



Teaching physics and citizenship: perspectives for conscious consumptions of electricity in Mozambique

Ensino de Física e cidadania: perspectivas para o consumo consciente de eletricidade em Moçambique

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Abstract

Electricity is an indispensable resource for the fulfillment of the most diverse activities and for the wellbeing of the society. Nevertheless, in the rural and suburban areas of Mozambique, there is still a lack of this resource from the national grid. Part of the electricity deficit is fulfilled by some alternative systems of low efficiency, such as photovoltaic solar panels, diesel generators, lead-acid and alkaline batteries. Therefore, a critical analysis of the technical and scientific work was carried out to raise some reflections on the role of physics teaching in the country, in the approach to the conscious consumption of electricity with the objective of raising awareness about the protection of the environment in citizenship practice. It was found that, with environmental education in Physics classes, it is possible to reflect on habits and behaviors for the conscious consumption of energy resources, in addition, to develop citizenship and practices seeking sustainability in the use and enjoyment of natural resources. In this case, it can be concluded that the conscious consumption of electricity is a great socioeconomic challenge in Mozambique, which has a direct and positive impact on the economy, society and on the environment.

Keywords: Conscious consumption of electricity. Citizenship. Physics teaching.

Resumo

A eletricidade é recurso indispensável para a realização das mais diversas atividades e para o bem-estar da sociedade. Porém, nas áreas rurais e suburbanas moçambicanas ainda se verifica a falta no acesso à eletricidade da rede nacional. Parte deste déficit é suprido pelos sistemas alternativos e de baixa eficiência, como os painéis solares fotovoltaicos, geradores à diesel, baterias de chumbo-ácido e pilhas alcalinas. Assim sendo, realizou-se uma análise crítica das obras técnicas e científicas com objetivo de levantar algumas reflexões sobre o papel do ensino de Física em Moçambique na abordagem sobre o consumo consciente de eletricidade, com vista à conscientização sobre a preservação do meio ambiente para o exercício da cidadania. Constatou-se que, com a educação ambiental nas aulas de Física é possível refletir sobre os hábitos e comportamentos para o consumo consciente de recursos energéticos, para além de desenvolver a cidadania e práticas buscando a sustentabilidade no uso e aproveitamento dos recursos naturais. Conclui-se que o consumo consciente de eletricidade constitui um grande desafio socioeconômico em Moçambique, com impacto direto e positivo na economia, na sociedade e no meio ambiente.

Palavras-chave: Consumo consciente de eletricidade. Cidadania. Ensino de Física.



Introduction

Energy, in its various forms, has always been an essential resource for the functioning and maintenance of life in society. Electricity stands out as one of the fundamental forms of energy in contemporary society, becoming indispensable for carrying out various daily activities. People in large cities and towns remain connected and use electricity to perform different tasks, such as preserving and processing food, communicating, and obtaining information, leisure, work, study, and more. Electricity can be obtained from various energy sources, being the most common in Mozambique, the hydro or hydraulic sources, and solar photovoltaic.

Therefore, education has an extremely important role in promoting sustainable development and improving the population's capacity to address environmental and socio-economic development issues and must incorporate these aspects as an essential part of learning, extolling the ability that individuals must assess sustainable development issues and address them. Conscious consumption, sustainable consumption, responsible consumption are the most usual designations to define consumption with less, or absent, negative impact on the environment (CARMONA *et al.*, 2017; SILVA, 2012).

These concepts and attitudes are associated with the spirit of citizenship that, a priori, consumers owe to collective public assets and the need to practice sustainable actions in the generation and use of energy resources, especially non-renewable ones, as in the preservation of the environment.

In this context, it is necessary that school curricula, at all levels, address the issue of environmental education, conscious consumption, and citizenship, as a way to seek better ways of using natural resources thinking of the next generations, not harming the environment and helping to improve the conditions of the Planet. Although environmental problems have a multidisciplinary scope, the Physics programs of secondary education in Mozambique (equivalent to primary II and secondary education in Brazil) relate them little to energy phenomena, being limited to the description in a complementary and transversal way, in various approaches and phases of the class.

In Physics, the meaning or applications of the energy concept is associated with quantities, thermal phenomena, energy sources, and their transformations. Energy and its manifestations connect several areas: (i) in classical mechanics, energy is associated with a force and causes changes (Newton's 1st and 2nd laws), and as the "capacity of the body to perform an action"; (ii) in quantum mechanics it treats it as a "form of matter" that can be transformed into mass and vice versa; (iii) in the study of the structure of the atom (of H₂), in atomic physics, introduces the energy quantization concept for the study of phenomena on the atomic scale; (iv) in electromagnetism, energy is associated with electrical and magnetic phenomena; (v) in thermodynamics, it brings the principle of energy conservation in isolated and anisotropic processes.

As a result, the study of the restricted relationship between energy and the environment based on the energy sources present in students' daily lives is the best way to inculcate in them the responsibility to actively participate in solving current environmental and energy problems, beyond reducing the boundary between empirical and scientific, theoretical and practical knowledge.

This text aims to make some reflections on the role of Physics teaching in secondary



education in Mozambique, citizenship, and the conscious consumption of electricity, in which, the school will have the role of raising awareness about the sustainable consumption of resources and the preservation of the environment to the exercise of citizenship, in addition to encouraging changes in attitudes towards the conscious consumption of resources in everyday school and extra- out-of-school life.

To do this, we will start by reflecting on consumerism: How much electricity do we consume? How do we consume? Is all the electricity we consume usefully? How can we balance our electricity consumption with the national energy deficit? What is the relationship between energy consumption and environmental problems? And in physics lessons, how can this be dealt with? Can we include education for citizenship in Physics lessons?

The methodology used in the research consisted of exploratory analysis based on the tripod "Physics teaching - Citizenship - Conscious consumption of electricity", based on bibliographical research (reading books, scientific articles, thesis, and dissertations), documentary (reading of Physics teaching programs and environmental legislation) and critical analysis of technical and scientific works. For data collection, the Cartesian method was used, and in the preparation of the final text, the inductive method was used, in order to identify the variables that influence the conscious consumption of electricity, citizenship practices, and possible approaches in Physics classes.

The issues addressed in this work are not just a resource for Physics teachers in Mozambique to use in their classes, but the work also seeks to collaborate so that students learn in a critical and meaningful way about sustainable and ethical practices for the construction of citizenship that contributes to the balance of nature.

Environmental education, sustainability, and citizenship

It is known that environmental education emerged as a response to needs that were not being fully met by formal education. That is, education should include values, skills, knowledge, responsibilities, and aspects that promote the progress of ethical relationships between people, living beings, and life on the planet.

According to Dias (2010, p. 27) "Environmental education is a process through which people learn how the environment works, how we depend on it, how we affect it and how we promote its sustainability". This concept shows that environmental education is essential at all levels of education and especially in the early years of schooling.

Environmental education aims to make people aware of the effects of their actions and the damage caused to the environment as a result. Thus, it is a very important topic that should be part of educational training (AMARAL *et al.*, 2020). As a result of this process, it is expected that the learner can develop a synthesis vision (planetary awareness) with new values and attitudes in their relationship with the environment, exercising planetary citizenship committed to the quality of life.

However, in Mozambique, environmental education is an activity that is not accepted and quietly developed in the school space, as it implies profound changes, especially in ways of thinking and acting already consolidated in the student's life (MEDEIROS *et al.*, 2011). And, when properly accepted, it can lead to changes in behavior, attitudes, and especially citizenship values that will have strong social consequences (FORTES; ELIAS, 2019; MEDEIROS *et al.*, 2011).



In the work of raising awareness, it must be clear that to raise awareness is not simply to transmit 'green' values from the educator to the learner; that is the logic of 'traditional' education; it is, in fact, enabling the student to critically question the values of the very educator who is working on their awareness. It is to allow the student to build knowledge and criticize values based on their reality (AMARAL *et al.*, 2020, p. 53)

Most environmental problems are associated with the energy issue and among them, electricity generation stands out as being responsible for approximately one-third of the world's primary energy consumption (OLIVEIRA *et al.*, 2009). Given the issues of global warming and other environmental problems derived from anthropic actions, a new development model that meets the needs of current generations without compromising the ability of future generations to have their own needs met (JACOBI, 2003; SANTOS *et al.*, 2017), i.e., a model of sustainable development, is sought.

The expression "Sustainability" derives from the concept "Sustainable Development" proposed in 1987 by the World Commission on Environment and Development of the United Nations. Sustainable development has three main components: alternatives to solve problems related to the supply of sustainable energy in an egalitarian way and at a reduced production cost; social equity, set of practices that aim to demolish all social, cultural, economic, and political barriers that imply exclusion or inequality; and environmental protection (SANTOS *et al.*, 2017).

Sustainable development can only be understood as a process in which, on the one hand, the most relevant restrictions are related to the exploitation of resources, the orientation of technological development, and the institutional framework. On the other hand, growth must emphasize the qualitative aspects, notably those related to equity, the use of resources, particularly energy. In addition, the emphasis in development should be on overcoming social deficits, on basic needs, and on changing consumption patterns, especially in developed countries, to maintain and increase basic resources, especially agricultural, energy, biotic, minerals, air, and water resources (JACOBI, 2003, 2005).

Sustainable development is not specifically about a limited problem of ecological adjustments of a social process, but to a multiple strategy or model for society, which must consider both economic and environmental viability. In a general sense, the notion of sustainable development refers to the necessary redefinition of human society-nature relations and a substantial change in the civilizing process itself. However, the lack of specificity and totalizing pretensions have made the concept of sustainable development, difficult to be classified into concrete and operational models and analytically precise. Therefore, it is still possible to say that it does not constitute a paradigm in the classic sense of the concept, but an orientation or a focus, or even a perspective that encompasses normative principles (JACOBI, 2005, p. 241).

The following aspects could be identified in the energy policy based on sustainable development: (i) guarantee of supply through the diversification of sources, new technologies, and decentralization of energy generation; (ii) use, adaptation, and rational development of resources; (iii) minimum energy cost; (iv) added value from the uses, generated in the optimization of resources (OLIVEIRA *et al.*, 2009). All these aspects can be met, totally or partially, with the use of efficient technologies, using clean and renewable energy sources.

Efficient use is that which allows us to take advantage of all the benefits of energy, but with the awareness of not wasting it and contributing to the preservation of the



environment (SILVA, 2000). These actions favor the conservation of energy distribution systems, which contribute to their expansion to other regions with supply deficits or the opening of new lines.

To reduce electricity consumption, some buildings use a roof that takes advantage of natural light during the day for lighting. According to Oliveira *et al.* (2009: p. 33) "The use of natural light can affect the functional arrangement of the space, the visual and thermal comfort of the occupants, the structure, the energy use in the building, as well as the type and use of electric lighting and associated control systems".

Physics teaching alone is not enough to train citizens, but we must value the many proposals put forward around it. The potential contribution of Physics teaching to human education is very great, so the composition of curricula should be expressed by diversified and articulated approaches, to strengthen the thesis that the development of numerous intellectual, social, and cultural capacities, in line with the ways of life and socio-cultural values, will favor human action in the private and political spaces of everyday life. It is in the diversity of ideas and knowledge that the offer of alternatives is multiplied so that people can choose, thus developing the capacity to make decisions, a necessary condition for self-determination. From this perspective, autonomy is achieved based on intellectual emancipation, which corresponds to the achievement of citizenship itself (SILVA, 2000).

Citizenship has to do with identity and belonging to a collectivity. Environmental education as training and exercising citizenship refers to a new way of looking at the relationship between man and nature, based on a new ethic, which presupposes other moral values and a different way of seeing the world and men. Environmental education should be seen as a process of permanent learning that values the various forms of knowledge and educates citizens with local and planetary awareness (JACOBI, 2003, p. 198).

Environmental education is understood as education that privileges the exchange of experiences, dialogue, and individual and collective practices that seek sustainability and awareness of those involved regarding the importance of respect for nature and individuals, as well as preservation and appreciation of the environment (TEIXEIRA *et al.*, 2016). Environmental education, as a component of comprehensive citizenship, is linked to a new form of human/nature relationship, and its everyday dimension leads to thinking of it as a sum of practices and, consequently, understand it in the dimension of its potential generalization to society (JACOBI, 2003).

Silva (2000) considers that the citizenship condition requires internalization of ethical-moral values, scientific and technological knowledge concerning individuals, i.e., the subjects in which it is configured as an expression of self-affirmation. In this view, the subject is not 'subjected' to the discourse of the other established in social massification but becomes capable of having his own discourse through the learning he does, placed in the ethical perspective of human emancipation. Hence the importance placed on the role of the school in the construction of citizenship.

Environmental themes in Physics classes (in Mozambique)

In *sensu stricto*, Physics is the science that studies nature and phenomena involving matter-energy and its interactions, from elementary particles to the Universe as a whole. Thus, the discussion of environmental problems, global energy issues, and



energy generation and use (renewable and non-renewable) through clean and sustainable technologies should be included in the environmental education grid of school Physics.

According to Franzol and Iachel (2016), the teaching of Physics should encourage the application of knowledge, enabling the critical formation of the student so that he understands the relationship between the study of this science and the understanding of the world in which he lives. From the perspective of stimulating meaningful student learning, the pedagogical work with the content "Electrical power" is interesting in the discipline classes since it is part of our daily life and can instigate discussions at this time of constant increases in tariffs and energy demands.

The introduction of contemporary socio-environmental issues in Physics classes, in high school, may constitute a significant strategy for the formation of critical citizens, capable of taking a stand in the current socio-environmental reality. These themes, together with the curricular contents of the subject, favor a more complex understanding of the state of our planet and enable discussions related to development and sustainability (FERREIRA; FREITAS, 2013).

In this context, Franzon and Iachel (2016) consider that the Physics teaching-learning process should be guided by the ability to instrument the student – future citizen with any profession – to better understand the reality in which they are inserted, enabling them to perform consciously. In another approach, Medeiros *et al.* (2011: p. 2) describes that "Children who are well informed about environmental problems will be adults concerned about the environment, transmitting the knowledge they obtained at school about environmental issues in their home, family, and neighbors".

Mozambican secondary education provides for the integration of themes related to the preservation of the environment, the ecosystem, and the sustainable use of natural resources in the form of contextualization of the themes in the subjects. The integration of these themes into the curriculum aims to develop a set of skills that enable the student to reflect on the socio-environmental problem and the challenges of applying non-polluting energies to the environment (MEC/INDE, 2007).

Physics teaching in Mozambique should likewise discuss the issues related to energy use and the promotion of efficient, effective, renewable, and sustainable energies, since the learning of Physics in secondary education aims to contribute to the formation of an effective science and technology culture, enabling the student to understand the technical and technological procedures and adjust them to a socio-cultural and environmental reality (INDE/MINED, 2010a, 2010b).

However, for many Physics teachers in Mozambique, working on transversal themes regarding the use of energy, the environment, citizenship, and conscious consumption is very difficult because, in addition to the structural problems of the Physics curriculum itself, the classrooms are always crowded, the exclusive dependence on the student's book, the low workload in secondary education, the lack of laboratory and experimental materials, the lack of continuing education programs for teachers and the need to comply with the vast program of the subject (FORTES; ELIAS, 2019). In this view, Medeiros *et al.* (2011) warn that it is necessary to teach classes that prepare the individual for life in the social environment, working the content in a more concrete way, leaving greater learning, which enables students to live in the ecological chaos they face daily.



As an alternative to traditional teaching approaches, Rodrigues *et al.* (2017) suggest a field trip as a strategy for teaching the relationship between "energy and environment", allowing direct contact with the object and physical phenomena in the natural environment, which can contribute to the understanding of the phenomena in a critical and reflective way. Furthermore, Ferreira *et al.* (2019) recommend the pedagogical workshops, supplementary texts, and group activities to approach themes with interdisciplinary characteristics, as is the case of energy and environment.

In this way, the study of Physics can provide the student with different approaches to observing nature and facing everyday situations with a more scientific and dynamic vision, where the student is called to question, experiment, observe and seek logical explanations of the phenomena natural around him. Based on scientific dynamism, it is possible to change the view that students have of socio-environmental problems, especially the anthropic ones referring to environmental pollution derived from the generation and use of energy. On the other hand, students should be encouraged to create solutions for the use of renewable energy, based on the conscious and efficient use of clean and sustainable electricity.

Conscious consumption: between theory and practice

Modern society, which has transformed, in the last two centuries, into a consumer society, where the act of consuming has become fundamentally important in satisfying new desires since consuming is the order of the day.

Consumption is the use, application, or expending of a good or service by an individual or a company to meet their needs. Consumerism, on the other hand, is the expansion of the culture of "having" at the expense of the culture of "being"; it is the act of consuming products or services, often without awareness, without the need (CORTEZ, 2016, p. 4).

According to Barbosa (2004, p. 7), "Consuming, whether for the purpose of satisfying 'basic needs and/or 'superfluous' needs, is an activity present in any and all human society". The consumer society is defined as that in which people buy products, this differs from the act of consuming superfluous products, not necessary for subsistence. The latter is attributed to the term "consumerism".

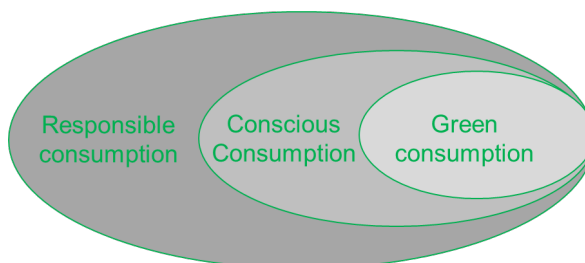
Consumerism or exaggerated consumption, according to Pereira (2016) is a fact that generates damage to the environment, not only at the stage of consumption, but the damage also starts in the production of these goods, develops with the use of most of them and, finally, when they are discarded for no longer fulfilling their functions. People consume without the real need for survival, but only for social demands or to show others that they have economic power. With these unruly attitudes, the human being has become the greatest danger for the destruction of the environment, as it is offered to the conservation of life on the Planet.

It must be acknowledged that nature has always provided man with conditions for life, food, and continuity of the species. However, today we live in a moment of inversion. The excessive use of natural resources, the great technological development and the exacerbated consumerism, among other factors, generates wear and tear on the natural environment (LEMOS, 2014, p. 78).

Consumerism is further encouraged by marketing strategies that encourage new purchases and often premature disposal of products and packaging. Sustainability is an important factor that should be considered in this debate as it is directly linked to the so-called sustainable development, a paradigm still under construction (CORTEZ, 2016). For Silva (2012, p. 224) “Conscious consumption is the act or decision of purchase or use of services, industrial or natural goods, practiced by an individual taking into account the balance between personal satisfaction, environmental possibilities, and effects of its decision”.

Conscious consumption, green consumption, and responsible consumption are “nuances” of sustainable consumption (Fig. 1), each of which focuses on the act of consuming. Conscious consumption, however, would be the broadest concept in which the consumer is aware of the various factors involved in production: the company's social and environmental responsibility, waste, eco-design, among other points that are important to this consumer. Sustainable consumption starts with the choice of products that, in part or throughout the production cycle, have reduced the use of natural resources. In addition, sustainable consumption contemplates social issues that are concerned with the people who work in production, considering the working conditions (SOUSA; IABRUDE, 2013, p. 7).

Figure 1 – Hierarchy of sustainable consumption practices.



Source: Adapted by the authors.

In the literature on sustainability in consumption, the term “sustainable consumption” still appears associated with the terms: “solidary consumption”, “fair consumption”, “ecological consumption”, “ethical consumption” and more. Carmona *et al.* (2017) relates conscious consumption to the speed of natural resource regeneration; with the capacity of the environment to assimilate waste without substantial impact on human health and the biosphere; and with the process by which substitute alternatives can supply sources of energy and materials with limited availability.

The concern with sustainable consumption is multidisciplinary and universal, whether due to the human being's science about its limitations in obtaining resources or the awareness that current trends in consumption behavior are unsustainable. The conscientious use of energy resources is very important to achieve the goal of energy sustainability and ensure the planet's future, which is increasingly uncertain.

For sustainable consumption to be practiced, consumption standards must be adjusted to the new social reality, understanding that from the reduction in the consumption of a large part of the materials, the redirection of practices developed so far facilitate its reach, a change becomes possible. On the other hand, sustainable consumption can be achieved by sharing responsibilities or raising awareness of players by means of education, advertising and broad access to information (SILVA, 2012).



Every change in behavior is revolutionary, as it affects habits and customs that have long been rooted in the culture of each people or region, and to affect this revolution requires more than knowledge; political will is essential. The participation of each individual and each community in decisions that concern everyone needs to be encouraged and implemented in participatory planning (MARTINS *et al.*, 2010: p. 3).

For Fournier and Penteado (2010), changing consumer behavior is currently a major challenge, as it is inserted in a consumer society where consuming confers greater status, higher places in the social hierarchy, classifies individuals according to the quality and, especially, quantity of purchased objects.

In addition to the act of consuming, it is important to reflect on what to consume, why to consume, how to consume, the origin of the product to be consumed (if necessary, its expiry date), what to do with the leftovers, and the packaging after consumption, how to discard without creating problems, especially for the aesthetics of the place, public health, and the environment. Therefore, changing behavior when it comes to consumerism can help preserve the environment and improve the economy, at home, at school, at work, and more.

Conscious consumption of electricity

In the energy field, conscious consumption is related to the rational use of electricity when, through a set of actions practiced by the individual in their home, one avoids wasting electricity, saving resources in the most diverse energy generation processes, in addition to the correct use of new technologies, new types of electronic devices that promise comfort, speed for daily activities, leisure and education within our homes, among other facilities of modern life (FOURNIER; PENTEADO, 2010). The electrification of everyday life becomes a barrier, sometimes difficult to be overcome to achieve the rational use of electric power.

For a conscious use of electricity in our homes, besides the slogan “The light you turn off, you don't pay” it is necessary to think about alternative sources of energy generation. These sources do not expressly need to generate electricity, but subsidies to save it. Therefore, we can think of solar heaters as an alternative form of energy consumption, not for the generation of electricity, but for the heating of water used in homes (FRANZIN; CARVALHO, 2015).

Conscious consumption has immediate effects on the economy and the environment, as well as having consequences for future generations, so that the environment in which we live is preserved to have quality of life in the present and to maintain it in the long term, also sanitizing the market itself.

The efficiency of energy systems occurs when equipment is used that uses less energy or there are no wasteful situations, of a different nature. Therefore, inefficiency is a factor that represents one of the greatest threats to the sustainability and efficiency of energy systems. Electricity waste is a serious problem that requires everyone's intervention to solve or reduce it (OLIVEIRA *et al.*, 2009).

The use of electricity in Mozambique is an aspect that concerns both the public and the government itself. According to data from Electricity of Mozambique (EDM, 2018), the residential sector is the one that most applies and wastes energy from the national grid through unconscious and inappropriate use of the resource, especially



in refrigeration systems (air conditioning, refrigerator, and freezers), lighting, irons and entertainment (TV, radio, stereo, and decoders). It is a practice, users leave these devices on for a long time without needing or on standby, unaware of the impacts and implications on society and on the monthly bill itself.

The conscientious and proper use of resources, especially energy, is an aspect that ensures socioeconomic and environmental sustainability, so it is extremely necessary to raise awareness of the population through environmental education and other transversal teaching approaches about good practice in the use of resources and helping to control their impacts.

The school should provide the link between scientific knowledge from various fields, guidelines for teaching programs, national and international policies for environmental management, conservation and sustainable use of renewable energy and the methodology that is best suited to typical situations and specific to each context.

Analysis and discussion: the importance of the discussion on electricity consumption in Physics classes (in Mozambique)

From the 20th century onwards, ecosystems began to suffer serious imbalances, because the current development model adopted by industrialized countries has been guided by the exacerbated exploitation of natural resources, revealing itself as an unsustainable model. In this context, the environmental crisis emerges and with it the need to rethink our way of life (FERREIRA; FREITAS, 2013). From the perception of the existence of an environmental crisis, numerous discussions began to occur to find solutions to minimize the impacts on the environment, but there is no consensus on the real factor responsible for the environmental crisis, as it depends on several factors: natural and anthropic.

A larger portion of this crisis derives from the processes of generation and use of energy, especially fossil fuels (oil, natural gas and mineral coal). Therefore, several fields of knowledge are discussing the generation (or production) and use of renewable energies, using clean and sustainable technologies that are efficient and generate fewer environmental conflicts.

Physics must educate for citizenship and this is done considering the critical dimension of scientific knowledge about the Universe of phenomena and not the neutrality of the production of this knowledge, but its commitment and involvement with social, political, economic, and cultural aspects (FRANZIN; CARVALHO, 2015). Educating for citizenship also means a teamwork approach, in which ideas and ideas intertwine.

Due to the gravity of the world environmental situation, it has already become categorical the need to root environmental education in schools for new generations in ages of formation of values and attitudes that preserve the man-environment-society balance and the construction of the sustainable development model (MARTINS *et al.*, 2010).

Educational processes that incorporate the environmental perspective should not be limited to the search for benefit or human development but open the horizon to the concern for environmental conservation. This concern is not only justified by the protection of the most elementary forms of life, which are the material basis of human sustenance, but also by the



inherent value that non-human species have for life itself (MORAES *et al.*, 2017, p. 543).

Environmental education aims that the man-nature relationship ceases to be instrumental and utilitarian, to become harmonious and respectful of ecological limits, where nature is not understood only as a natural resource subject to appropriation at any cost for human enjoyment (ARAUJO, 2015). Medeiros *et al.* (2011) understand that environmental education can change habits, transform the situation of the planet Earth and provide a better quality of life for people, through practices where each individual feels responsible to do something to contain environmental degradation.

One of the purposes of teaching Natural Sciences in Mozambique is to help in the construction of knowledge, using resources and teaching materials that allow students to exercise the ability to think, reflect and make decisions, that is, to start the process of maturation. In this process, the teacher has a crucial role as he is responsible for guiding the students, making them actively participate in this construction, learning to argue and exercise reason, he should question and suggest instead of providing them with definite answers or imposing his own views (FOGAÇA, 2013).

When Physics is inserted in the context of the environment and citizenship training, it enables secondary school students to understand and apply the academic contents in different situations of conscious consumption of natural resources and in the resolution of community problems, both in Physics and other areas, such as natural and social sciences, as in the daily lives of communities.

Moreover, solving concrete problems based on monthly consumption or simulation of expenses due to the main appliances, is a didactic alternative in the teaching of Physics, as it allows the development of the ability to analyze and create logical reasoning about science, technology, and society. In this type of activity, it is always important to explore the students' prior knowledge, to guide the way to approach the content.

For the insertion of environmental education effectively in Physics classes, it is necessary to present and dialogue with students the important concepts to understand the global environmental crisis, through the concepts of globalization, environment, as well as reflecting on the current development model and local environmental problems, reflections of the unbridled exploitation of natural resources and the man-nature relationship (TEIXEIRA *et al.*, 2016).

In addition, students should be encouraged to create mechanisms for the use of clean and renewable energy through locally available and low-cost resources, they should always be encouraged to opt for non-polluting energy generation technologies as a form of conscious energy consumption of electricity (FRANZIN; CARVALHO, 2015).

Regarding the daily actions on conscious electricity consumption, some habits may be practiced, such as (i) adoption of solar energy as an alternative source of electricity and the main source for residential water heating; (ii) adjust electrical and electronic devices according to the seasons and opt for low electrical power devices; (iii) opt for natural sunlight during the day; (iv) use the iron for large quantities of accumulated clothing and avoid using small quantities of clothing; (v) turn off lamps and other household appliances during periods that are not necessary; (vi) reduce energy consumption on devices that are on standby for long periods; (vii) know the



estimated consumption of all appliances working in your home and regularly control energy consumption to check for possible failures in the meter or appliances.

Teixeira *et al.* (2016) suggest the extension of scientific knowledge and traditional knowledge are found in the community, as Schools and Universities participate in the daily life of communities, associations among others, know and dialogue with reality, so they must leave the epistemological field and experiment with the concrete. On the other hand, the environmental extension projects expand the environmental discussions, from practices of environmental education, research and teaching on important environmental issues, to know and thus promote environmental conservation.

Final Considerations

In Mozambique, studies on the conscious or sustainable consumption of natural energy resources are recent. The approaches on the teaching process (in Physics) and issues of citizenship and energy sustainability are incipient.

In the research, the strict relationship between the teaching of Physics, citizenship training, and the conscious consumption of electricity was identified. Approaches on the conscious consumption of electricity in Physics classes aim to build awareness about the preservation of the environment, natural energy resources, and more sustainable society, in addition to forming conscious citizens committed to individual well-being and of the community. Therefore, the conscious consumption of electricity and other resources must be included in Mozambican education and included in the students' daily habits.

It is concluded that (i) actions to achieve conscious electricity consumption should be practiced from the bottom to the top, i.e., from home to school (ii) environmental education in secondary school, through approaches on the consumerism and citizenship formation, consolidates the formation and ethical stance on anthropic environmental problems, especially, on the conscious use of electricity, in a country where only 25% of the population has access to these services; (iii) the approach to the consumerism of electricity in Physics classes reinforces the commitment of education as a system for the formation of a conscious society concerned with solving local problems, going beyond curricular themes and the geographic limits of the school as an institution.

Finally, the question goes to the dear reader, “what have you been doing to contribute to the conscious consumption of electricity in your home or workplace”?

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