

## **ASPECTS OF INTERDISCIPLINARY NETWORK OF PHYSICS**

**Daniela Manolea,**

Teacher, High School Henri Coandă, Craiova, Romania

Corresponding Address: Rodna Street no. 46, Craiova, Dolj, Romania

E-mail: d@yahoo.com

### **Abstract**

The study explores the scientific environment of Physics. It is argued in the direction of proving a double thesis:

a) an important tendency appeared in the evolution of the contemporary education is interdisciplinary towards formation of the competence in the scientific knowledge in interdisciplinary context that becomes an educational priority of the millennium III.

b) we can talk in this regard about the interdisciplinary Physics, about relationship between physics – geography – geology, about relationship physics and astronomy, about relationship between physics and philosophy, about relationship physics and medicine, about relationship physics and technical disciplines.

Keywords: scientific knowledge, Physics, interdisciplinary vision, interdisciplinary Physics

### **1. Introduction**

The formation of interdisciplinary vision of the world and at the same time the students training to be able to perform this type of approaches requires the call to practice ways of working which afford the practice of the main processes of thought, without which it is not possible the knowing of multiple and various interdependencies between the phenomena of real world (Cucoş, 2002; Cerghit, 2006; Jinga, 2008). Interdisciplinary issue has concerned the philosophers and teachers since ancient times: the Greek sophists, Pliny, Comenius and Leibniz, and in Romania Spiru Haret, Iosif Gabrea, G. Găvănescu, G. Văideanu, Basarab Nicolescu.

An interdisciplinary education aims to establish an integrated curriculum, i.e. an organization of educative action, in which the student to perform activities that require acquired skills not only to a educational discipline (Stoenescu & Florian, 2009; Vlăduţescu, 2014). It is necessary an effective integration, anticipatory of learning, so that they can systematically transfer the thought endeavors or of the action in a wide range of situations. The interdisciplinary treatment of issues promotes the Physics integration with the other educational subjects is performed through selection and ordering of the contents of this subject, as well as through organization of instructive-educational process, in order to highlight the common elements for physical and “neighbors” subjects: research domains, research methods, language.

### **2. Some of interdisciplinary relationships of Physics**

The study of physics aims to help the training and developing the student’s capacity to reflect on the world, to formulate and solve issues based on relating the knowledge from different domains, and also providing a set of skills, values and attitudes designated to ensure an optimal

professional integration (Constantinescu, 2001; Staicu, 2010). The interdisciplinary treatment of issues promotes the student's uniqueness identification, his creative skills training: flexibility, elaboration, originality, fluidity, sensitivity for issues and their redefinition.

### **2.1. The relationship between physics – geography - geology**

The relationship between physics, geography, geology is performed through the border science: geophysics, whose object, as shown in the name, is the study of the Earth. The atmospheric studies (meteorological, air layer movements, temperatures distribution, the pressures and the evolution of these distributions, the thermal, optical, electrical and magnetic properties of the atmosphere), the studies of the properties and evolution of the crust of the earth and terrestrial interior (seismic waves, the physical conditions of the interior of the Earth such as: the structure, density, temperature and pressure distribution, the origin and characteristics of the earth magnetism) are performed using the specific procedures of physics. In Physics of elementary school there is an interesting experiment of this relationship between physics and geography representing the study of distance on the map using the graphic scale (Schlick, 2010; Dima & Vlăduțescu, 2012; Vlăduțescu, 2013c). Also, about a relationship with meteorology would be integration of the language of mathematics and physics.

### **2.2. The relationship between physics - philosophy**

A special and subtle relationship there is between physics and philosophy. Notions such as "duality", "complementary" or "necessitarianism" are concepts which physics operates, but equally philosophy.

There is a direct influence of the philosophy on scientist's, one of the most remarkable is the influence of Kantian philosophy of Bohr's work. It is known that Niels Bohr started from philosophy and only later came to deal with science. Bohr's interpretation for quantum mechanics can be much better understood reading before Kant's work. The role awarded by Bohr to the relationship between classical physics and quantum physics is a particular expression of Kantian thinking. Prigogine says that he began straight from the topics kept alive in philosophical reflection by Bergson and Hegel. Also, Heisenberg himself said that he would not understand too much of contemporary physics without having taken contact with Platonic dialogues.

### **2.3. The relationship between physics - astronomy**

Astronomy is also a discipline that operates with many concepts from physics, especially related to the motion of the celestial bodies, the law of universal gravitation, optical tools used in astronomy (lunette, telescope). Also, physics offers the possibility of determining the speed of cosmic physics, mathematics and physics calculus of the solar parallaxes, and the principle of special and general relativity in new approach of the modern astronomy.

The study of optical systems and their applications in cosmic space exploration:

- Physical and mathematics calculus of solar parallaxes.
- Principles of the cosmic speed determination - consequences and applications of calculi.
- Principle of the special and general relativity – the new approach of the astronomy issues.

## 2.4. The relationship between physics – medicine

**a) Radiology** is medical specialty that uses Imagistics both of diagnosis and the treatment of the diseases. Radiologists use a set of imaging technologies (such as ultrasound, computed tomography (CT), nuclear medicine, positron emission tomography (PET) and nuclear magnetic resonance (NMR) to diagnose or treat disease. Radiography film-screen is replaced with digital radiology, DR, the X-rays strike a plate of sensors which then converts the signals generated into digital information and an image on the computer screen. Plain film radiography was the only imaging modality available during the first 50 years of radiology. Still is the first study called to assess the lungs, heart and skeleton due to its wide availability, speed and relatively low cost.

**b) Fluoroscopy and angiography** are special techniques for imaging using X-ray wherein a fluorescent screen and an intensifier tube of the image is connected to a closed circuit television. This allows real-time monitoring of the structures in motion, to outline the anatomy and functioning of blood vessels, the genitourinary system or the gastrointestinal tract (Rinia, van Leeuwen & Van Raan, 2002).

**c) Ultrasound** through their special properties allowed a medical application extremely useful in medical investigations, called ecography. Ultrasound scanning probe involves an ultrasonic generator and a detector for the reflected waves (echoes) to the interference of human organs. The detector converts the ultrasonic signal into an electrical signal that can be displayed on a TV monitor. Repeating the procedure in a sufficient number of points is obtained an image of the relative organ. Ultrasound are successfully used in cataract operations for fragmentation of opaque lens to extract it easily by a pump through the small incision made with a laser in the eye.

Another application of ultrasound in medicine is also breaking of the kidney stones and avoidance in this way of some painful surgery interventions and physically traumatic but also mentally. For cosmetic and medical treatments, there are two ways of ultrasound using:

1. Continuous ultrasound: in this case, the sound is produced continuously at a certain frequency and amplitude (power) of the signal;
2. Ultrasound as form of pulses: in this case, discrete pulses are produced by a certain frequency and amplitude.

Ultrasounds can be used also for removal of dental plaque.

**.d) Lasers** are also devices extremely useful in medicine, numerous surgery interventions being performed with different types of lasers. Performed interventions in this manner not only the less painful, by the shorter hospitalization and faster healing, represents a major breakthrough in the medical world and human health.

Low intensity lasers used in physiotherapy did not prove a significant clinical efficacy, even in experimental studies seem to show certain biological effects. Their role is adjuvant, to increase the comfort and efficiency of recovery exercises, essential for a long-term rehabilitation.

### **e) Infrared light**

The temperature measurement of a person provides basic information on his health. The technology is used for the non-invasive analysis of the body fluids and tissues. Images infrared is used to determine the depth of burns, as well in the analysis of blood flow.

### **f ) Ultraviolet radiation**

Ultraviolet radiation is mainly used in dermatology (psoriasis with ultraviolet type A), aesthetics (artificial tan) and disinfection. They can be used in recovery, because of their healing and antiseptic action, in the treatment of bedsores and varicose ulcers.

Nuclear medicine is a branch of modern medicine, used to treat the cancer by radiotherapy and chemotherapy. The radiotracer or radiopharmaceutical substances are used, that contain a carrier active substance and a radioactive isotope. These substances are introduced into the body by different routes of administration (most commonly intravenously). Once inserted the substance is distributed in various organs according to the used active substance. Distribution of the radiopharmaceutical substance is detected by a radiation detector device range called gamma camera and stored digital. Later the resulted information is processed obtaining the image of the body or the image of studied organ. These images are functional and molecular images, that show how function various explored organs and tissues or indicate their alterations at the molecular level. Explorations of nuclear medicine are not invasive, they have not secondary effects.

Examples of investigations:

Renal scintigraphy: is used to examine the morphology and renal function to detect abnormalities such as scars or type of obstruction of the urinary tract (Dulieu & Gabbanini, 2009); Thyroid scintigraph: useful to evaluate the morphology and function of the thyroid, especially in hyperthyroidism;

### **2.5. The relationship between physics and technical disciplines**

Technological disciplines, not a few, especially in technologic high schools have all theoretical support of physics but also many practical and experimental applications. Moreover, there isn't a performant engineer, a real professionals without a solid base of physics knowledge of specific preparation domain: mechanical, electrical, electronic electromechanically ... In this case often appears the issue of correlation of knowledge from these disciplines and their application in practice to form some good specialists.

In this case the purpose of teaching it is not to present to students working mechanisms, such as: the lever, the pulley, the inclined plane, the hydraulic press, fuses and their use, certain electrical circuits with well established role (protection, measurements, etc. .), but they must be thus guided that, through their own activity, to be the possibility to discover, to have the ability to forecast the possible applications of a mastered principle of physics. It has to be created more frequently teaching situations that favor the emergence and development of creative-inductive thinking.

A set of discoveries and progresses of physics were stimulated by technical necessities. The second law of thermodynamics was the result of technical studies for optimization of the steam engine (Petrescu, 2008; Spitzer, 2013; Vlăduțescu, 2013d). Telecommunications development has stimulated researches of electricity, optics and physics of the solid. Physics provides engineering the support of the principles and laws underlying the technical applications. The experimental research could not develop without precision apparatus and devices and a functionality becoming better and better.

### 3. Conclusions

The concept of interdisciplinary can be better understood by comparing with other concepts, correlative:

Monodisciplinary is the traditional form of organization of the contents learning on the independently relatively taught disciplines each other, providing student the safety of linear progression, gradually ascending, on a cognitive well defined route.

Multidisciplinary is a less developed form of disciplinary transfers, which is done most often by juxtaposing of certain knowledge from several domains, towards to point out the common aspects of them.

Pluridisciplinary is a point of departure in contents structure that represents a theme, a situation, an approached problem by much more disciplines, with specific methodologies. It has the advantage of the approaching of a phenomenon from different perspectives, highlighting its many relationships with other phenomena from reality.

Transdisciplinary is described as an overlapping form of more disciplines and of coordination of researches, so that they can lead in time, through specialization, to emergence of a real phenomenon of knowledge. Transdisciplinary reality based learning, global vision promotes the transfer of knowledge in different contexts, but brought excessive accumulation of gaps present danger, lack of rigor and depth in knowledge (Vlăduțescu, 2006).

Interdisciplinary is not only a treatment of simultaneously type of a certain phenomenon from the point of view of several sciences, but also an integrated and integral approach of this, each science bringing their own conceptual system, thinking mode and specific methods of research and representation.

Application of the interdisciplinary develops an integrative thinking, able to replace the summative thinking specific to traditional education. Using in the study of certain aspects of reality, a system of concepts belonging to certain related disciplines, allow the students to discover concepts with high generalization degree and thus to understand the importance of an integrated vision on knowledge. Such concepts are: system (= state), process (= development), environment, energy, model (= representation), theory, legitimate (= principle), function, database etc..

### References

- Dulieu, O., & Gabbanini, C. (2009). The formation and interactions of cold and ultracold molecules: new challenges for interdisciplinary physics. *Reports on progress in physics*, 72(8), 086401.
- Stoenescu, George, & Florian, Gabriel (2009). *Didactica fizicii*. Editura Sitech, Editura Else.
- Spitzer, H. (2013). Introduction of Interdisciplinary Teaching: Two Case Studies. *Science and engineering ethics*, 19(4), 1451-1454.
- Vlăduțescu, Ștefan (2013a). Three Diachronic Paradigms of Communication. *International Journal of Education and Research*, 1(12).
- Moreira, A. A., Andrade Jr, J. S., & Amaral, L. A. N. (2002). Interdisciplinary Physics: Biological Physics, Quantum Information, etc.-Extremum Statistics in Scale-Free Network Models. *Physical Review Letters*, 89(26), 268703-268900.
- Vlăduțescu, Ștefan (2014). Eight Computational-Communicative Operations of Building Information. *Mitteilungen Klosterneuburg Journal*, 64(1).
- Lu, T. P., Li, S. T., Zhang, K., Liu, C., Xiao, G. W., Zhou, Y. G., ... & Yang, X. D. (2011). Interdisciplinary Physics and Related Areas of Science and Technology: The advantage

- of blue InGaN multiple quantum wells light-emitting diodes with p-AlInN electron blocking layer. *Chinese Physics B*, 20(9), 098503.
- Constantinescu, Radu (2001). *Metodica Predării Fizicii*. Craiova: Editura Sitech.
- Vlăduțescu, Ștefan (2013b). Communication Beings: Four Communication Prototypical Figures. *International Journal of Education and Research*, 1(11).
- Vlăduțescu, Ștefan (2013). Message as Fundamental Discursive Commitment of Communication. *Journal of Studies in Social Sciences*, 5(2), 276-287.
- Cerghit, Ioan (2006). *Metode de învățământ*. Iași: Editura Polirom.
- Cucoș, Constantin (2002). *Pedagogie*. Iași: Editura Polirom.
- Jinga, Ioan (2008). *Manual de Pedagogie*. București: Editura ALL.
- Petrescu, Ștefania (2008). *Legătura fizicii cu biologia*. București: Editura ALL.
- Vlăduțescu, Ș. (2013c). Feedforward irradiation in Psychology, Psychopedagogy and Communication. Principle of Feedforward. *Revista de Psihologie*, 59(3), 254-263.
- Vlăduțescu, Ștefan (2013). A Completion to the Traditions Matrix-Standard - R. T. Craig, Induced by the Transformation of Communication-as-a-Field Membrane in Communication-as-a- Universe Membrane. *American International Journal of Contemporary Research*, 3(10).
- Staicu, Ionelia (2010). Interdisciplinaritatea fizicii cu matematica. Teză de doctorat. Universitatea Bucuresti. Conducător științific Prof.dr. Ștefan Antohe. [www.unibuc.ro/...%20Interdisciplinaritatea%20fizicii%20cu%20mate](http://www.unibuc.ro/...%20Interdisciplinaritatea%20fizicii%20cu%20mate)
- Dima, Ioan Constantin, Grabara, Janusz, & Vlăduțescu, Ștefan (2012). *The Situation of Competitive Clusters in Some EU States*. *Journal on Business Review (GBR)*, 2(2), 4. DOI: 10.5276/2010-4804\_2.2.193
- Brenner, D. J., Vazquez, M., Buonanno, M., Amundson, S., Bigelow, A., Garty, G., ... & Xu, Y. (2013). Integrated Interdisciplinary Training in the Radiological Sciences. *British Journal of Radiology*, 20130779.
- Schlick, T. (2010). *Molecular modeling and simulation: an interdisciplinary guide*(Vol. 21). Springer.
- Dima, Ioan Constantin, & Vlăduțescu, Ștefan (2012). Risk Elements in Communicating the Managerial Decisions. *European Journal of Business and Social Sciences*, 1(6), 27-33.
- Vlăduțescu, Ștefan. A Battle with Uncertainty of Communication as an Academic Discipline.
- Rinia, E. J., van Leeuwen, T. N., & Van Raan, A. F. (2002). Impact measures of interdisciplinary research in physics. *Scientometrics*, 53(2), 241-248.
- Vlăduțescu, Ștefan. Communicative Message as Nuclear Thinking of an Aspirational Desire.
- Wang, Y. M., & Li, C. Z. (2010). Interdisciplinary Physics and Related Areas of Science and Technology: Efficient One-Step Generation of Cluster State with Charge Qubits in Circuit QED. *Communications in Theoretical Physics*, 53, 190-194.
- Dima Ioan Constantin, Vlăduțescu Ștefan (2012). *Persuasion elements used in logistical negotiation: Persuasive logistical negotiation*. Saarbrücken: LAP Lambert Academic Publishing.
- Dima, IC & Vladutescu, Ștefan (2013a). Some Consequences of the Negative Journalistic Communication in the Austerity Period. *Science Series Data Report*, 5(7), 2-7.
- Vlăduțescu, Ștefan (2006). *Comunicare jurnalistică negativă*. București: Editura Academiei.
- Krems, R., Friedrich, B., & Stwalley, W. C. (Eds.). (2010). *Cold molecules: theory, experiment, applications*. CRC press.
- Vlăduțescu, Ș. (2013d). The Communication Membranes. *European Scientific Journal*, 9.