SOCIAL REPRESENTATION AND NUCLEAR CHEMISTRY EDUCATION

Farias, L. A.[1]; Fávaro, D. I. T.[2]

[1]Setor de Licenciatura em Ciências, Universidade Federal de São Paulo, São Paulo, Brazil, lufarias2@yahoo.com.br
[2]Laboratório de Ativação Neutrônica, Instituto de Pesquisas Energéticas e Nucleares, IPEN /CNEN-SP
Av. Prof. Lineu Prestes 2242, São Paulo, Brazil, defavaro@ipen.br

INTRODUCTION

- August 6, 1945, the first atomic bomb "Little Boy" is dropped on Hiroshima, Japan.
- August 9, 1945, the second atomic bomb "Fat Man" is dropped on Nagasaki, Japan.
- April 26, 1986, the Chernobyl nuclear reactor explodes in Pripyat, Ucrania.
- September 13, 1987, an abandoned 137 Cs capsule leaks in Goiania, Brazil.
- March 11, 2011, a nuclear power plant exploded in Fukushima, Japan.

These are only four examples but they that can be used to illustrate the phenomenon of Social Representations (SR). Our image of nuclear energy was changed after these events and now most people associate this technology to danger and war.

The negative social representations, coupled with the difficulty of working the "Nuclear" and "Radiation" themes in Brazilian high schools have led many higher educational students to a substandard understanding of nuclear energy. Thus, there is no acquisition of adequate knowledge concerning the subject in order for a critical and reflective option.

Within this perspective, this study investigated the perceptions of students at the University of São Paulo (USP) on this theme, from the term inducer "Nuclear Energy", highlighting the structure of Social Representations (SR) on the subject.

The initial premise was that students of USP would have greater knowledge about the topic, since those who enter the university come mostly from private schools in Brazil. Nowadays, Brazilian private schools offer better education than public schools.

The second premise was that since Nuclear and Energy Research Institute (IPEN) is located in the USP campus, the students would have more knowledge and understanding of nuclear energy.

MATERIALS AND METHODS

The methodology used was the free evocations from word technique by using the EVOC program, given the frequency in which each element was raised and their average order of evocation to an issue-oriented semantic (cognitive). A closed question was also used in the questionnaire:

- HOW DO YOU ASSESS YOUR KNOWLEDGE ABOUT NUCLEAR ENERGY?
  With the following options: very good, good, reasonable, basic and none.

In this study 124 students were interviewed: from the Chemistry, Pharmacy, Environmental Chemistry, Chemical Engineering and Nutrition Departments (62), Oceanographic Department (29) and Economics, Business Administration and Accounting Department (33), in the period June-August 2010.

Of those interviewed: 47.6% were female, 52.4% male and 69% graduated from private schools with the average age of 21 years.

RESULTS AND DISCUSSION

In respect to the closed question used in the questionnaire :

- "HOW WOULD YOU RATE YOUR KNOWLEDGE ABOUT NUCLEAR ENERGY?"

55.6% of the respondents said that their knowledge was basic or none.
These, 71% were from private high schools in the country.
This suggests that the theme of "nuclear" or "radiation" is not sufficiently dealt with in high schools, private or public.

For the construction of the quadrants, words mentioned only once or twice were discarted (< 10%).

From this *corpus*, we performed the calculation of the average frequency of appearance of words, by dividing the total words (394) by the number of different words (36). The average frequency of 10 was obtained.

The average order was obtained by dividing the number of words evoked by the number of individuals. As individuals evoked 5 words, the average order was 2.5 per person evocations. Based on these criteria, it was possible to construct the diagram with four quadrants (Table 1).

	Average Order of Evocation < 2.5			Average Order of Evocation >= 2.5		
Frequency >=10	atomic	18	1.500	energy	36	2.556
	atom	15	1.533	explosion	11	3.182
	bomb	31	2.484	Iran	12	3.000
	fission	15	2.467	waste	17	3.353
	fusion	11	2.182	nuclear	17	2.588
	radiation	21	2.476	danger	17	2.882
	radioactivity	13	2.154	reactor	16	2.563
				technology	13	3.393
				uranium	41	2.585
				plant	13	3.231
3<= Frequency <=10	alternative	5	2.400	research	4	3.750
	high	5	2.400	plutonium	5	2.600
	cost	3	2.333	policy	3	3.000
	economy	3	2.333	pollution	6	3.667
	clean	8	2.250	protons	4	2.500
	dangerous	3	1.667	chemistry	4	3.000
	radiative	3	1.000	renewable	3	3.000
	sustainability	4	2.250	waste	3	3.000
	plants	3	1.000	risk	5	3.600
				safe	3	2.667

Table 1. Diagram of the structure of social representations of USP students.

The top ten most evoked words corresponded to 46.5% of the total with emphasis on two words in the first quadrant: bomb and radiation. Since every representation is organized around a central core that defines it, its significance and internal organization is related to one central and peripheral system. It is observed that these two words possibly represent the central core of the nuclear theme. This is because the elements belonging to the central system of the SR are those that occurred most frequently, with quick evocation and are located in the upper left quadrant of the diagram, while the peripheral elements are those located in the other quadrants. The periferic system of this condition, particularly the second quadrant, consists of elements that refer to the words of the first quadrant (explosion, Iran, waste, nuclear, danger, reactor technology, uranium mill). It is interesting to note that in the period in which interviews were conducted (June-August 2010), Brazil was mediating negotiations with Iran over its nuclear program, and this was widely covered by the media. The influence of this event is reflected in the appearing of the word Iran (N = 12) in the second quadrant. Most likely, if the interviews had being more recent words, such as Japan and Fukushima would have been raised, pointing out the importance of the media in the development or "reworking" of social representations of the population.

In none of the quadrants do words such as IPEN, cyclotron, radioisotopes, radiopharmaceuticals, etc appeared. The research word appeared in the last quadrant but with low frequency (N = 4), indicating the minimal or complete lack of knowledge about the activities of the IPEN), located within the campus.

CONCLUSIONS

- It was observed that these students entered the University with a limited view on the subject, which suggests that the theme is little worked in high school in the country, independently whether the school is private or public. The presence of the IPEN in the University campus has not contributed to increased knowledge about the theme for population of the campus.
- From the social, political, economic and environmental perspectives, high schools must expose students to a wider understanding of nuclear energy.

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