

ARE UPPER SECONDARY SCHOOL STUDENTS INTERESTED TO CHOOSE A CAREER IN SCIENCE?

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Abstract. *In the contemporary school, claimed itself as a stronger one and assumed as connected to the actual social realities in a great measure, the students' counseling process represent an important issue. In this sense, a particular component of the process is represented by the professional counseling or career counseling. Practically, it includes a set of activities designed and implemented in order to facilitate the choice of a profession, by raising the students' awareness on their competitiveness, objectified level of knowledge, interests, attitudes and professional skills, but also on their realistic reporting related to their future professions, labor market requirements and specific professional standards in the selected field.*

In this sense, the teachers should be concerned to identify and cultivate the students' interests for a particular professional field and present them in a realistic manner, the characteristics of the professions or careers which are subsumed to a specific area.

The paper tried to identify the ways in which the Science teachers (Physics, Chemistry, Biology) are able to cultivate the students' interest for a research career, especially dedicated to the scientific area. In this respect, it was designed and monitored a Case Study, involving secondary school students as main actors, beneficiaries in fact of the activities proposed in the frame of the FP7 European project called IRRESISTIBLE. The study had the main objective to train the Science teachers with the view to promote formal, informal and non-formal learning activities, considering the introduction of Responsible Research and Innovation dimensions in those specific contexts.

The obtained results let us to consider that a proper design and implementation of modern teaching approaches and interactive processes may guide the students on choosing a career in science research.

Keywords: *school counseling, professional counseling, Responsible Research and Innovation, IRRESISTIBLE project.*

1. INTRODUCTION

The *vocational / career counseling* represents an ensemble of activities designed and carried out in order to facilitate the choice of a profession among students in different schooling stages. It involves raising awareness of their own knowledge, interests and professional abilities as well as their realistically relation to the needs of the job market and professional standards, specific to each field of activity.

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In this context, students will become familiar with school network and qualifications for each major area or specialization, they will learn about the job market offers, current and future requirements of the society in relation to the labor market. In addition, and with the help of a large range of psycho-pedagogical instruments, the specialized teaching staff will assist students to get to know themselves and to picture a fair image of themselves, in-line with the acquired competences.

The most important objectives of the *career counseling*, also designated as *vocational counseling*, are: forming and developing self-knowledge and self-appreciation skills among students; knowing the social and professional integration mechanisms in harmony with the requirements of the job market; raising awareness of the continuity of professional development activities along the initial education-improvement-reconversion trajectory; becoming aware of the need to maintain the balance between aspirations and individual capacities on the one hand, and social requirements on the other hand; getting to know the characteristics of each profession, including its advantages and its limits.

When a profession is generally characterized, there must be taken into account a series of aspects regarding: social and economic importance, working operations or particular procedures, materials and equipment, working organization (individual and/or group activities), hygienic conditions, day or night schedule, lightening, ventilation, humidity, work safety, specific economic conditions concerning remuneration, welfare, other monetary advantages, but also the necessity amount of professional training seen as an ensemble of competences relating to general knowledge and specialization knowledge, promotion methods, self-development etc.

Correlatively, *vocational counseling* is defined as “the cluster of actions designed, organized and conducted as part of the educational process, with a view to identify, stimulate, structure of specific capacities, but also passions, as complementary issues to those requested capacities” [1].

Another concept used in connection to the professional counseling is *school and vocational orientation (S.V.O.)*. It represents a “system of educational measures and actions taken by responsible factors, in order to assist the student (the orienteer) in the process of choosing of a school/profession which best matches the personality and the societal demands (life requirements)” [2].

School and vocational oriented activities may be organized by the class master-teacher (during the educational classes), the school counselor (during the psycho-pedagogical assistance practice time), and by the teachers of different disciplines, through capitalization of the formative-professional character of different disciplines. All those activities help the student to make a choice in full knowledge, and in connection with the studies they want to explore or the profession they want to practice in the future. In this respect, the S.V.O. activity has three main functions [2]:

- a) an *investigative function*, i.e. identifying students' personality features, different professions and requirements of the social life;
- b) an *informative function*, i.e. informing beneficiaries (students, parents, teaching staff) on the issues that school and vocational orientation involves;
- c) a *formative and educative function*, i.e. forming students with a view to make an appropriate choice, in terms of school and profession.

School and vocational orientation covers a narrower set of problems than psycho-pedagogical counseling, being focused only on the aspects leading to the choice of school and profession. Actually, over the past decades, the literature has particularly used the terms of *vocational counseling* or *career counseling*, to the detriment of school and vocational orientation.

But how much interest show students to research, as a career, mostly taking into discussion that *research* activities constitute extremely important issues in the context of the contemporary society. In this sense, the member states of the European Union adopted the *European Charter of Researchers* [3], which represents “a set of general principles and requirements which specifies the roles, responsibilities and entitlements of researchers as well as employers or funders”. Additionally, it constitutes “a framework for researchers, employers and funders who invite them to act responsibly and as professionals within their working environment and to recognize each other as such”.

In this context, explanations are given for a series of specific elements on which research activities are substantiated such as: professional responsibility, professional attitude, contractual and legal obligations of researchers, good practice in research, dissemination, exploitation of results, public engagement, supervision and managerial duties, continuous professional development etc. [3].

2. METHODOLOGY

Coming near *Science Education*, in order to identify suitable methods that Science teachers (in Physics, Chemistry and Biology classes) may use to cultivate the students' interest in a research career, it was designed and conducted a *Case Study* that involved participant students in the IRRESISTIBLE project, which has as main objective to train Science teachers on combining formal and non-formal informal learning activities, by proposing educational strategies (*Inquiry-based Science Education*) in conjunction with *Responsible Research and Innovation (RRI)* dimensions.

The Case Study involved - in the beginning - a 5-questions questionnaire addressed to a sample of 48 students from upper secondary school (11th and 12th forms), with two predetermined closed questions and three open questions. The questions aimed to discover the students' perceptions in relation to what a career means, its advantages and disadvantages, related information about a research career in Science, and what type of person(s) who they would like to consult when choosing a research career. In addition to the application of the questionnaire, it was organized a focus-group discussion with the students, centred on the aspects regarding how Science may be promoted among the general public and how the RRI dimensions are present in the research activities (ethics, social responsibility, gender representation etc).

The students filled-in the questionnaire in appropriate conditions of confidentiality. The data collected from the questionnaires were processed through statistical and mathematical methods, being correlated also with qualitative appreciations derived from the discussions with students.

3. RESULTS AND DISCUSSION

When asked with what they associate a (Physics, Chemistry, Biology) research career, the students considered the following issues (Fig. 1): *assuming scientific responsibilities* (33%), *assuming social responsibilities* (24%), *low remuneration* (13%), *considerable physical effort/demanding intellectual work* (11%), *possibility to solve various problems the actual world faces* (9%), *vanguard scientific experiments/studies* (8%) and *full devotion to professional line of work* (2%). Those results confirm that students are - to a great extent - aware of the personal and social implications required by a researcher, as involved in a research profession. Furthermore, the fact that the highest percentages were recorded for the

indicators like *assuming scientific responsibilities* (33%) and *assuming social responsibilities* (24%), makes us believe that during the Science classes, the students have had the opportunity to identify and internalise the RRI dimensions, in a satisfactorily measure.

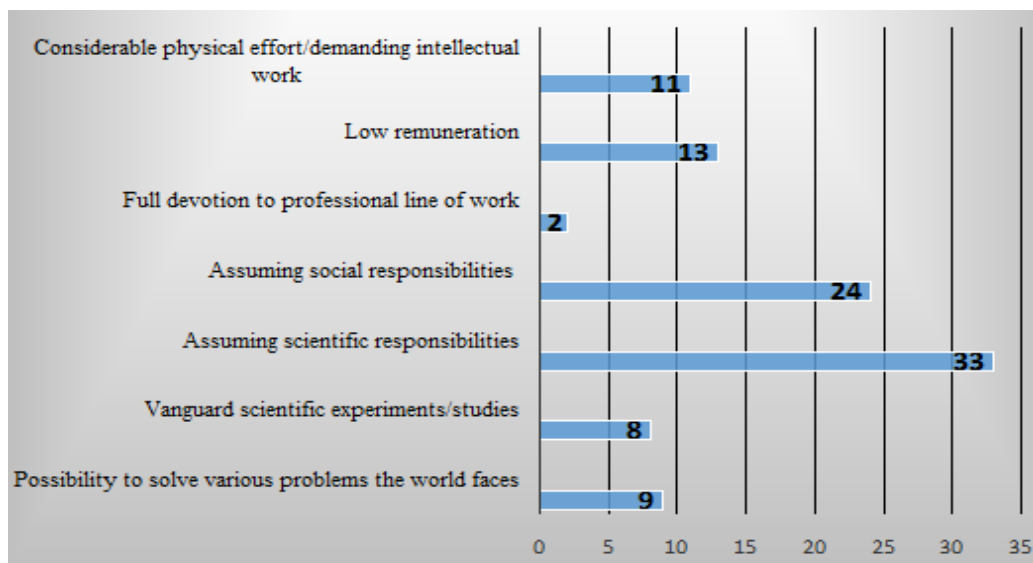


Figure 1. Students' feedback related to the issues they associate the profession of researcher

The following two items were represented by open questions which aimed to identify the advantages and disadvantages implied by a research career in the field of Sciences.

As advantages, the students identified the following: *cooperation with researchers from other countries, opportunities for being exploited in the research profession, access to the latest researches in the field, chance to discover something new, inedited, which may revolutionise the field of Sciences as well as the possibility to find solutions to the problems of the contemporary society.*

As disadvantages relating to the career of a researcher in the Sciences area, the students enumerated: *possible occupational diseases due to the work in toxic environments, possibility to lose contact with the reality, accidents caused by deficient manipulation of equipment or substances in the laboratory or even demotivating salary.*

The fourth item also requested an open answer with regards to the information that the students received during Sciences classes about the research career. They stated that - following the discussions with their Science teachers - they learned the following: they may study about nanoscience and nanotechnology as example; the research can be beneficial for people and society; being a researcher means to have at least one higher education degree (bachelor or master degree in Science) which should preferably be continued with postgraduate studies (Ph.D. degree); they may conduct researches in related fields such Biophysics, Microbiology, Biotechnology, Advance Chemistry / Physics, Technology of Organic or Inorganic products, Seismology and others; a researcher in Science needs solid scientific knowledge and research methodology knowledge; the researchers have to be motivated for their work, have to make continuous efforts, to be perseverant and to pay strong attention to what they do.

In addition, following the discussions with students, we have noticed that they had a clear representation of the areas in which they could activate professionally, after they get their bachelor degrees. Therefore, the university graduates - with majors in Chemistry - may become researchers in test and quality control laboratories (food, public health, clinic analysis, anti-doping control, environment protection agencies etc.), chemists or biochemists in different areas of the pharmaceutical industry, cosmetic industry, detergents, construction

materials, chemists in waste recycling and environment protection laboratories, inspectors in anti-drug laboratories etc.

For graduates of Biology, the employment possibilities are: research biologist in research laboratories, clinic and environmental laboratories, product quality control laboratories, laboratories for biosynthesis industry, inspector within the inspectorate of sanitary / veterinary issues, preventive medicine, biologist or microbiologist in research institutes, in laboratories of public health departments, pharmaceutical industry; specialist within the Environmental Police or employee in Science and Nature Museums, botanical gardens, zoos etc.

In their turn, graduates of Physics may be employed as: researchers within some institutes for scientific research, physicists in biotechnology and nuclear technology, specialists in communications; physicists in archaeology; specialists in the medical field, biophysicists; specialists in environmental protection, physicists in the field of non-conventional energy etc.

Being asked who they would consult first, if they are about to choose a scientific research career, the students answered as follows: 45% - Science teachers (Physics, Chemistry, Biology), 34% - parents, 18% - school counsellor, and 3% - friends (Fig. 2).

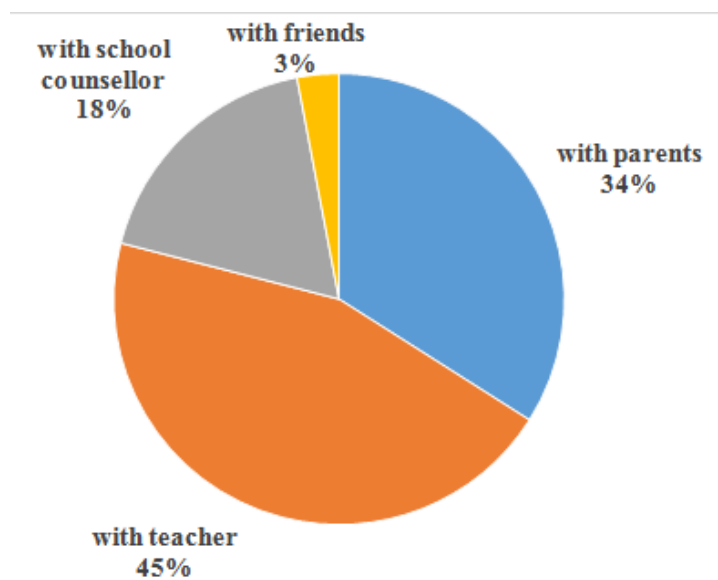


Figure 2. Students' answers concerning who would they consult first if they chose a scientific research career.

Those results lead us to the conclusion that Science teachers represent - for their students - the most important factor in the school and vocational orientation process, in terms of choosing a scientific research career. The students also stated that, in the context of current teaching activities, the Science teachers provide a special importance on getting know them from the psycho-pedagogical point of view. Therefore, a series of students' dominant personality features, as well as their interests, motivations, attitudes and professional aptitudes, are highlighted.

4. CONCLUSION

The training strategies and the quality of the relations established between the teacher and students play an extremely important part in the orientation of the teaching-learning-assessing process, and on the coordination of the school - vocational orientation. Starting from the current and systematic observations made by Science teachers during the classes and other forms of activity, the teachers manages to assess the school performance and to objectively appreciate the students' interests, aptitudes and attitude towards learning and their future profession. Helping the student to choose a future career in Sciences is - of course - strongly related to the student's desire and knowledge, but asks for *particular skills* and imposes a *positive attitude* related to the scientific issues [4], which can be transferred in the teaching-learning-assessing process. Under such premises, the Science teacher can help the student upon making a decision with regards to a research career, by maintaining a balance between what the student wants (motivations, interests, wishes) and what the student can (capacities, aptitudes, competences) on the one hand, and the requirements of the job market and dynamics of professions on the other hand. Not in the end, in order to complete the panel able to help the student on choosing a scientific career, we cannot let away the mass-media which tries to provide updated information about job opportunities, specific conditions and requirements, but also news concerning the labor market dynamics [5].

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