ORIGINAL PAPER

CONSIDERATIONS RELATED TO THE SECONDARY SCHOOL STUDENTS' INTEREST FOR A SCIENTIFIC CAREER

GABRIEL GORGHIU[1], ELENA ANCUTA SANTI[1]

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Abstract.*From the psychological point of view, an important step in human development is the moment when you discover who you are and what you should do with your life. The success in career depends heavily on the goals and the effort you deposit, but also depends on better knowledge about capabilities, needs and personal interests. The psychological interests refer to a person's preferences for certain things, knowledge areas of activity and have particular relevance for the future careers.*

At the level of the Romanian society there are a series of changes that create fluctuations in the motivational structure and also in the axiological profile of the individual, and that has influence on the sphere of interest and on the personally vision of career. Considering the area of Science, in Romania, the Physics, Chemistry and Biology teachers have an important role to stimulate the students' interest in Science, and consequently, they can advise or guide the students towards choosing a scientific career.

In this respect, the present paper aims to discover to what extent students are interested in the scientific activities, particularly on the cognitive interests measured in relation to their options for a possible scientific career. The study was performed in the FP7 European project called IRRESISTIBLE which has the major objective to promote the dimensions of Responsible Research and Innovation in educational activities.

Keywords: *cognitive interests; career; students; vocational counseling; IRRESISTIBLE project.*

1. INTRODUCTION

The changes occurring in the society, the scientific and technological evolution and revolution, the globalization influences and tendencies and the psychological structure of the new generation have significantly contributed to the emergence of a new category of special interests, in-line with the accelerated rhythm of life - on the one hand, and the internal needs to stand out and have a successful career - on the other hand. The need to professionally succeeded, falls under the category of personal achievement needs, which make life meaningful, and provides us with a social, emotional and material support - a role, a status, a future. Now, more than in any other period in the history, the contemporary society promotes the vision of the victorious accomplished human, as being the one who has a successful career.

In the case of Science disciplines taught in Romanian school (Physics, Chemistry, Biology), the teachers have to motivate the students for learning Science, to raise their interest for developing the knowledge in this area, but also to offer the necessary advises or to provide

[1]Valahia University Targoviste, Teacher Training Department, 130105 Targoviste, Romania.
E-mail:ggorghiu@gmail.com, santi.anca@yahoo.ro

the requested orientation related for choosing a scientific career. As structured in the *Didactics of Sciences*, the teacher must exploit two fundamental dimensions in which Science can be disseminated: (a) content and (b) methodology.

From the content perspective, two important aspects have to be mentioned: (a) the integrated approach, and (b) the didactical transposition. In this respect, the provided activities (here we have to take into consideration not just the formal educational activities, but also the informal and non-formal ones) should be performed by the teacher in relation to specific elements of the disciplines (Physics, Chemistry, Biology) and to classroom structural particularities: the sequence of the Science disciplines in the curricula, students' prior knowledge, students' knowledge and expressed interest, capacity of processing the scientific information, the social or individual relevance of the acquired knowledge etc.

But the methodological dimension seems to be very important, designed to highlight a range of strategies, methods, means and procedures - specific for Science teaching. In this context, teaching strategies - mainly interactive ones - such as: inquiry education, cooperative learning, problem-based learning, learning based on scientific research, problematization typologies, role-playing, reflection, case-study etc. are designed to transform the student into an active participant that develop his/her own learning, in this case, the teacher targeting to stimulate the student's interest on studying socio-scientific problems and to help students for choosing a scientific career.

2. EDUCATION AND RELATED FACTORS INVOLVED IN THE CHOISE OF THE VOCATIONAL CAREER

The scientific career, as like any career, represents a component of the expanded *ego*, due to the fact that it speaks about the individuals' occupational identity, defined through each person's interests, capacities, skills and competences, in relation to the level of aspiration and work carried out. For students, school plays an essential part on discovering their internal resources and driving them towards optimal development for a successful career. The education is the basic factor which influences the maximal development of the individual potential, the educational paradigms evolving in harmony with the changes within the society, which means that the education is responsible for anticipating the developments to come and preparing the educational subject to become able to cope with the world challenges. One of the school responsibilities is to form and develop competences which meet the job market requirements, to shape individuals prepared for challenges and a competitive career. In addition, the school has to develop the capacity to take optimal decisions in relation to personal life, in consideration of the implications derived from a choice with consequences and repercussions on the future of the individual.

The choice of the career or the field in which a person wants to work or grow, represents a complex process, which psychologically implies self-knowledge, self-esteem and self-confidence competences, the desire to evolve in relation to oneself and the others (*personal development*) and to fulfill the needs connected to esteem, status and professional achievement. The vocational option is influenced by a series of internal and external factors which may contribute at some time to build a hypothetically successful vocational model towards which the individual tends. The psychological internal subjective factors involved in the vocational choice are: *cognitive factors* (knowledge, notions, information regarding work, professions, career), *emotional factors* (passion, interest in particular activities) and *motivational factors* (intrinsic), as well as some *dominant personality features*; the external, contextual, objective factors which may influence the process of vocational choice: family,

role models or promoted trends (through mass-media, life environment, entourage), demanded issues on the job market.

3. INTEREST AND DYNAMICS IN THE VOCATIONAL CHOICE PROCESS

I. Holban (1974) appreciates that *the interest* represents [1]: a psychological variable of motivational nature, which in the determination of a person behavior, expresses, in terms of the relation with the environment, the orientation direction, the category of values to which is attached its importance, or which, in a wider sense, gets the subject attention [2]. In fact, the interest represents an expression of the personality, manifested as attention, as preference, as attraction to a person, object, idea, situation, activity, and which generates satisfaction. J. Dewey defined the interest as an emotional force which energizes the action, which includes both motivational-emotional components and operational-cognitive components [3]. Interests are formed and developed during the educational process. It is considered that the interests result from the interaction between internal neuro-endocrine structures and social circumstances and represent the expression of the ratio between the needs and objective conditions. More, it was demonstrated that in the extension of the interests, appropriate skills are frequently formed [3].

In the early '50s, Ginzberg, Ginsburg, Axelrad and Helma considered that there are 4 categories of factors that interfere in the vocational choice [4]:

- Environment;
- Educational process/training level;
- Emotional factors;
- Individual values.

The same authors consider that there are several periods (stages/ages) in each individual's development. Those periods correspond to a specific level regarding the forming of interest for the future career:

- *fantasy period* (first ten years of life) - is the childhood time, when the first options relating to vocational choice are expressed (at around 4-5 years), through games; however, the child's choices are aleatory, due to their inability to anchor to the reality;
- *period* of *attempts and explorations* (between 11-18 years old), consists of 4 significant moments: when they are around 11-12 years old, the children start to be aware of the necessity to identify a vocational direction. The choice usually reflects the identification with the occupation of a parent. Around 13-14 years old, the notion of *ability* is introduced in the vocational considerations and this is also the time when the assessment of the personal possibilities starts. The age of 15-16 triggers the outlining of the first signs of their future career; they get aware of how their personal abilities may be useful to them. In the last stage, just before they turn 18, a realistic conception on the professional future of the young person is crystallized.
- *realist period* (between 18-22/24 years old) is the time when they reach the maturity, the final destination being their option for a profession, completion of training for the career they want, and the choice of a specific job, in respect to the graduated specialization [4].

John L. Holland correlates the elements relating to the internal structure of the individual, to the characteristics of the professional environments [5]. He thinks that the choice of a career is the expression of *personality* [4], as a correspondence between the type of personality and the vocational option, identifying six typologies of vocational personalities (Fig.1) - *realistic*, *intellectual*, *artistic*, *social*, *entrepreneurial* and *conventional*:

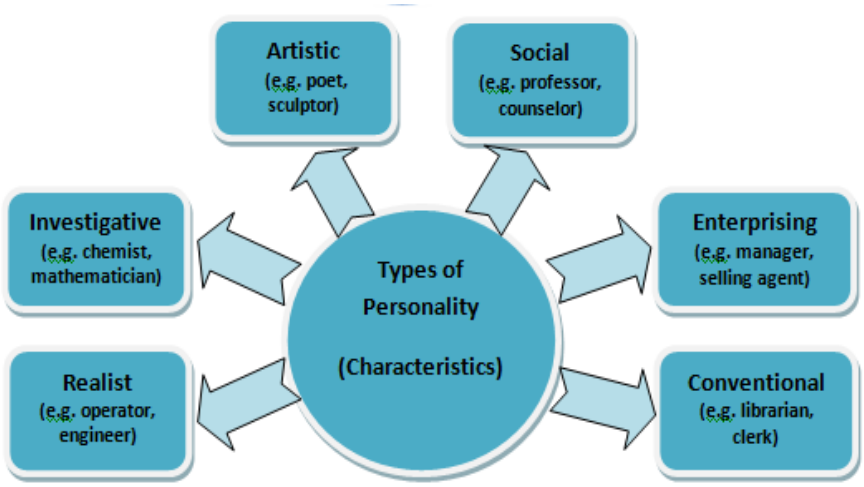


Figure 1. The Interest Model, adapted in line with Holland's ideas (1979, 1997) [6].

- *realist* (*motor*) - prefers activities requiring force, it has a good motor organization, lacks verbal skills and develops relational skills, prefers concrete issues instead of abstract and it is not sociable. The realists may have competences falling under the sphere of technical, mechanical, farming activities etc. and dislike social and educational activities.
- *investigative* (*intellectual*) - is task-oriented, thinks problems through, is focused on the abstract, prefers the activities implying creative investigations regarding physical, biological, cultural phenomena, acquires scientific and mathematical competences, dislikes persuasive, social and repetitive activities.
- *artistic* (*esthetic*) - prefers unstructured activities which involve creation of new artistic forms; manifests artistic competences in the musical, literary, linguistic, artistic-plastic field, dislikes orderly, systematized, administrative, business activities.
- *social* (*supportive*) - chooses the teaching and therapeutic activities, has verbal and relational skills, being socially oriented, prefers the activities which imply information, training, development, taking care for the people around.
- *enterprising* (*persuasive*) - prefers to capitalize the verbal skills in situations that bring in front selling opportunities, domination, leading the others. They have persuasive, leading and interpersonal relations skills.
- *conventional* (*conformist*) - has a formalized verbal structure, prefers activities with numbers, chooses subordination roles, achieves the goals through conformism, being loyal to the power. The conventionals prefer activities requiring orderly and systematized data manipulation which enable them to achieve their organizational or financial goals. They dislike unstructured, non-systematized and artistic activities [4].

The basic idea of Holland's theory starts on the assumption that the individuals are successful in their careers when the specific of the career resonates with the elements inside their internal structure, bringing working satisfaction, professional results, internal balance, evolution in-line to the work done. Therefore, the occupations which imply personal interests or preferences for specific activities have a higher degree of bringing success compared to the other professions which do not enhance the value of those components related to the personal sphere of interests. Concerning the mentioned aspects, a successful career may be predicted considering the condition that an individual is helped to discover his/her interests, preferences towards a certain domain, but also cognitive and practical possibilities, aptitudes, capacities, competences. The congruence between individual interests and school / chosen profession determines [6]: (a) academic/professional satisfaction; (b) stability and a better capacity to

adapt to the environmental changes; (c) academic/professional performance; (d) low level of academic / professional stress.

4. METHODOLOGY

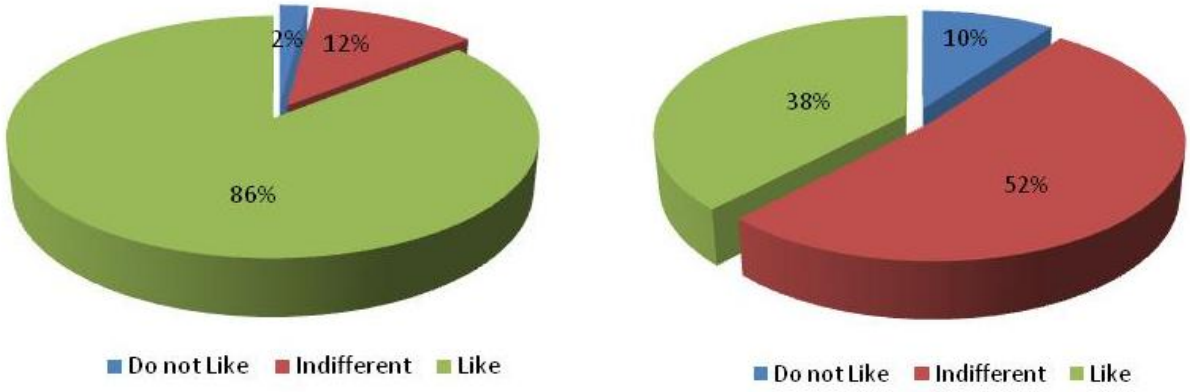
The present research is oriented on discovering the measure in which upper secondary students are interested in the scientific activities, mainly on the cognitive interests, determined in a possible relation to the embracing of a scientific career. The research was conducted in the frame of the FP7 European project named IRRESISTIBLE, which proposes to promote the dimensions of *Responsible Research and Innovation* in formal and informal / non-formal educational activities.

During the project life, several *Workshops* - mainly oriented on presenting the "*Nano-World and its practical applications*" to students - have been organized, especially in the special week dedicated to the national program "*School, in Another Way: To Know More, To Be Better*". In those settings, the students were asked whether they thought to take into account a future scientific / research career, offering also their feed-back to a specific questionnaire, having three pre-established answers to all items: *do not like*, *indifferent*, *like*. The investigated sample consists of 50 students, all of them from upper secondary education - 25 coming from the 9^{th} form, and 25 from the 10^{th} form.

The processing of their feed-back was made using quantitative statistical method, in the format of percentage analysis.

5. RESULTS AND DISCUSSION

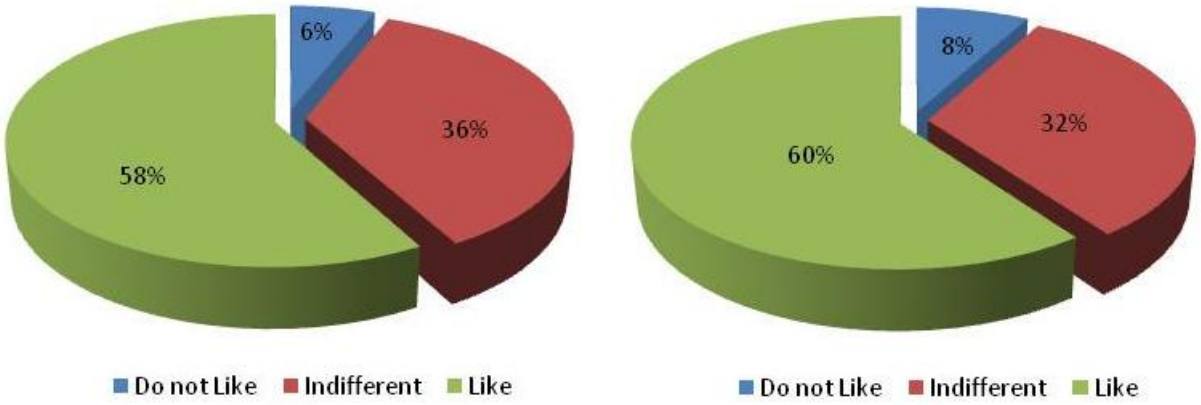
The questions addressed to students were grouped in pairs, according to the congruence or complementarily criteria. Thus, the first pair of items consists of: *(a) performing scientific experiments - (b) making research in the area of Renewable Energy* (due to the fact that one of the issues presented during the Workshops were related to the using of nanomaterials in Renewable Energy). In this respect, Fig.2 illustrates that there is an increased rate of interest to make scientific experiments (86 %), but a relative lower availability (just 38 %) to practice scientific research on Renewable Energy. On the other hand, even that just 12% are indifferent when performing scientific experiments, there is a considerable increase of the percentage (52%) related to the students who want to make research in the area of green energy. It seems that the knowledge related to the Renewable Energy must be enriched (especially in the classrooms, in direct connection to Psychics subjects), and important aspects of green energy have to be taught to young students, in order to valorize this area of study.



(a) **(b)**

Figure 2. Students' feedback related to: (a) performing scientific experiments; (b) making research in the area of Renewable Energy.

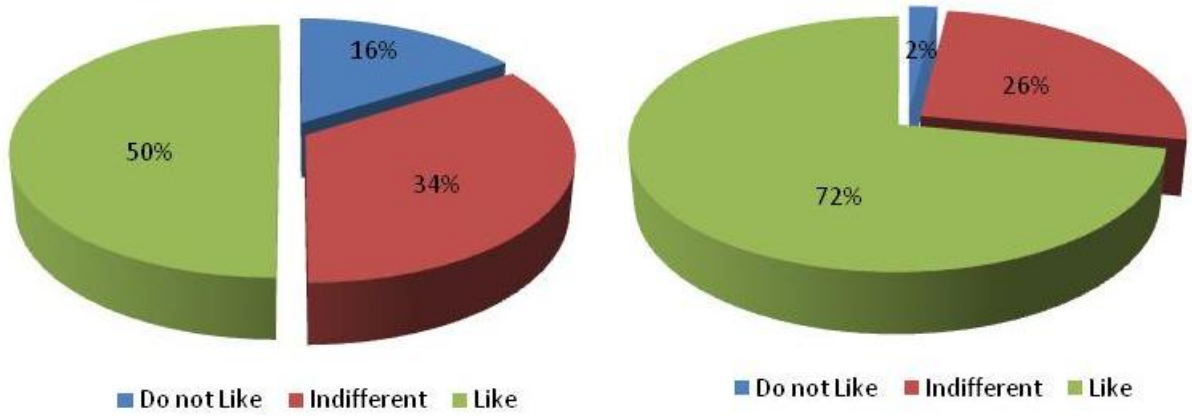
For the second pair of items - *(a) using the microscope for studying the cells and bacteria - (b) inventing new research equipment*, Fig.3 shows that it results an approximate equality between the interest of students on using the scientific equipment, and their intention to be involve in the creation or invention of new type of equipment. The recorded percentage is very high (58%, and respectively 60%), which indicates a high interest of students for the equipment used in science, generally.



(a) **(b)**

Figure 3. Students' feedback related to: (a) using the microscope for studying the cells and bacteria; (b) inventing new research equipment.

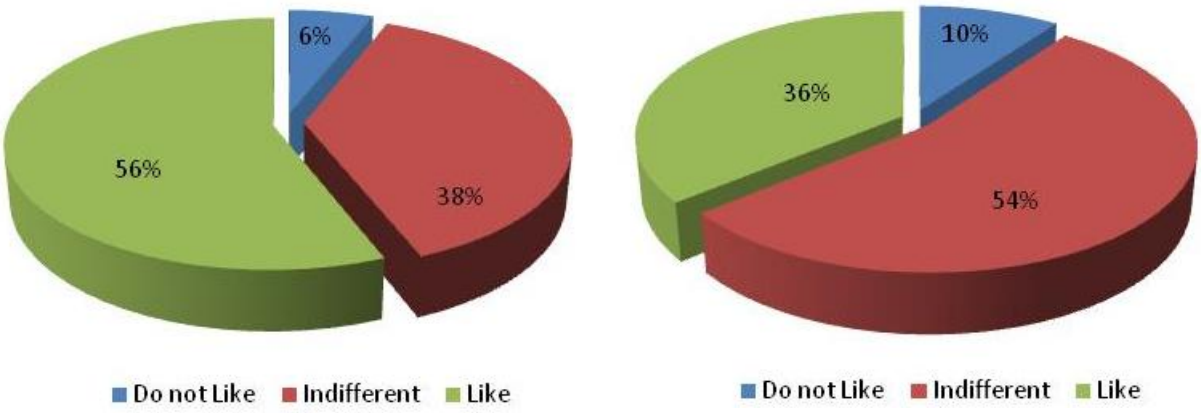
In the third pair of items - *(a) reading books and scientific journals - (b) making scientific studies*, Fig.4 illustrates a globally correlation between the process of reading - being informed, knowing scientific issues - being able to apply or exploit the knowledge into practice. Here, there are recorded reasonable percentages (50%, in the first case) and also important ones (72%, in the second case), which indicate an unexpected degree of cognitive interest to science, mostly taking into consideration the low engagement in science of young people emphasized at the EU level, as expressed clearly by the Rocard Report (2007) [7].



(a) **(b)**

Figure 4. Students' feedback related to: (a) reading books and scientific journals; (b) making scientific studies.

In the next pair of items: *(a) making research in a scientific laboratory - (b) using Mathematics for scientific purposes*, it is pursued the students' interest on working in a laboratory and the exploitation of their knowledge to solve problems, but also on tracking the correlation between the acquired theoretical concepts and practice. However, the interest of involving Mathematics for scientific purposes is not valued by students, despite the fact that even the process of research means the using of a lot of mathematical issues in practice (Fig.5). At this level, the teachers have the role to explain more the involvement of Mathematics in the daily life, but also its importance for research and development.



(a) **(b)**

Figure 5. Students' feedback related to: (a) making research in a scientific laboratory; (b) using Mathematics for scientific purposes.

At the whole, there can be emphasized - as following results - that the surveyed students responded in a very large percentage in the favor of the activities involving research, scientific study, experimentation - all those activities being recorded as indicators of interest for the scientific knowledge. More, there is an increased attraction for scientific activities, students wishing to deepen their knowledge and developing particular skills for science.

6. CONCLUSION

When investigating the type of interest in science, it is clear that there is a level of consistency between the intrinsic component of the personality, personal interests, abilities and individual skills, and the type of particular profession. In general, the individuals usually choose occupations in those areas where they can prove related skills and capacity. What does it mean the congruence between the interest in a particular field of study and the career choice? Probably, the highest level of the job satisfaction is achieved when is a tie between what an individual like to do and what motivates him/her to make something in accordance with the own life ideals. Because an individual is the builder of his/her own future, the career choice is important, to know mainly what each want do and what each can do. This is also important when talking about young generation - choosing a career in strong relation to their knowledge, but also with the students' desire must be discussed strongly in school, especially during the counseling classes. A scientific career claims *particular skills* but also a *positive attitude* related to all scientific issues.

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