

# FROM SECONDARY SCHOOL TO UNIVERSITY: ATTRACTING YOUNG STUDENTS TOWARDS A CAREER IN NUCLEAR

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## INTRODUCTION

From its creation, Spanish Young Generation in Nuclear (Jóvenes Nucleares, JJNN), a non-profit organization that depends on the Spanish Nuclear Society (SNE), has as an important scope to help spread knowledge about nuclear energy, not only pointing out its advantages and its role in our society, but also trying to correct some of the ideas that are due to the biased information and to the lack of knowledge. To try to have success in that goal, some high school lectures were taught and it has been organized regularly a Basic Course on Nuclear Science and Technology

## HIGH SCHOOL LECTURES & SURVEYS

With this goal in mind, lectures were given in several high schools, aimed at students ranging from 14 to 18 years old. This paper explains the experience accumulated during those talks and the conclusions that can be drawn, so as to better focus the communication about nuclear energy, especially the one aimed at a young public.

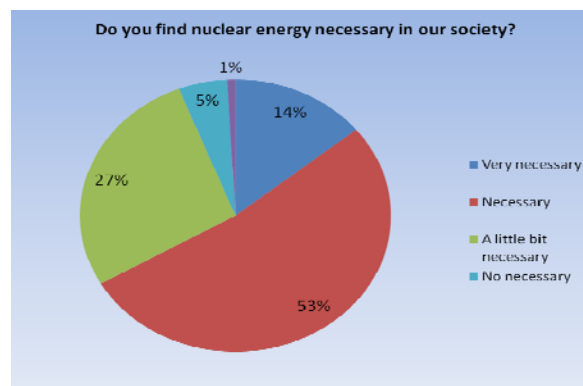
In order to evaluate the degree of knowledge and information on a specific topic of a given group of individuals, statistical methods must be used. At the beginning of each lecture (and sometimes at the end, in order to evaluate the impact of the talk) the students were submitted to a short survey conducted by Spanish Young Generation. It consisted in eight questions, dealing with the relation between the main environmental issues (global warming, acid rain, radioactive waste...) and nuclear energy.

The answers can be surprising, especially for professionals of the nuclear field who, since they are so familiar with this topic, often forget that this is just the case of a minority

of people. A better knowledge of the degree of information of a given group enables to focus and personalize the communication. Another communication tool is the direct contact with students: it starts with their questions, which can then lead to a small debate. If the surveys inform about the topics they are unaware of, the direct exchange with them enables to find the most effective way to provide them the information.

## Statistical results of the surveys

In this section, the results of most relevant answers to the survey are shown.



- Figure 1. Answers to the question: Do you find nuclear energy necessary in our society?

The results are surprising since Spanish people have always been against nuclear energy

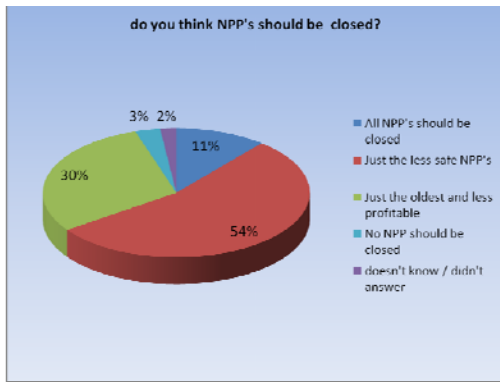


Figure 2. Answers to the question: do you think NPP's should be closed?

Most of the students attach importance to nuclear safety, more than plant profitability

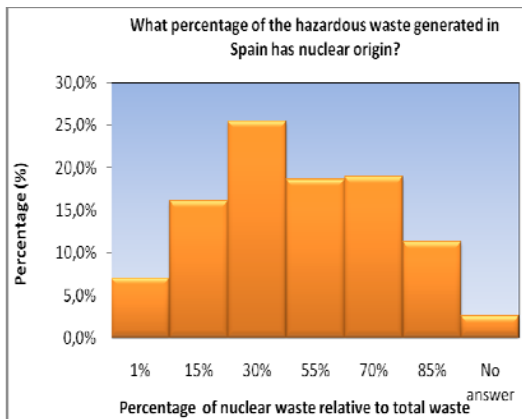


Figure 3. Answers to the question: what percentage of the hazardous waste generated in Spain had nuclear origin?

The answers show a wide range of students' opinions; it is important to highlight that less than 8% of the students answered this question correctly.

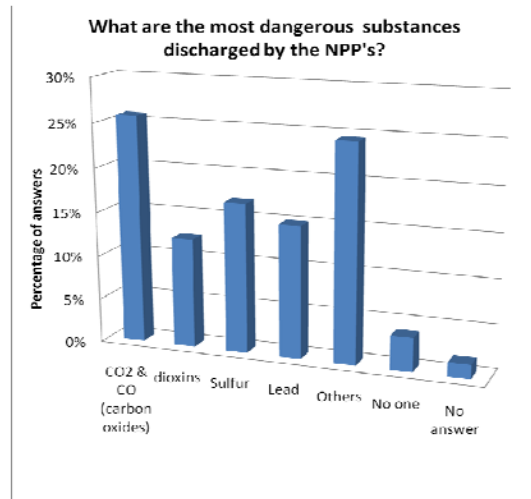


Figure 4. Answers to the question: what are the most dangerous substances discharged by the NPP's?

The ignorance about what kind of substances can discharge a nuclear plant is fairly widespread and wrong nonsense answers are also typical.

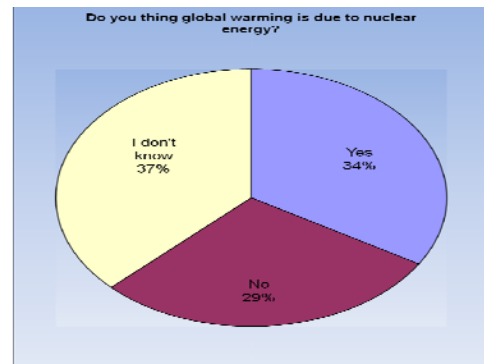


Figure 5. Answers to the question: Do you think global warming is due to nuclear energy?

Only a third of the students are sure that nuclear energy has nothing to do with climate change.

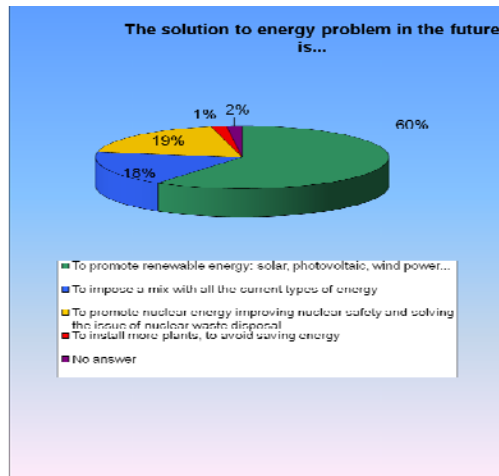


Figure 6. Final question: choose the statement that would solve the issue of energy in the future

Most students want to increase the weight of renewable energy to solve the energy problem of the future

## Conclusions

Therefore, the outcome of the performed exercise is that Spanish teenagers have still a lack of knowledge about nuclear energy. We can learn that items that are evident for nuclear young professionals are unknown for high school teenagers.

It is considered that the sample of 354 teenagers of different Spanish high schools is big enough to draw preliminary conclusions.

Nevertheless, in order to make the sample more representative of the Spanish teenagers' perception of nuclear energy, it is necessary to have more opinions and more answers to the surveys.

The main conclusions are the following:

- Spanish teenagers think that nuclear energy is necessary in our society.
- Nuclear safety has more importance for them than plant profitability.
- There is an obvious lack of information about the quantity of

hazardous waste generated by nuclear power plants.

- Spanish teenagers still believe that nuclear power plants are responsible for some environmental problems that are obviously not related with nuclear power plants
- The Spanish teenagers that are opposed to nuclear energy usually justify their position by accusing nuclear energy to be responsible of all environmental problems: acid rain, oil sick, greenhouse effect...

## The Basic Course on Nuclear Science and Technology

On the other hand, JJNN also organizes regularly a Basic Course on Nuclear Science and Technology. The purposes of this course are to provide general information, to answer the most common questions about Nuclear Energy and to motivate the young students to start a career in nuclear. Therefore, it is directed mainly to high school and university students, but also to general people that wants to learn about the key issues of such an important matter in our society. Anybody could attend the course, as no specific scientific education is required.

The course is done at least once a year, during the Annual Meeting of the Spanish Nuclear Society, which takes place in a different Spanish city each time. The course is done also to whichever university or institution that asks for it to JJNN, with the only limit of the presenter's availability.

The course is divided into the following chapters:

- Physical nuclear and radiation principles
- Nuclear power plants
- Nuclear safety
- Nuclear fuel
- Radioactive waste
- Decommission of nuclear facilities
- Future nuclear power plants
- Other uses of nuclear technology
- Nuclear energy, climate change and

sustainable development.

The course is divided into 15 minutes lessons on the above topics, imparted by young professionals, experts in the field that belongs either to the Spanish Young Generation in Nuclear, either to companies and institutions related with nuclear energy. After chapter 4, a 15 minutes break is used by teachers to have a rest.

It is important to highlight that after the course a debate time is left to allow the attendance to ask the teachers about all the issues that they think are confused.

At the end of the course, a 200 pages book with the contents of the course is handed to every member of the audience. This book is also distributed in other course editions at high schools and universities in order to promote the scientific dissemination of the Nuclear Technology. As an extra motivation, JJNN delivers a course certificate to the assistants.

At the end of the last edition course, in Santiago de Compostela, the assistants were asked to provide a feedback about it. As it is said, also the course teachers and the authorities provide this feedback. Some of the most relevant ideas, recommendations and opinions are in the next list:

- It is highly necessary to be self-critical. The course is good but it is very improvable.
- To consider that not all the people have the capacity to communicate.
- To make flexible the content of the course adapting it to the type of audience
- To be advised by experts once prepared the lessons. They could be expert of the own SNE so that one felt more contributor of the course.
- To evaluate the course by the assistants.
- The coordinator should answer the questions if they are brief or if not, he should distribute them to one of the experts.
- To try to lower the level of the lectures, that continue being very theoretical technician/and more for the gauging than was had normally
- To use simple examples to try to explain the distributed subjects (for example the nuclear safety is like a football team and to be goaled, it must have failed the forwards, the defenders and finally the goalkeeper).
- To speak about radiation protection with comparisons of the magnitudes so that the assistants do not lose themselves with the numbers (for example a X-ray test is equivalent to 3 mSv and the limit for the exhibited personnel is 1 mSv)
- To give the course in two parts, morning and afternoon, to give time to the people to understand the ideas, to comment, to debate and to attend better the lectures.
- To update the contents with the last information available and to document better the sources.
- To deal with subjects of the time being, incorporating a lesson of "Subjects of the present time" with contents like Chernobyl, Polonium and the Russian spy, terrorist attacks to power plants, press article compilation...
- To include security of nuclear power plants as a subject
- To distribute a survey between the assistants.
- Some presentations were extended more than planned, which contributed to went behind schedule.
- It would be good that when sending the inscription to the course, the students would indicate what studies are doing (also it would serve like statistic) and to adapt the lectures to those levels.
- To come so suited up, it gives a sensation that the nuclear power is an old technology.

- It is important to prepare a good didactic material. For that, it is better that the content of the book is updated every year.
- The course has been very interesting, very formative and of great value to clarify a little plus a so interesting area. It was a very reasonable and very didactic course.
- I have liked very much the format with brief lessons and different lecturers.
- The level is like an introductory course but without sacrificing rigor
- Perhaps it would be possible to be useful plus the book, not to deepen more, but to give more references to whoever that wants to deepen in the subject.
- I took one pleasing surprise when attending the Course, believe that the work that you do is very important and in fact, I have been investigating to see how I can make me Young Nuclear, I am convinced that I will be able to contribute in something.
- That people participate more actively in the course and that lasted more time.
- I liked that everybody could give its opinion although it was not in agreement with the use of the nuclear power.
- Very didactic, comprehensible course for people related to science and people nonrelated to it.
- The main target of was obtained perfectly; to make arrive at the town the energy nuclear
- The question-and-answer session is very useful, thanks to the lecturers good attitude to respond all the questions.
- The part of exhibition of the subjects to me became very basic, but I understand that it had that level if what you looked for it were to arrive at the boys of the institute.
- The course is very good, I liked much, and for the time that is arranged, it is very ambitious.
- The course seemed to me very interesting and the exhibitions were quite good and easy to follow.
- A service of buses must exist and if this one is annulled, communicate it to the assistants.
- It would be good that the course were validated with ECTS. Then, the attendance would be greater, although it entails to increase the hours of the course.
- The time of the lectures is not sufficient since in some subjects the interesting part could not be deepened and they had to make more agile the lectures.
- I liked very much the course, it is a very interesting subject and I consider that the subjects were treated rather well.
- Perhaps the form to explain all the subjects is very good, but there is a lack of experience.
- Perhaps subjects more technicians not arrive either at public, I would deal with, like the person made who spoke of safety, resemble or put examples of the daily life (like the one of the Formula 1).
- Subject of safety, next to the one of management of residues, that is what it worries to the public opinion more would have to be more extensive, with photos, where people can see the real things
- It would be a good idea to have a stand in the feria.
- The book is spectacular.
- The option of not discussing or facing the opponents to this type of energy, and to try simply to transmit information is perfect.

## Conclusions and lessons learned

The conclusions obtained from the received feedback and after internal discussions in Spanish Young Generations are presented in this section. The feedback obtained in other courses has also been taken into account, as well as the expertise of some former course teachers.

The main conclusions are the following:

- Although the course attendance use to consider the course to be positive, it is important to evaluate every course edition and do self-criticism.
- Not only has to be improved the content of the course, but also how to communicate this content to the attendance.
- In order to commit this improvement, next courses editions should be prepared also by experts in communication.
- It is important to adjust the course level to the age attendance; technical and theoretical lessons, and easy comprehensible examples have to be better balanced.
- The course has to be systematically evaluated by the attendance. An official course survey has to be created and distributed in order to have an organized feedback.
- A new chapter linking technical chapters and known events as Chernobyl accident has to be added.
- After the course, during the question-and-answer session the course responsible should coordinate the answers to the course attendance. He should try to answer the question and if he is not able to he should address the question to only one teacher.
- Some important Radiation Protection issues have to be highlighted in the Nuclear Safety chapter. How to measure the radiation and its potential danger has to be better presented and explained.
- The radiation effects in the environment and in the human health

should be more detailed, as it is always asked at the end of the course, as well as the management of the radiation waste.

- If the purpose to consider this course as a reference in the Spanish Nuclear Society and in the specialized universities has to be fulfilled, the above conclusions and a hard course preparation have to be done in the future editions.

## GLOBAL CONCLUSIONS

As a general conclusion of the talks and courses it can be said that many of the students who attended have increased their motivation towards the nuclear field, and hopefully it will help the young talents to choose such path to develop their careers