions.

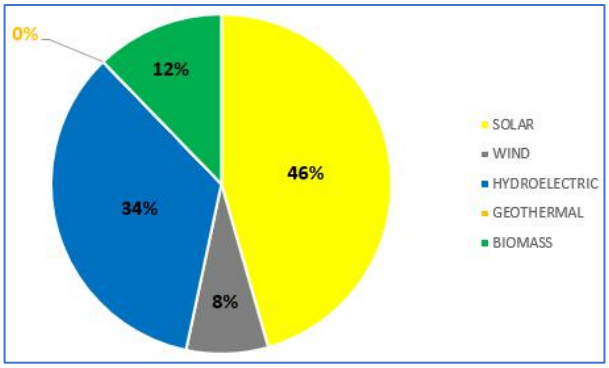

Fig. 4: Renewable energies that stand out in the state of Amazonas in the conceptions of teachers and students.

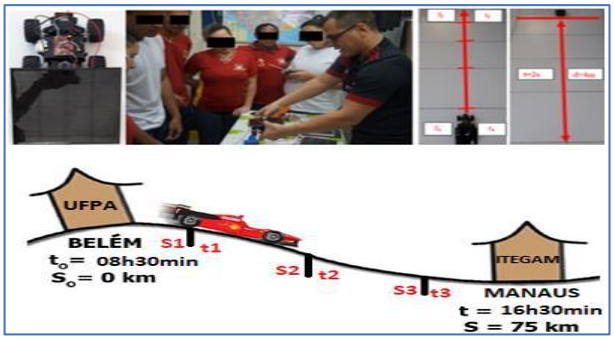

Fig. 5: Practice of solar energy.

Fig. 6: Wind energy practice.

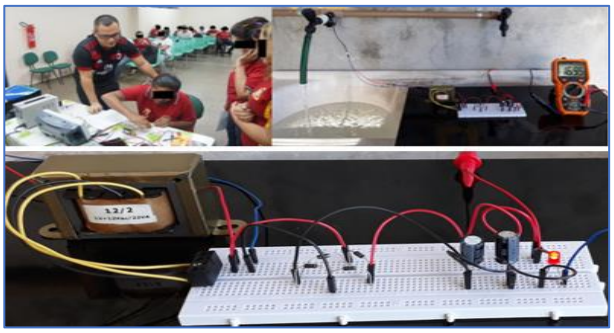

Fig. 7: Hydropower practice.

Fig. 8: Geothermal energy practice.

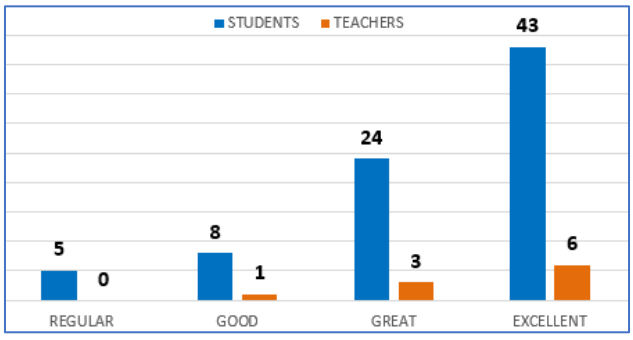

Fig. 9: Concepts of teachers and students regarding experimental practices carried out at school.

VIII. CONCLUSION

In view of the work exposed, we realize the importance of interdisciplinarity in the educational context involving young people and adults. Although most public schools do not have laboratories for carrying out physical practices and experiments, teachers can adopt environmental themes and their applicability in physics as a study methodology. Therefore, renewable energy was adopted as a method, as experimental practices in physics teaching of YAE, where students and teachers were the target audiences. These practices enabled the development of educational and environmental projects, where the construction of

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knowledge started from the theoretical foundations related to YAE, environmental education, teaching physics and renewable energies, up to their respective experimental practices applied by solar, wind, hydroelectric and geothermal, being addressed in the school physics syllabus. However, these practices aroused students' common and critical sense in relation to the subjects studied in the classroom, where motivation and interest in wanting to learn was evident during the course of each experiment.

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