

RENEWABLE ENERGY WITH EMPHASIS ON BIODIESEL: ENVIRONMENTAL EDUCATION THROUGH VIDEOS AND SIMULATOR

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ABSTRACT

The present research had as main purpose to innovate the methodology of approach of the theme on Renewable Energy emphasizing Biodiesel through a didactic sequence applied with 14 students enrolled in the 3rd year of High School, located in the city of Cajazeiras-PB/Brasil. As a methodological resource, two videos and a simulator were used. For data collection was applied a previous questionnaire and after the execution of the didactic sequence, the students answered another questionnaire to check if in fact there was significant learning on the methodology was used. It is classified as an applied research, bibliographical, action-research and quantitative. In the initial questionnaire although 92.9% of the students affirmed have already heard about Biodiesel, they answered some questions in a way incomplete and / or superficial, thus demonstrating the importance of providing them with a better understanding so that their doubts would be healed. When analyzing the data measured in the questionnaire, after the didactic sequence, the students demonstrated in a clear way that they were able to assimilate the content worked in this research, this stays clear when 85.8% of the students affirm to be the transesterification one of the processes most used in the production of Biodiesel.

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INTRODUCTION

With the advent of the Industrial Revolution, the industrialized countries started to explore the natural resources of the planet with more intensity. The majority of the activities that man realizes during the day hardly needs a primary energy source to realize it. For example, get the car and go to the bakery to buy bread; go to work and access social networks through the computer are some examples of countless activities developed by man daily. Stay the questioning: What do these tasks have in common? Both need a primary energy source in which it is converted into secondary energy to work, in other words, the car needs fuel to move (the great majority has gasoline as the main fuel), already the computer needs the electrical energy. Shigunov Neto *et al.* (2009) presents the natural resources of the present way:

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Natural resources are classified according to the concept of renewal into two types: renewable and non-renewable. This concept of renewal takes into account only the temporal question. Therefore, according to this classification, natural resources are renewable if they can be obtained without limitations, without, however, running the risk of being exhausted at any given time. Non-renewable natural resources, however, are limited and subject to extinction. As a direct consumer of renewable and non-renewable energy sources society needs have knowledge of its origins, disposition, benefits and harms, and why the importance of replacing non-renewable sources by renewable. In this context, educational environments become a propitious place to work on issues of this nature. The teacher, in turn, must articulate the methodology be used, because, besides to students being saturated with notebook, pencil and book, certain thematic require much more than this. Besides to digital resources, teachers can, according to national curricular guidelines, use interdisciplinary, through themes that are present in the reality of their students, it is possible create a link between

Environmental Education and Chemistry Teaching, an example is treated in this research being Biodiesel the central theme. It developed the present research with the purpose of innovating, through video and simulator, the approach of the Renewable Energy thematic with emphasis on Biodiesel. Participated in this study, 14 students enrolled in the 3rd year of High School of the State School of Basic and Secondary Education Professor Crispim Coelho, located in the city of Cajazeiras/ PB.

THEORETICAL REFERENCE

In general, the global community began to live in a practical way always in search of comfort that means saying today it is almost impossible live without natural energy sources. Petroleum, mineral coal and natural gas are examples of fossil fuels; they are a type of natural resource found on our planet with great energetic potential. Barrutini (2008) highlights that petroleum is responsible for half of all energy consumed by the world population. Despite the great energy potential found in fossil fuels, in the last decades some questions have been listed about their exorbitant consumption. Fossil fuels are not renewable, in other words, in the same proportion as it is consumed, the petroleum remove from the field is not replenished, this process over time can cause its extinction. Another worrying point related to fossil fuels is amount to their burning. For example, gasoline, product derived from petroleum, to be used as a power source in automobiles, releases Carbon Dioxide in its burning, polluting the air and contributing to the greenhouse effect. Baird (2002) explains:

The term "greenhouse effect", commonly used, means that the average global air temperature will increase by several degrees as a result of the increase in the amount of carbon dioxide and other gases in the atmosphere. There may be as much as positive and negative effects associated with any significant increase in mean global temperature. Actually, the rapid phenomenon of global warming - with its demand for large-scale adaptation - is generally considered one of our major environmental problems at level worldwide. In the last decades environmental issues have emerged in society with more intensity, thereby organizations focused on the environment has been struggling to reduce environmental impacts caused by man.

According to Burattini (2008), at international level, the Kyoto Protocol is a document that was presented by the United Nations at the meeting of the climate convention in 1997 in Kyoto, Japan, and has as main proposal industrialized countries to decrease by at least 5% the emission of greenhouse gases. However, as approach Shigunov Neto *et al.* (2009), since 1970 some of the industrialized countries concerned with the conservation and preservation of the environment have formulated national legislation directed for the environmental issues within their own country. On account of the impasses found in non-renewable energy sources a viable alternative that comes supply the energy needs of the world population is the use of sources of natural energy resources, called renewable. The advantages of exploiting these resources, occurs mainly, for being inexhaustible, the impacts on the environment through the exploitation of these resources are almost insignificant. In practical terms, renewable natural sources can produce electricity, be used in the transport sector as fuel and others. In some cases, the natural sources of renewable energy are not exploited, as

should. One reason for this is the high financial cost necessary for its exploitation compared to non-renewable energy sources. However, it should be not only the extraction and production of its derivatives, should be placed highlighted the environmental catastrophes that themselves cause, being this point analyzed, the financial value for the exploitation of renewable energy sources do not represent an exorbitant or inaccessible value (Bermann, 2003). Countless are the options for exploring renewable energy sources, as for example, hydraulic energy (hydroelectric), wind energy parks which works by means of the wind, photovoltaic panels that generate energy through sunlight, biomass and others. Burattini (2008) explains that biomass on the other hand is formed for all organic matter be it vegetable or animal, with good energy potential for energy production, and can be used as fuel in the production of electricity in thermoelectric plants. Currently, biomass is responsible for approximately 14% of the primary energy consumed worldwide. The biodiesel, which on the other hand is a source of renewable energy from biomass, used as fuel in cycle-diesel or stationary engines and has as its raw material vegetable oils (extracted from castor beans, palm, sunflower, babassu, peanut and others) or fats of animal origin. The biodiesel production method is well diversified, the transformation of the crude oil may be by cracking, esterification and transesterification. Burattini (2008) defines transesterification as a chemical reaction between a crude oil and an alcohol in the presence of a catalyst; besides producing the biodiesel, also the glycerin is extracted that is much used in the production of cosmetics. In the classroom, Biodiesel can be approached as a generating or informative theme, through Environmental Education. With transversal character, the Environmental Education must be incorporated in the school curriculum in all the levels of education. Brazil (1999) explains:

Environmental education is understood as the processes through which the individual and the collectivity build social values, knowledge, skills, attitudes and skills directed at the conservation of the environment, well of common use of the people, essential to the healthy quality of life and its sustainability. As a methodology in the presentation of contents, teachers can include Virtual Learning Objects (OVA), such as videos, simulators, hypertexts, etc., available in various databases and electronic addresses, which contemplate environmental issues, as auxiliary and facilitators for the teaching / learning process. Spinelli (2007) defines OVAs as:

[...] a reusable digital resource that assists in the learning of some concept and, at the same time, stimulates the development of personal, as for example, imagination and creativity. In this way, a virtual learning object may that to contemplate a single concept amount comprise whole body of a theory. It can also compose a didactic course, involving an ensemble of activities, focusing only on a certain aspect of the content involved, or forming, with exclusivity, the methodology adopted for a concrete job.

MATERIALS AND METHODS

The present research had as main purpose to innovate the methodology of approach of the theme on Renewable Energy emphasizing Biodiesel through a didactic sequence applied with 14 students enrolled in the 3rd year of High School of the State School of Basic and Secondary Education Professor

Crispim Coelho, located in the city of Cajazeiras/PB. Initially a questionnaire was applied in order to ascertain the previous knowledge of the students referring to the thematic. Based on the analysis of the previous questionnaire, with the objective of providing meaningful learning, a methodology was adopted using digital resources (two videos and a simulator). The first video: "BRAZIL – Renewable Energy", available at: <https://www.youtube.com/watch?v=76eAZH0krzw>, brings some information about the main renewable sources that compose the Brazilian energetic matrix, as, the importance in search new sources of renewable energy in the world. The second video entitled "How to make Biodiesel-1" available on the link <https://www.youtube.com/watch?v=pX1QopDBN30> This is the process of producing a renewable energy source such as Biodiesel as well as chemical processes to which they are submitted. Posteriorly, a virtual learning object was applied entitled: The journey of Kemi - Fuels - The chemistry that moves the world - Biodiesel already! of the category Animation / Simulation available at the International Bank of Educational Objects (BIOE), <http://objetoseducacionais2.mec.gov.br/handle/mec/20303>, as in the Multidisciplinary Repository of Learning Objects of the Regional University of the Northwest of the State of Rio Grande do Sul as shown in the link: <http://www.projetos.unijui.edu.br/formacao/paginas/quimica.html>. The virtual object aims to show the importance of fuels generated from renewable natural sources. Lastly, a questionnaire was applied containing 08 questions to evaluate the knowledge acquired by the students after the didactic sequence executed on the thematic approach up of the research. As for technical procedures, this research is classified as bibliographical and action research. For the theoretical contribution was searched in bibliographic databases such as periodicals, scientific articles, books, among others. Fonseca (2002) says that bibliographic research refers to a detailed survey of references of a theoretical hallmark, already analyzed and published by means of electronic or subscribed as books, scientific articles. Already action research occurs when the researcher identifies some problem situation and proposes actions to solve it so that the researcher and participants are involved simultaneously in the proposed action. Vergara (2000), highlights that: "[...] action research can be defined as a type of social research designed and implemented to solve a problem, where the researcher is involved in the problem and works in a cooperative or participatory manner". As for nature is classified as an applied research, so that to afford new knowledge for the purpose of solution specific problems. According to Prodanov and Freitas (2013) applied research "aims to generate practical application knowledge presided at solution specific problems". Regarding the approach is classified as quantitative, because the data were analyzed from numerical way based on the representative collection of information related to the explanation of the facts through the quantification of data statistics, can be arranged in the form of graphs, charts and tables (LIRA, 2014).

RESULTS AND DISCUSSION

With the objective to identify students' prior knowledge in front of the Renewable Energy thematic emphasizing Biodiesel, a previous questionnaire was applied. In figure 1, shown that the majority, 92.87% of the students said they had heard about renewable energy before the survey and only 7.13% corresponding one student, not yet. In figure 2, when questioned about which means of information, 35.7% affirmed in the school; 21.4% for both internet and television; 14.3%

answered the speech and 7.1% did not answer. Since it is an important thematic in different social spheres, economy, preservation of natural resources and reduction of environmental pollution, it is common for students to have actually heard about. Prado *et al.* (2006) emphasize that the topic biodiesel is much discussed in the media, implying on political issues, but also covers energy need and environmental preservation. In the chart 1, the response of some of the students about the definition of Renewable Energy is observed. Of the fourteen students only the student 02 did not respond, being the student who stated that he did not know about this thematic. The others have been able to define renewable energy as something that continues to be renewed, and student 01 still cited solar energy as an example. In the chart 2, the students defined non-renewable energy, it can be noticed that even in an incomplete or superficial manner, the students were able to define non-renewable energy, the student 03 still mentioned the petroleum and the 14 affirmed to be "the one that does not use natural sources". Again only student 02 did not answer this question. In question 3, the following situation was formulated: John has two cars, the first one has as main fuel source biodiesel, the second has as a source of energy the gasoline product from the petroleum. What of the cars, do you use renewable energy for your locomotion? The majority, 64.3% corresponding to 9 students affirmed that John uses renewable energy in Car I and 35.7% of the students answered wrongly when to affirm to be Car II. In figure 3, the students answered among the mentioned alternatives what would be sources of renewable energy. It is noticed that 11 students answered solar energy; 8 biodiesel and 6 wind energy, totaling 25 correct answers. However, had some students who answered wrong while choosing natural gas, petroleum and gasoline, as both are fossil fuels, therefore, non-renewable. In figure 4, the students answered among the mentioned alternatives what would be sources of non-renewable. Among the alternatives to geothermal and biodiesel are renewable energy sources, it is noticed that 9 students chose geothermal energy and 1 student biodiesel, and these students are mistaken. The petroleum option was chosen 8 times, followed by gasoline with 7, coal 4 and natural gas 4, totaling 23 correct answers. Relative fossil fuels as Petroleum, natural gas and coal, Bermann (2001) highlights that these "may no longer be used before the depletion of its reserves because to be one of the major responsible for the greenhouse effect, which is currently considered the most important global environmental problem". After answering the previous questionnaire, watching the two videos and using the simulator the students involved in the survey answered the questionnaire that was posterior formulated with eight questions. In the chart 3, it is observed the representative speech of six students in differentiating renewable energy from nonrenewable energy. In summary, all the students were able to make this differentiation, linking the responses to the fact that renewable energy sources are inexhaustible and present in nature, while the sources of nonrenewable energy are exhaustible. The chart 4 summarizes some answers about the importance of exploring renewable energy sources. The students were consistent with in affirm that the exploitation of renewable energy sources reduces pollution when compared to the environmental impacts caused by the exploitation of non-renewable energy sources. In fact, prove that the use of biodiesel reduces the emission of polluting gases compared to gasoline. Santos (2012) reinforces that biodiesel: "For being biodegradable, non-toxic and practically free of sulfur and aromatics, is considered an ecological fuel".

Chart 1. Definition of Renewable Energy

Question 2: What is renewable energy?		
Representative speech, Student 01 "It is all energy that regardless of consumption, it does not end, so it continues to renew itself. An example is solar energy".	Representative speech, Student 04 "They are energies that renew themselves through nature".	Representative speech, Student 05 "Renewable energy is the energy that can renew itself after some time".
Representative speech, Student 07 "It is the energy that is reused for another procedure, that is, the energy that is renewed".	Representative speech, Student 08 "They are the sources that when they are finished they can be renewed".	Representative speech, Student 12 "It is the energy that is used by totally natural sources".

Sources: Own Authors (2017)

Chart 2. Definition of Non-Renewable Energy

Question 3: What is non-renewable energy?		
Representative speech, Student 03 "It is one that does not renew itself like oil".	Representative speech, Student 04 "It is an energy that cannot be reused".	Representative speech, Student 09 "It's the energy made by man".
Representative speech, Student 11 "It is the energy that is not renewed way none".	Representative speech, Student 12 "It's an energy that ends and cannot be used again."	Representative speech, Student 14 "It is the one that does not use natural sources".

Sources: Own Authors (2017)

Chart 3. Differentiation between sources of Renewable and Non-Renewable Energy

Question 1: What is the difference between renewable and non-renewable energy sources?		
Representative speech, Student 01 "Renewable energy are energies that are found in nature and that are renewed. Non-renewable energy: which is not renewable and is not found in nature".	Representative speech, Student 02 "These energies have different: the renewable is the one that can be consumed and still does not end, already the non-renewable is energy that can come to an end".	Representative speech, Student 09 "Renewable renews itself through nature with a shorter time, already non-renewable takes centuries to produce, and when they run out they do not appear in that place, as the Petroleum".
Representative speech, Student 08 "Renewable energy is that it comes from nature, it is not renewable, and it is not renewable because it has no renewable source".	Representative speech, Student 12 "It's because one renews itself and the other does not".	Representative speech, Student 14 "Renewable energy is one that can be reused, and nonrenewable cannot".

Sources: Own Authors (2017)

Chart 4. Importance of exploration of Renewable Energy sources.

Question 2: What is the importance of exploring renewable energy sources?		
Representative speech, Student 05 "It's important because they're less polluting".	Representative speech, Student 06 "To avoid pollution through gaseous pollutants".	Representative speech, Student 07 "To reduce atmospheric pollution by up to 50%".
Representative speech, Student 10 "Because they do not pollute."	Representative speech, Student 11 "The reduction of pollution".	Representative speech, Student 13 "They are less polluting; they do not contribute to the greenhouse effect".

Sources: Own Authors (2017)

Chart 5. Importance of exploration of Renewable Energy sources

Question 7: What contribution do videos assisted and the simulator used for their learning?		
Representative speech, Student 03 "It made it easier my learning".	Representative speech, Student 04 "I learned some of the products used to produce biodiesel and how it is produced".	Representative speech, Student 05 "Agent learns more through video and simulator because they put their heads to think".
Representative speech, Student 07 "It contributes to the best learning, and study on the subject".	Representative speech, Student 09 "It helps understand more".	Representative speech, Student 12 "It was very good because the person learns the content better".

Sources: Own Authors (2017)

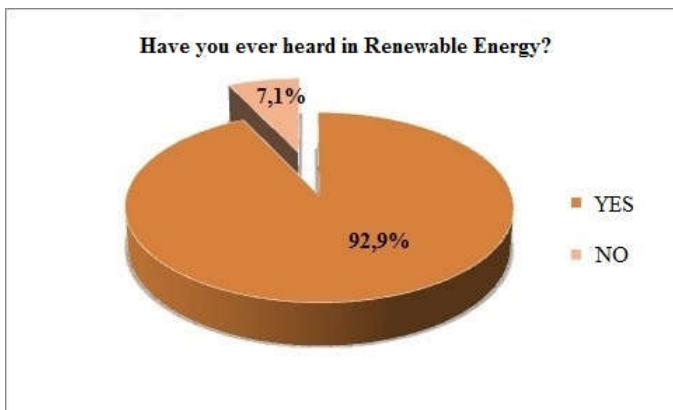
Chart 6. Preference between Video and Simulator

Question 8: Between the videos and the simulator which contributed more effectively to the understanding of the content? Why?		
Representative speech, Student 02 "The simulator, because the pilot is trying to hit the issues to pass the stage".	Representative speech, Student 06 "The simulator, because it draws the attention of the student".	Representative speech, Student 08 "Simulator because it is discovering the products that are used to make the biodiesel".
Representative speech, Student 10 "The simulator, because it puts into practice what we learned in the video".	Representative speech, Student 11 "The simulator, because of the learn in a fun way".	Representative speech, Student 14 "The simulator, because through games you learn have fun".

Sources: Own Authors (2017)

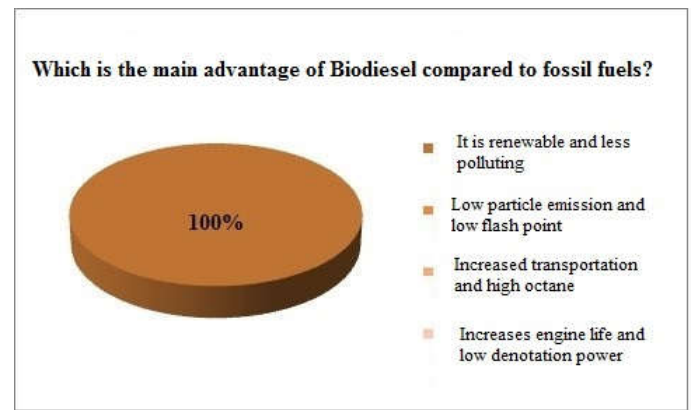
In figure 5, which represents the answers when asked about the main advantage of using Biodiesel, in comparison to fossil fuels, 100% of the students agree that Biodiesel is renewable and less polluting in relation to fossil fuels. Thus, the other three alternatives did not receive no answer. Lima (2008) points out among the advantages in the use of Biodiesel: Renewable, biodegradable and non-toxic; its combustion emits despicable quantities of compounds, containing sulfur;

Recycling of CO₂ emitted in the combustion; etc. In figure 6, the majority of 85.8% affirmed that transesterification is the most used process in the production of Biodiesel, characterizing a chemical reaction of vegetable oils or fats, such as ethanol or anhydrous methanol and a catalyst. Only 14.2% of the students missed, answering with equal percentages of 7.1% for saponification and esterification. In Figure 7, the students answered which of the products



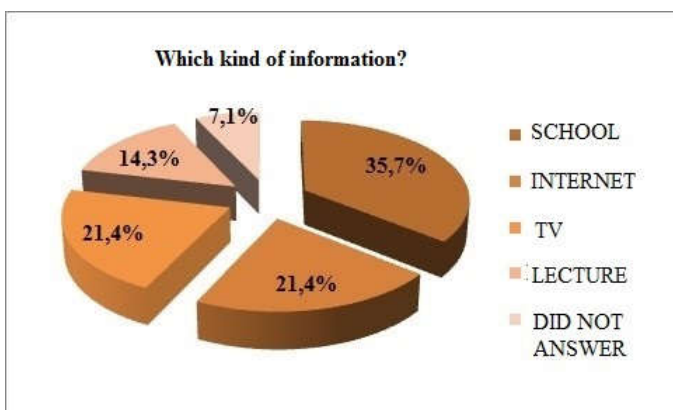
Sources: Own Authors (2017)

Figure 1. Knowledge about Renewable Energy.



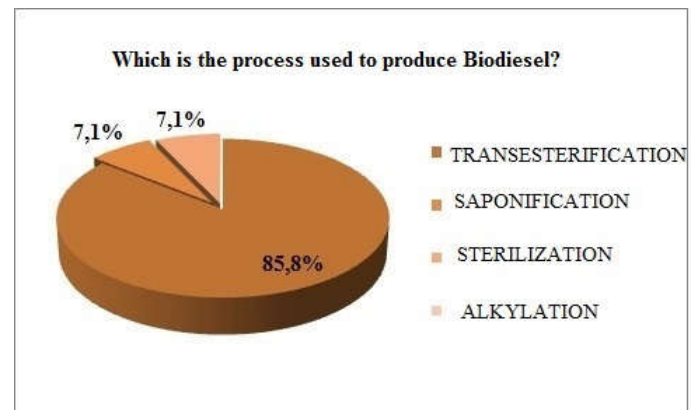
Sources: Own Authors (2017)

Figure 5. Biodiesel Advantage



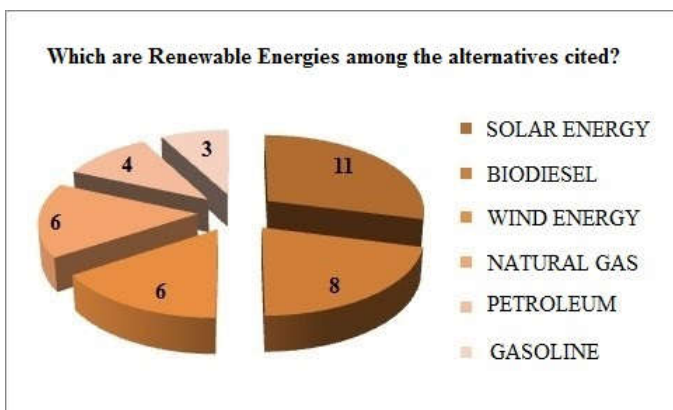
Sources: Own Authors (2017)

Figure 2.Means of Communication



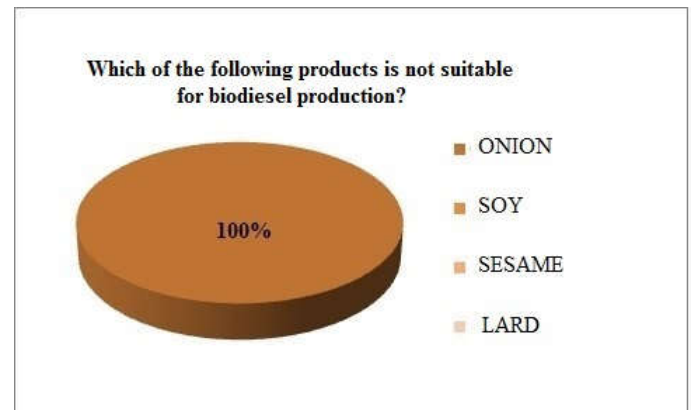
Sources: Own Authors (2017)

Figure 6.Biodiesel production process



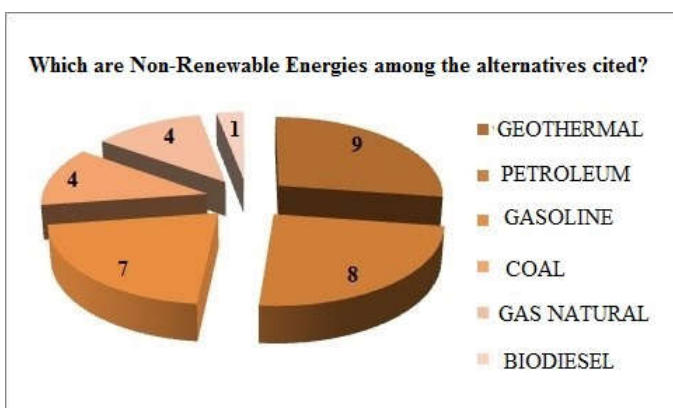
Sources: Own Authors (2017)

Figure 3.Renewable Energy



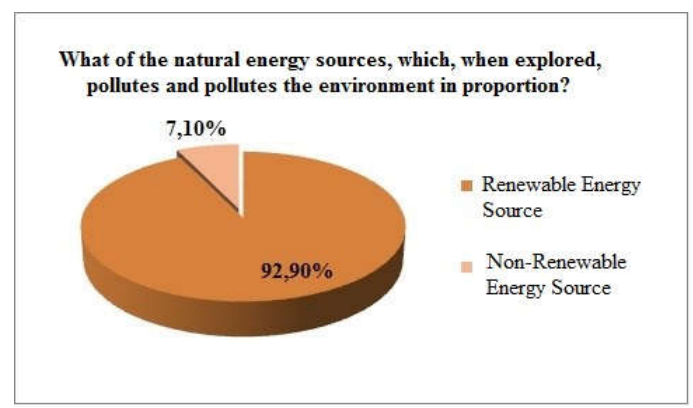
Sources: Own Authors (2017)

Figure 7.Product for Biodiesel Production



Sources: Own Authors (2017)

Figure 4.Non-Renewable Energy



Sources: Own Authors (2017)

Figure 8. Lower Pollution

suggested was not suitable for the production of Biodiesel, it is noticed that 100% of the students were correct when answering onion. According to Benevides (2011), organic matter of animal and vegetable origin can be used for the production of Biodiesel. Oilseeds are generally used, macaúba; cotton; peanut; babassu; sugar cane; soy; castor bean; sesame; sunflower; palm tree; etc. In figure 8, a majority, 92.9% of the students reaffirmed that renewable energy sources pollute and contaminate the environment in smaller proportion of non-renewable energy sources. Only one student, who corresponds to 7.1%, did the wrong answering the opposite. In questions 07 and 08, the students evaluated the methodology used to approach this thematic. In the chart 5, the students reported the contributions of the two assisted videos and the content learning simulator. All affirm that the methodology adopted facilitated the absorption of the content, affirmed that one learns better through videos and simulator. In chart 6, the students answered the preference among the resources used. All students preferred the simulator; because the same attracts the attention of the student, puts into practice what they learned in the video; stimulates thinking and decision-making; as well as the products that can be used in the production of Biodiesel. Face the results, doing a comparative of the previous questionnaire with the later didactic sequence, it can be affirm that the students were able to absorb the information about the thematic work. It is important to emphasize that all of them identified with the methodology used and participated actively in the research.

CONCLUSION

For representing a subject with promising characteristics for interdisciplinary, Biodiesel generates a range of information that can be listened to by various aspects. Connecting Environmental Education versus Teaching Chemistry can address both the environmental impacts related to the exploration of renewable and non-renewable energy sources, and explain the chemical processes for the production of this biofuel. In possession of the data collected, initially it was observed that the students presented knowledge on the subject, but this was incomplete taking into account all the premises that can be approached about Biodiesel. Faced with the applied didactic sequence, it is concluded from the data obtained in the later questionnaire that the students obtained a significant learning on the subject in question, being the objectives proposed in this research achieved. The own students involved in the research affirmed that the insertion of digital resources contributes to the process of teaching learning, this affirmation is in line with the numerous researches developed on the new digital technologies as a methodological support for the teaching of sciences. It is hoped that this research will serve as an incentive for other professionals interested in innovating Chemistry Teaching through interdisciplinary with Environmental Education.

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