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Education, Knowledge and Innovation from a Mechatronics Perspective

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Abstract

The new European strategic framework for 2014-2020 focuses on intelligent, durable development, favorable to inclusion. In this context, the role of the educational system is essential from both perspectives: it supports the development of the society through learning and contributes to the research and innovation activities.

Applied in education and research, the Mechatronics concepts allow a higher involvement of all the actors in the learning process. At the same time, Mechatronics ensures the framework for the conceptual approaches, operating methods and tools for reaching the objectives of the Integrated Education and the development of the educational technologies suitable for a knowledge-based society.

This paper addresses the synergy between education, knowledge and innovation from the perspective of the Mechatronics education due to the fact that the education system has a major contribution in developing the new profile of a worldwide citizen.

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1. Progress through generating knowledge

In the context of the transition towards the knowledge-based society, the European Union, through the Europe 2020 Strategy, aims to ensure the framework for an intelligent and durable development, favorable to inclusion [10]. Regarding this aspect, one of the priorities of this strategy is “the smart growth represented by the development of an economy based on knowledge and innovation”, which entails the integration of the new technological infrastructures with the research, development and innovation processes, and also the educational ones, contributing directly to the development of the intellectual capital, considered the primary resource of the society today.

Ensuring a sustainable development is based on generating knowledge which results from the stimulation of the intellectual capital’s use. The aspect of the massive knowledge diffusion, through its main effect – considering knowledge as the main economical resource – will impose a change in perception and also in the practice of obtaining added value.

Knowledge generation, the intensive use of knowledge, represents the essence of some processes that have an economical outcome, but society represents a more comprehensive framework than Economy. Progress, beyond the economical effects, represents a more complete achievement of the human personality.

2. The Knowledge Triangle: Education, research, innovation

The knowledge triangle represents the cornerstone of the 2020 Strategy for Europe in achieving the desired level of competitiveness at worldwide level. [2]

By establishing tight and efficient connections between the three sides of the triangle, education, research and innovation, the education’s contribution to occupying the work force can be increased.

2.1 Knowledge and education

A major component of any activity, particularly the socio-economical processes, knowledge is a result of perception, learning and reasoning. Increasing the level of knowledge directly depends on the lifelong educational and professional training system, which supports directly the creation of a new profile of the individual engaged in the knowledge-based society, one that is characterized by lifelong learning.

The educational system must play a fundamental role in the consecration of a society. The countries that knew how to invest in education to broaden the access to preparation and to improve the educational and professional training standards have, in time, obtained the most spectacular and the most durable economical growths.[4]

Education represents the essence of the human capital. It is a means to disseminate knowledge, to develop skills and create values, and the formative contents target both the cognitive components that reunite aspects of an intellectual nature of the educational offer, the driven components that include skills, abilities and competencies specific to the training profile and the direction of specialization, but also the affective and behavioral components that target responsiveness, flexibility, motivation, attitudes and beliefs, feelings, in short the conduit of the subjects to be educated.

“Education must be related today to psychological, cultural, economical and social stakes, having multiple competencies, often contradictory. Its ultimate finality is finding forms of freedom, equality, solidarity, dignity and prosperity in the post-modern society”.[3]

2.2 Creativity and innovation

Creativity is more and more one of the essential human implications of the contemporary culture and civilization, of any social progress. It represents one of the most important human, social and educational values.

Creativity consists in the capacity to combine and recombine former experience in new patterns, of shaping, restructuring the perceptive experience in new and diverse configurations, in the ability to discover unexpected connections between things, in new structures, in a certain experience, in providing perceptions in a new way;

creativity is the ability to ask about and solve a problem, situations from which technical inventions and artistic creations appear.

Creativity as a determinant of individual and social progress is a fundamental condition of success in life, which is why it has to become a target of education, being cultivated, stimulated and developed by all people in all training fields. Creativity is a mental process which involves generating new ideas or concepts or new associations between ideas and concepts already existing. George Kneller surprises this concept as follows: “Creativity consists in rearranging what we know with the purpose of finding out what we don’t know”. [5]

From an economical perspective, creativity is an important factor of recombining elements in order to produce new technologies and products, thus generating economic growth. In today’s perspective, creativity is the engine of the modern economy.

The process through which creative ideas are applied in a specific context defines innovation. In the knowledge-based society innovation is one of the key words in education, research and technology. Thus, the European Committee defines innovation as [11]: the production, the assembly, the exploration of what is new in the economic and social sector.

In the conditions of a sustainable development, the question of the innovative learning is raised, which could lead to change through anticipation. Thus, the education systems that do not develop their ability to capitalize knowledge in diverse situations, creativity or innovative spirit, cannot be considered efficient and qualitative. [9]

3. The Mechatronics education

Knowing the trends in the society’s evolution represents a requirement to adapting the educational system to the requirements of the socio-economic environment. The working environment is in constant change, influencing the skills asked for by the workforce market. The level of knowledge accumulated through basic education has to allow the beneficiary to be able to resolve problems of medium complexity and also to change his specialty depending on the necessity of the moment. Education is not limited to a single subject, [1] “but forms complex realities of which clarification asks for the cooperation of an entire panel of dimensions and perspectives of knowledge”.

Recently the steps to renew education and research bring forth the problem of Mechatronics as an educational environment in the knowledge-based society, respectively in the designing and integrated fabrication environment. Mechatronics has opened unforeseen horizons in all fields, due to the stimulation of the synergy effect.

Mechatronics receives the European citizenship in March 1986 when the Advisory Committee for Industrial Development and Research of the European Community admits that “Mechatronics is of a major necessity for European research and for the educational programs”. Mechatronics was thus recognized as a reality in permanent development, both in the educational and in the educational environment.

Offering efficient solutions for promoting interdisciplinarity, Mechatronics has become the support of the steps taken to stimulate initiative and creativity. The Mechatronic platforms are the technical-scientific foundation for promoting the Mechatronic philosophy in education, training, as well as in technological research and development activities. [8]

Mechatronics, as a science, is [6] “an intelligent and unifying paradigm, that offers an area of interdisciplinary knowledge and interactions regarding ways of working and thinking, practical experiences, as well as theoretical knowledge”. As an answer to the new changing needs resulted from the interaction of several subjects, Mechatronics has developed new theories, models, concepts and instruments.

Associating the concepts of creativity - interdisciplinarity - Mechatronics and applying them as teaching and learning methods can bring new life in the efficient conduct of the educational act.

The Mechatronic education is the efficient solution to promoting interdisciplinarity, stimulating initiative and creativity. Interdisciplinary training facilitates solving the professional reconversion problems.

3.1. Mechatronic principles in education

In the present moment, in the entire world, education has at its core the Mechatronic principles. Mechatronic education ensures flexibility in thought and action, defining features of the market economy specialist. The creative facets of the Mechatronic philosophy have been confirmed both in research and in production. [7]

The Mechatronic principles target the development of the systemic thinking and forming team working skills.

“Systemic thinking probably represents the greatest revolution in thinking since Renaissance.” – so claims Russel Ackoff. Systemic thinking designates a set of judgments which target the understanding of the way things generally run. It is a perspective which aims to penetrate beyond events, the search for behavioral models, the identification of relations from within the system that are responsible for the processes taking place in the system. Through developing the systemic thinking, Mechatronic thinking ensures not only thought and action flexibility, but also a training on a wide range of fields. In education general objectives cannot be reached without the contribution of all subjects.

Forming team work skills represents a major objective of the Mechatronic education. Finding optimum solutions for general issues cannot be done without involving all the members of the team, depending on each of their individual level of training and preparation.

Team work allows its members to learn to accept the others ideas in the same extent they are able to present theirs, to show empathy and courage in contradictory discussions, to acquire the ability to identify their strengths and those of others.

3.2. Mechatronics, support for Integrated Education

The Mechatronics teaching approach intends to give up the concept of passive theoretical learning and replace it with an active-educational attitude. The new educational systems are characterized by democratization, humanization and modernization. Thus, in education, the child must be perceived based on a set of biological, psychological and social rules, taking into consideration the individual characteristics, beliefs, necessities, ideals and aptitude of each one.

The Integrated Education is based on the holistic approach of scientific knowledge, which demonstrated the impossibility of one subject to research globally and to explain the complex problems of reality. So, Mechatronics comes to harmonize the dimensions and forms of education, allowing the connection of subjects to real life and the treatment of contents of inter and transdisciplinary options.

Among the benefits of the Mechatronic education is the development of the secular and spiritual nature of man, these also becoming benefits of the society. Education is the one that transforms the egocentric man, that “regards all through the light of personal interests and feelings” [12] in an ethnocentric one, that involves himself and judges the values of those in the immediate vicinity, and the Mechatronic education, through its exhaustive character, brings man in the center of society, a society from which he is part of and that it is created by him.

The Mechatronic platforms ensure the conceptual approaches framework, the operation methods and instruments for reaching the objectives of the Integrated Education and developing the the proper educational technologies.

4. Conclusion

Education is the activity of disciplining, cultivating, civilizing and moralizing man, and its purpose is to develop in the individual all the perfection he is capable of (Kant), but also the action of shaping of an individual for he himself, developing a variety of interests (Herbart).

The Mechatronic platforms are reform and change factors, because the change is induced by many associated factors, among which the first is the capacity of innovating, as well as the willingness to cooperate, to interconnect performant and competitive activities from the sphere of knowledge. These abilities are acquired through education, resulting in creative people, capable of formulating hypotheses, able to communicate and to cooperate in an effort to reach common goals.

Establishing the educational process on new principles and elaborating adequate didactic technologies are essential elements for orienting education towards the future.

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