

Nuclear Technology in Secondary School in the City of São Paulo

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ABSTRACT

Nowadays, much has been said about nuclear technology development in Brazil. The importance of introducing the nuclear energy in the Brazilian energetic matrix has been now recognized by the society. There is a highly accepted assertion about the role developed by the energy offer for the country development, although it is well-known that this is a necessary condition, but not enough. Another major issue is the environment preservation, so that future generations may live in adequate climatic and environmental conditions. Industrial activities and mining are some of the issues debated in the world scenario. Therefore the option to introduce nuclear energy in the country energetic matrix is a decision that should be supported by its knowledge. Nevertheless, do the youth know what nuclear energy is? What this kind of technology applications and implications are? To answer these questions, this project aims to analyze to what extent secondary schools are aware of nuclear technology and its applications, to verify whether there are the minimal necessary conditions for their interpretation and comprehension of related phenomena, as well as to analyze whether these students are able to critically opine on this subject. The methodology consists in using, as a data collection tool, a questionnaire applied to the students. For this purpose, the research field is constituted of the 3rd year secondary school students, from public state schools, in the city of São Paulo. The data survey was restricted to schools belonging to three levels of classification, in the National Examination of Secondary Schools 2007. The questions proposed in the questionnaire were elaborated in considering what students, according to their age, were supposed to know concerning nuclear technology having as reference the “Leis de Diretrizes e Bases da Educação Nacional” (National Education Guidance Law), the “Parâmetros Curriculares Nacionais” (National Curricula Parameters) and basic nuclear physics concepts. The questionnaires also present questions, such as age, family income and number of persons, among others, which will enable a social-economic profile analysis of the subject. After collecting the questionnaires, a lecture is given to the students. This lecture is an introduction to some basic nuclear technology concepts and its applications. In the sequence, the students are asked to answer, once more, to the same questions previously proposed and to participate in a discussion, focusing on the lecture content, allowing them to expose their questions and ideas. The results from the two questionnaires are analyzed using basic statistical techniques, aiming to map the educational scenario in the physics field, in the city of São Paulo. In addition, it is also the subject to find out if the minimal necessary tools for the comprehension of the proposed issues are offered. The secondary school students need, as future opinion-holders of this country, and representing an expressive share of those who will elect society representatives, to have well-known fundamentals of our society challenges. The proposed work still enables to verify if the Education Ministry guidance has, at the moment, conditions to be applied to the city of São Paulo public schools, since the subject considered is part of a proposal by this Ministry. The questionnaire has already been applied to 6 classes for a sampling in a public school located in Itaquaquecetuba (SP). In this first evaluation, 84% of the students were observed not to have a partial view of nuclear energy beneficial applications. The nuclear theme was verified not to be approached in São Paulo city secondary school. It is important, especially at this moment when nuclear field is being considered as one of the electric energy sources in the country, that this void be analyzed.

1. INTRODUCTION

In 1996, a reformulation in the Brazilian high school was done, established by the “Leis de Diretrizes e Bases da Educação Nacional” (National Education Guidance Law) – of 1998 by the Education National Council and by the “Parâmetros Curriculares Nacionais” (National Curricula Parameters) . The main goal of this reform was to make the high school students prepared for life and citizenship, turning them able to progress on their studies and for the market.

In the field of physics, school should play its role by helping in the formation of a contemporaneous citizen, who is willing to act through some have the necessary tools in order to understand the general laws of nature. At the same time, physics should be seen a historical construction of the human kind including social, cultural and economical aspects. Physics stimulates the technological development which will affect the society created by mankind.

Among the technological contributions made by physics throughout the years, there is an extremely important technology for the human kind : the nuclear one.

There are several applications for nuclear technology, such as in Medicine, agriculture, industry, energy production, etc..Yet some polemic is found when this technology is mentioned due to its non- peaceful applications because this was the way it was known by modern society. All these subjects are really worthed nowadays for the society development.

The importance of nuclear energy inclusion in the energetical matrix also must be mentioned. Brazilian Govern programs for its use as a source of energy have been fairly discussed .It's been said that the development of a country must come along with the increase of energy offer

Another important question is the concern about the environment preservation so that the future generations may live in bearable ambient climatic conditions, with unpolluted environment etc. This remits us to the release of gases that provoke the greenhouse effect or health problems, of self-sustained development etc. Industrial activities, extraction of ores, effluent treatments, among others, are some of the questions debated at the world-wide scene. Therefore, the introduction of the nuclear energy in the energetic matrix of a country is a decision that must be based in knowledge as the increase of the energy offer is one of the conditions to reach the level of a developed country, as pursued by Brazil.

However, do the young people that will be part of this future know what nuclear energy is? Do they know the applications and implications of this type of technology? Through this work, it is possible to get a vision of the knowledge young people have about the nuclear energy. It is possible to see if the minimum tools necessary to understand this subject are offered by the state schools, allowing them to effectively be part of the future of the country.

It is also possible to verify if the orientations offered by the Ministry of Education are really followed by state schools in São Paulo city, since the related subject is part of the educational proposal of this Ministry.

2. METODOLOGY AND PROCEDURES

Interviews with students of the third grade of public schools of São Paulo city were made. The main goal of these interviews was to evaluate the level of knowledge of the students about the nuclear technology and its applications.

These interviews were done in a way that the participants used only their previous knowledge to answer the questions, without any type of external help.

The schools chosen for the accomplishment of these interviews were selected using the classification of the school in the National Examination of Secondary Education 2007 (ENEM 2007). The first 20, the last 20 and 20 schools with intermediate classification were pre-selected. From this pre-selection, the schools which would represent the different Directories of Education of São Paulo were elected aiming to get the best parameters of the state education in the city.

The proposed questions for these interviews were elaborated in accordance with the knowledge that students of the analyzed age group should have about the nuclear technology considering as reference the Directives Laws and Bases of the National Education, the National Curricular Parameters and rudimentary concepts of nuclear physics.

The questionnaire also contained questions of personal character like age, number of people living in their residence, familiar income, among others, which allowed making an analysis of the socio-economic profile of the interviewed ones.

Afterwards, a theoretical class regarding nuclear technology was presented to the students; this class had an introductory character about some basic concepts of nuclear technology and its applications in areas like medicine, agriculture, industry, and energy production, and after that, the same interview was done with the students.

Then, the students had a chance to participate of a discussion whose main focus was on the theoretical class and the questionnaire

After the theoretical lesson and discussion, the results of the two interviews were analyzed. The analysis was made using basic statistics techniques and presented in a way to demonstrate a perspective of the state education regarding the nuclear technology and its applications in the city of São Paulo.

3. PARTIAL RESULTS DISCUSSION

The questionnaire was applied in a sample space of 10 classrooms (3rd grade of Average School) in 03 public schools - 5% of the selected schools, totalizing 304 interviewed students. The selected school number 1 is located in Itaquaquecetuba (SP), the school number 2 in the south zone of São Paulo and the school number 3 in the west zone of São Paulo. Each one of these schools represents a grade by the ENEM 2007 classification. In this first evaluation, one observed that about 55% of the interviewed students do not have the basic knowledge about the energy concept, especially the concept of nuclear energy.

It was observed that approximately 84% of the students have a limited vision about the benefic applications of the nuclear energy and the importance of this power source for the Brazilian energetic matrix. It was verified that 67% of these students believe that the only applications of the nuclear technology are related to the production of bombs and nuclear submarines, as well as the study of genetic mutations.

Figures 1, 2, and 3 show the student replies to question number 1 of the interview (what is Nuclear Energy?) and compare the answers gotten before and after the theoretical class. The correct reply for this question was alternative “a”.

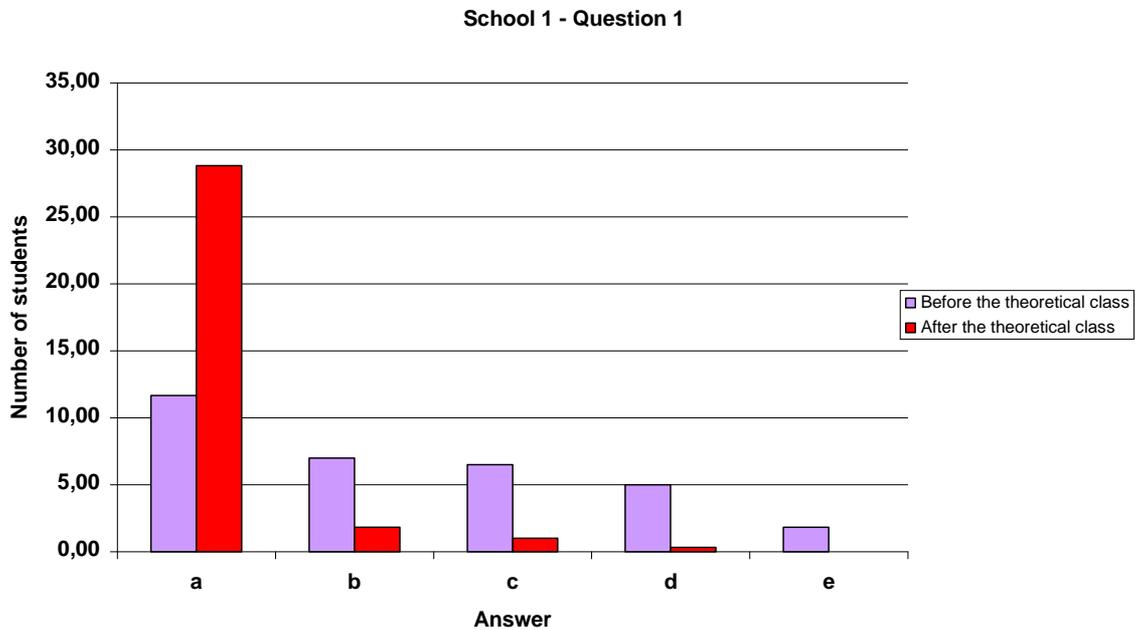


Figure 1 – Reply of the students of school 1 to the question 1.

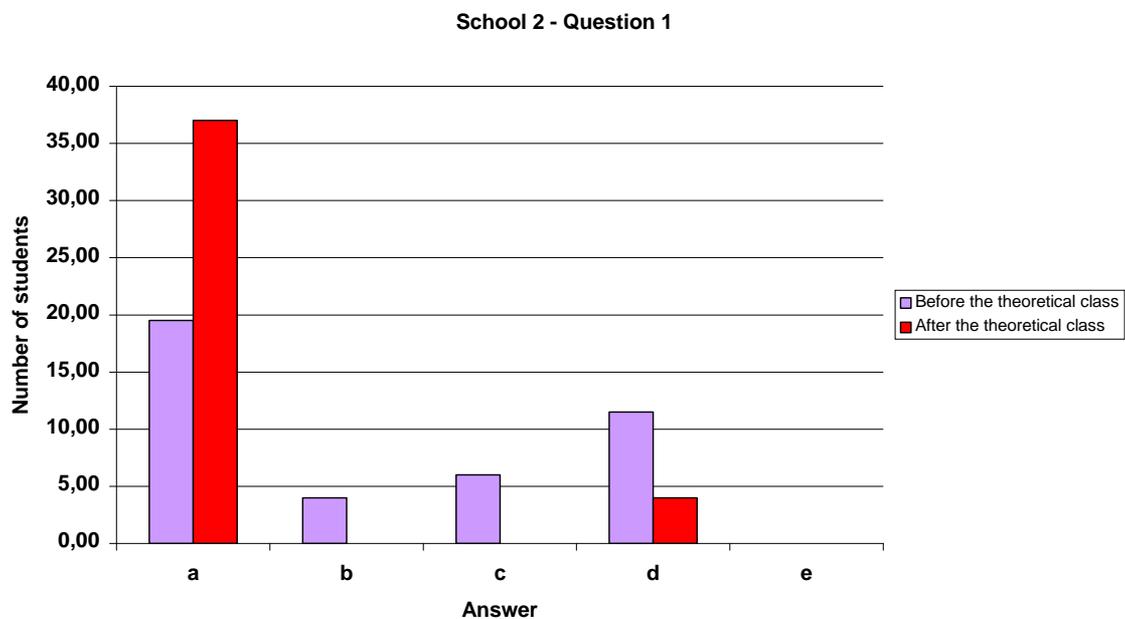


Figure 2 - Reply of the students of school 2 to the question 1.

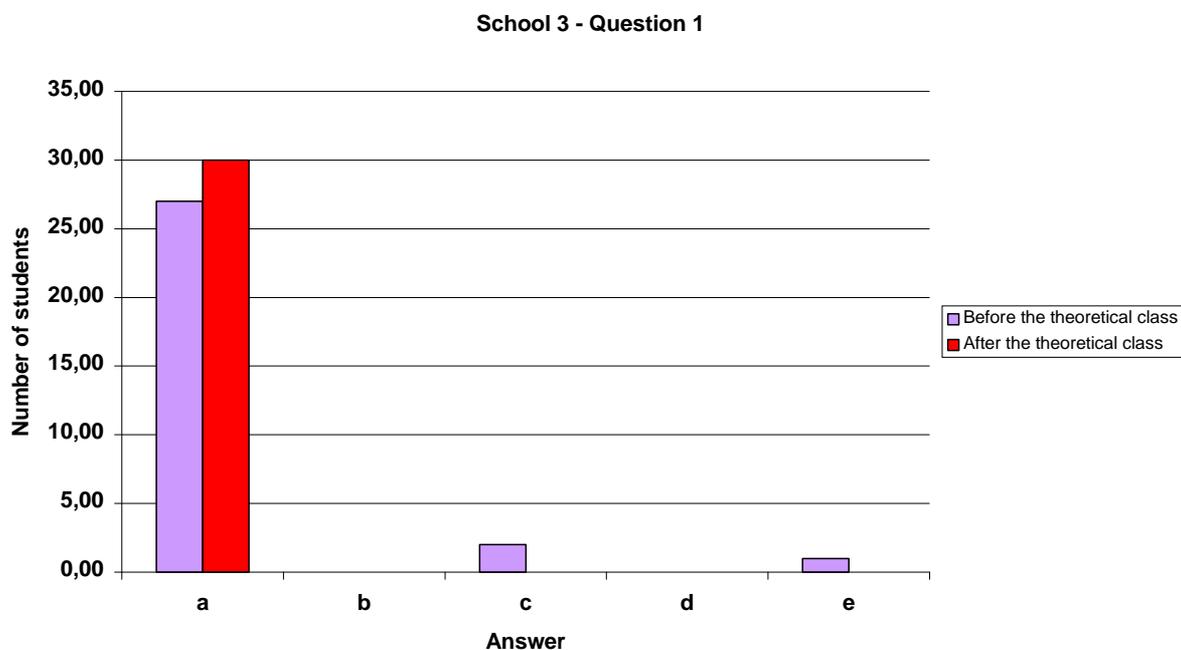


Figure 3 - Reply of the students of school 2 to the question 1.

Figures 4, 5, and 6 present the answers of the interviewed ones for question 2 (What are the immediate applications of the nuclear energy?), as correct reply was item “b”. A comparison among the student answers before and after the application of the theoretical lesson is also made.

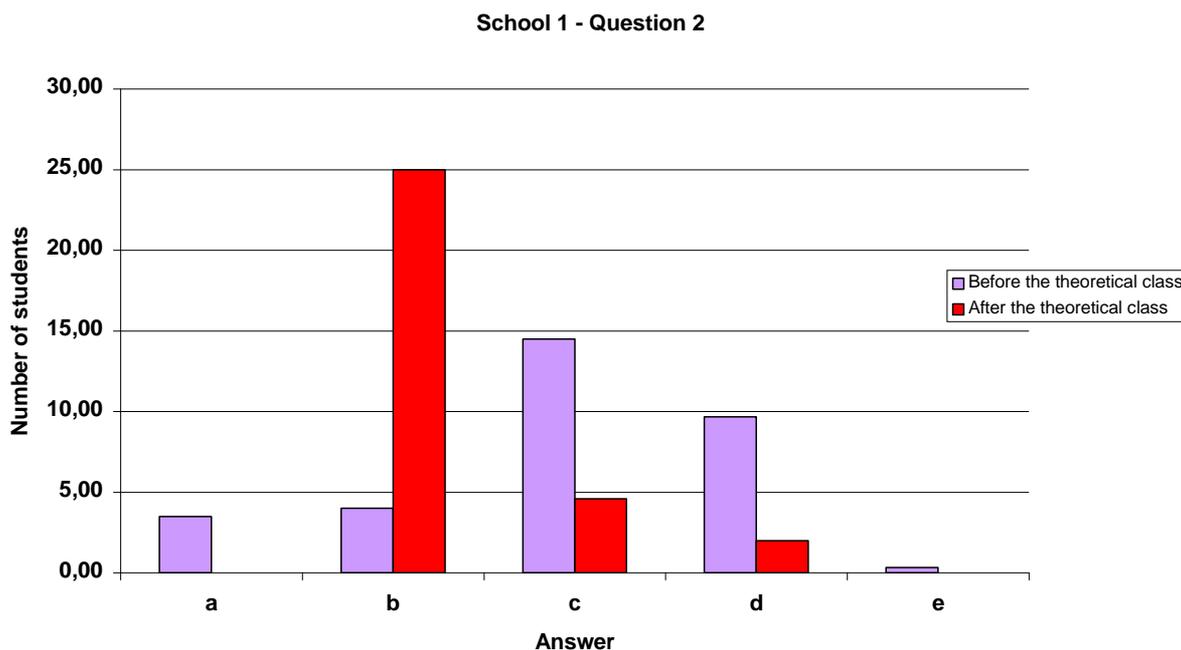


Figure 4 - Reply of the students of school 1 to the question 2.

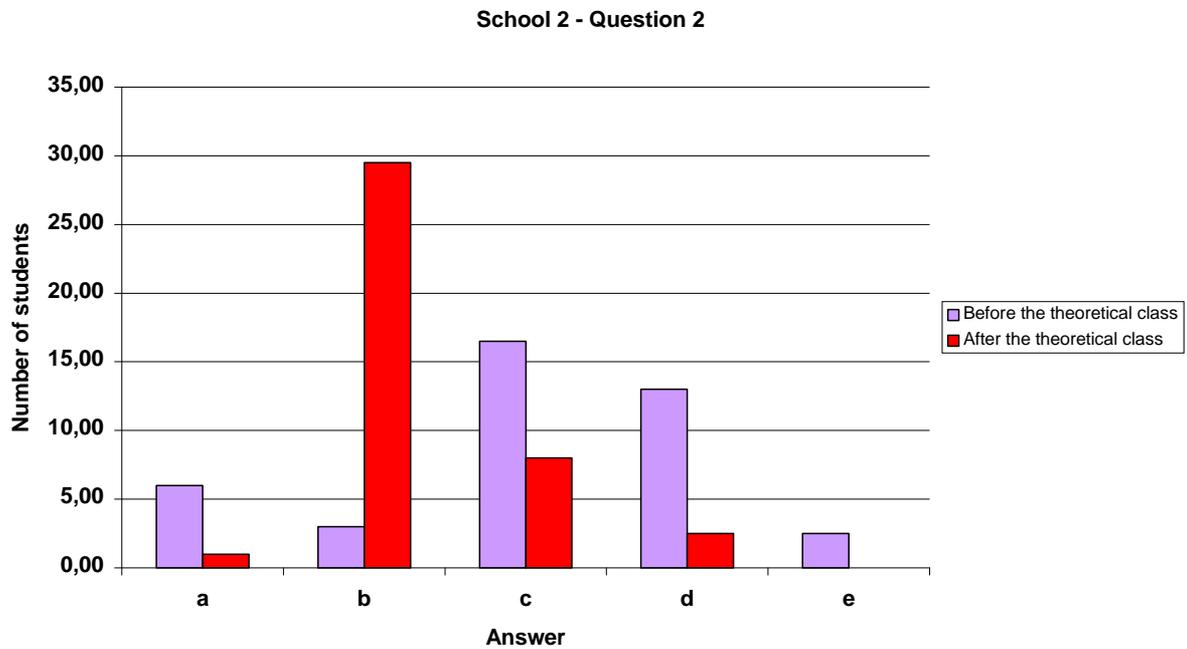


Figure 5 - Reply of the students of school 2 to the question 2.

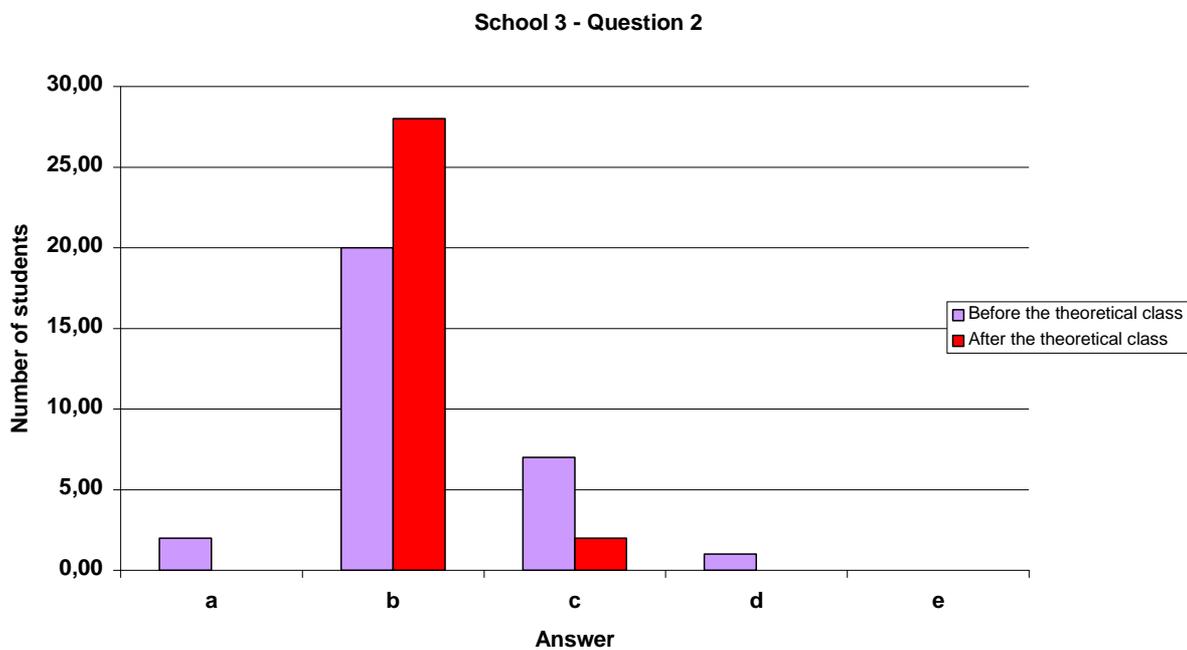


Figure 6 - Reply of the students of school 3 to the question 2.

The aim of question 3 was to know how the students had previously gotten information about the nuclear energy. Only 27% of the students had already heard about it at the school and, from these, 34% come from the same school (school number 3).

The following figure shows the answers of the interviewed students to question 3.

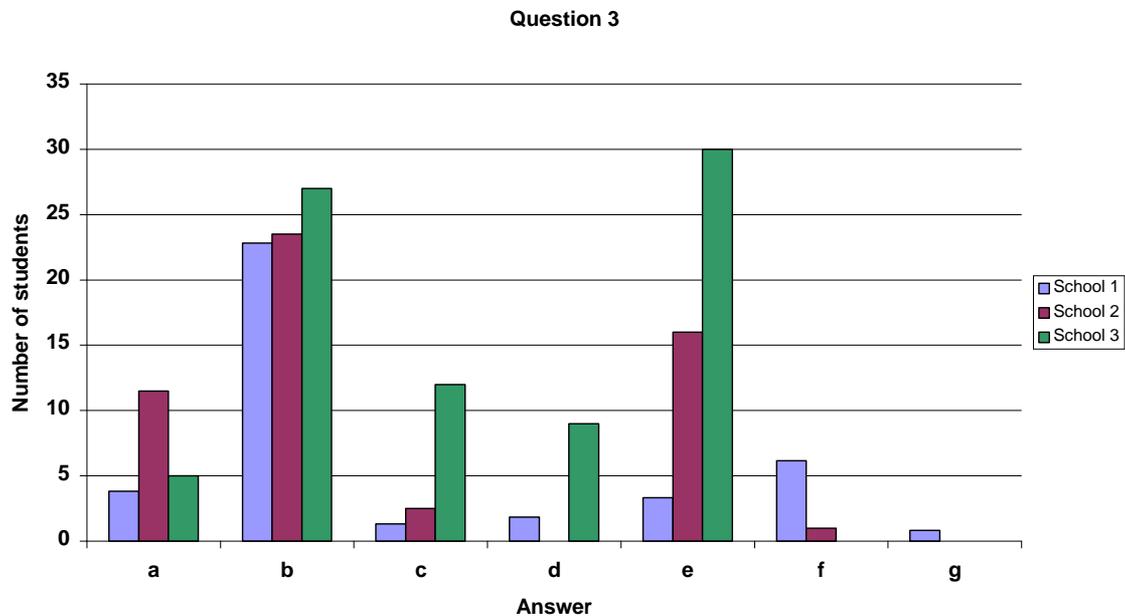


Figure 7 - Reply of the students of all the 3 schools to question 3.

From this figure one notes that the great majority of the students only had information about nuclear energy through proposition “b” (television) and a very small number of students had access to this information in the school (item “e”), excepting students from school 3.

Figure 8 reveals the socio-economic profile of the interviewed students considering the monthly familiar income:

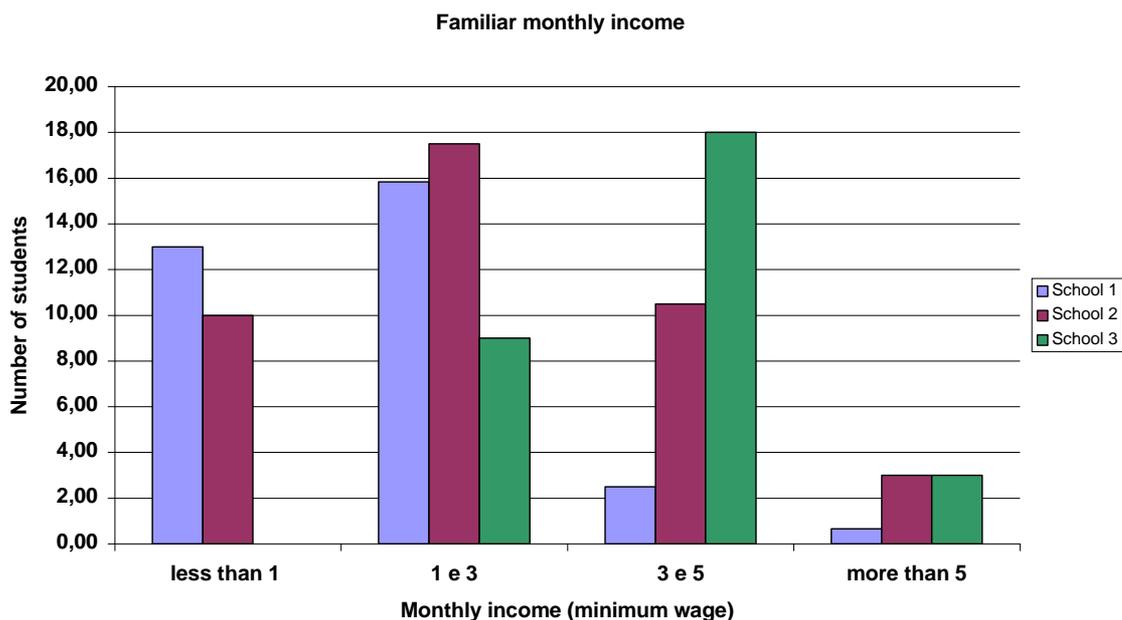


Figure 8 - Familiar monthly income of the students of all the 3 schools.

From the results of the interviews, one may see that students who had answered correctly the proposed questions were those having already heard about nuclear energy at the school. Moreover, these students have also higher monthly familiar income. This finding indicates the need for more studies during the continuation of this work.

One notices yet that, after the theoretical lesson, 92% of the interviewed ones answered correctly question number 1, while 80% replied correctly question number 2. This demonstrates that there was a lack of basic clarifications at the education of these pupils that did not know, for example, about the medical or industrial applications of nuclear technology.

It is evidenced that the nuclear subject is not taught by all the educational institutions and, at each analyzed school, a different degree of knowledge of the students was observed, fact that leads to the initial observation that the use of the National Curricular Parameters is not obeyed by all state schools, suggesting the need of explanation of the cited subject during the secondary education, as the base for their curricular grade.

From the accomplishment of the interviews, one realizes that the most shocking form of nuclear energy present inside the minds of the students is, in fact, the nuclear bomb. During the discussions with the students, one of the biggest questionings made for them was about the nuclear bomb; the majority of them said that they would like to know why this is the only subject divulgated and why the benefits of the nuclear technology are never spoken about.

Obviously, the nuclear bombs and their catastrophic implications for the humanity must be disclosed and people must be warned about the danger of the nuclear technology. However, the history of this technology is not only this. Why do not show to the students the good things produced by this technology? It is necessary that all information become accessible to the students, so they can, as the school and the educational proposal of the Government would like to, critically reflect and decide what they think of this type of technology, especially now that the nuclear area is being retaken as one of the sources of electric energy in the country.

Another important factor that must be highlighted is that the students felt themselves much more comfortable to answer the questionnaire after the theoretical lesson. They were motivated and self confident during the application of the questionnaire. During the lesson and the wheel of discussion, the students shown themselves very interested in the subject, which again indicate that this has not been treated inside the educational institutions in general.

It is important to point out that this work is still in progress and it is still necessary to analyze a higher number of schools to get an educational map of the nuclear energy in the city of São Paulo. However, there are a lot of difficulties to accomplish it. The considerable number of schools to visit and the distance between them are relevant problems for this research. There is also a certain resistance from the educational institutions in accepting this research. The coordination of the institutions fear that their names might be associated to negative results in the study. This leads to several non authorizations to accomplish the interviews, even under the condition of not having their names disclosed.

3. CONCLUSIONS

By the accomplishment of this work, it was possible to observe that around 55% of the interviewed students have an incorrect vision about the concept of nuclear energy.

Furthermore, 84% of the students have a limited vision regarding the benefic applications of the nuclear energy. Such data still represent a small part of the schools in the city. However, these results are alarming, since they demonstrate the lack of explanations to the population about the nuclear technology, its applicability and its importance. If a so huge number of students of the third grade of the Secondary Education (73%) had not heard about it at the school, then one concludes that there is a serious educational problem that should be analyzed and solved, especially now that the introduction of the nuclear energy in the Brazilian energetic matrix is extremely important.

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