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NUCLEAR EDUCATION AND TRAINING



Considerations on new Study Plans for Higher Education in Nuclear Engineering and Radioprotection

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INTRODUCTION



- *Many countries introduced important **changes in curricula** of Universities and other Higher Education Institutions.*
- ***Study Plans** on Nuclear Engineering and Radioprotection have been also widely modified.*
- ***Changes affect students** going through nuclear courses.*
- *It is necessary to **encourage new generations** to choose the nuclear option.*
- ***Active learning methodology** is recommended to improve the formation of students.*
- *The general situation and particular features of **nuclear related courses** are analysed. In particular at UPV.*
- *Some **solutions** are proposed.*

- **External factors** can influence on the decision of new generations of students about the nuclear option.
- **Negative impact** on the public opinion of nuclear energy.
- **Well accepted** in medical, but not for energy production.
- **Impact of accidents:** Chernobyl, Fukushima.
- Developing of nuclear sector depends on **economy planning** and other factors in each country
- Nuclear engineers and scientists going to **retirement**.
- A good program for nuclear matters in **universities** is essential as well as a planning of **education and training in companies** working in the nuclear sector.

GENERAL FEATURES

- 14 Bachelor level degrees and 9 Master degrees.
- Not all of them have Engineer **professional attributions**.
- **Degree diploma** (4 years, 240 ECTS) + Degree Thesis.
- **Master** (2 years, 120 ECTS) + Master Thesis.
- Different **specializations** with too many optional courses.
- A high increase in the number of offered courses.
- An almost completely **free choice of optional courses**.
- Difficult organization of lecture timetable \Rightarrow negative impact on the **schedule** of students and professors.
- Studies on Nuclear Engineering and Radioprotection become also affected by these changes.

NUCLEAR RELATED COURSES

- **4th year Energy Engineer Degree (GIE)**
 - ◆ Nuclear Technology (1st semester)
 - ◆ Advanced Nuclear Plants (2nd semester)
 - ◆ Reactor Operation (2nd semester)
 - ◆ Radiological Protection (2nd semester)
 - ◆ Nuclear Safety (2nd semester)
- **2nd year Industrial Engineer Master (MII)**
 - ◆ Nuclear Energy and radiations (1st semester)
 - ◆ Radiological Protection in Radioactive and Nuclear Installations (2nd)
- **Really, GIE and MII are independent studies.**
- **The analysis is centered on GIE.**

optional courses

NUCLEAR RELATED COURSES

- *A student of 4th GIE usually chooses 1-2 **optional courses** (rarely all of them).*

Consequences:

- *The formation of GIE students becomes incomplete in the nuclear field.*
- *A decrease in the number of students per course.*
- *With the choice of courses completely free, formation of students on nuclear fields is apparently not improved.*
- *An optimal curriculum on Nuclear Science and Technology cannot be easily configured.*
- *It is necessary a **Nuclear Energy Master** or an Energy Master, more general, including a nuclear option.*

POSSIBLE SOLUTIONS



- *It is **not good the dispersion of attention** on non-related subjects for the education from a global point of view and also for the formation in the nuclear field.*
- *A **well-structured planning** for Energy Engineer Degree with specific Master on Nuclear Engineering is required.*
 - ◆ ***Introductory and basic courses** at Bachelor level.*
 - ◆ ***Specific and specialized courses** at Master level.*
- *This probably could help to have **good engineers** and scientists in nuclear fields.*
- *The teaching **methodology** applied may also have a positive impact on the learning process as well as on the disposition of students to choose the nuclear option.*

- The use of an **active learning methodology** is highly recommended as it can improve formation of students.
- However, the active methodology is not just to increase the number of exams and to program in all details the activity to be developed by students.
- Students are the **active** subject of their own learning.
- Professors should supervise and drive this process to optimise learning results.
 - ◆ Involving students in the development of lessons.
 - ◆ It is indispensable the personal **motivation** of students.
- To **encourage students** to actively participate in class by discussing each lesson, although they have no background in the field.

METHODOLOGY



- *The objectives of each lesson are proposed by means of questions to stimulate the participation of students in the discussion.*
- *Questions addressed to obtain ideas from students not just to get answers read in a book.*
- *The best quality of professors should be to stimulate students.*
- *The best quality of students is to think and to work.*
- *Students must be previously provided with the information necessary to prepare the discussion.*
 - ◆ *A text book is important.*
 - ◆ *Notes, books, journals, bibliography, practical exercises, questions, software and web pages.*

- Preferable a **continuous evaluation** of students with...
 - ◆ *comprehensive understanding of basic concepts,*
 - ◆ *application to practical cases,*
 - ◆ *verifying the accomplishment of objectives.*
- The development of **individual projects** with an oral presentation should be stressed.
- This active learning methodology becomes more difficult to apply when the **number of students per course** is increasing.
- **E-learning** (partial or total) can be an alternative, although direct **contact teacher-student** can be lost and it is important to keep active this contact as much as possible.

CONCLUSIONS



- ***New Study Plans*** for Higher Education in Nuclear Engineering and Radioprotection have a possible ***negative impact*** on the formation and training of engineers and scientists in nuclear fields.
- It would be convenient to ***decrease*** the ***optionality*** of courses to avoid the dispersion of the attention and to get a more complete formation of students.
- It seems necessary to ***establish a program*** of basic courses at ***Bachelor*** level for Energy engineers followed by a well-structured ***Master on Nuclear Engineering***.

CONCLUSIONS



- *An **active learning methodology** is recommended as it can improve the formation of students.*
- *The **self-learning** should be stimulated trying to maximize the **thinking** activity of students.*
- *A **common action** to improve the situation must be taken in three sectors:*
 - ◆ *Institutions elaborating Study Plans.*
 - ◆ *Universities developing and applying them.*
 - ◆ *Companies involved in the nuclear sector through training.*

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Thank you for your attention

