

Results of the optional subject "Physics of biological systems"

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ABSTRACT

This paper presents the implementation of the subject "Physics of biological systems, from the optional subject for students of the Bachelor of Physics, which shows different aspects of the method of acquisition of scientific knowledge; as well as the preparation of it for a postgraduate course. On the other hand, the concepts and laws of physics are widely used in the field of health, which has motivated the emergence of new areas of knowledge such as Biophysics, Medical Physics, Neurophysics, Bioengineering, Genetics and Biotechnology, among others. For the above reasons, the authors set ourselves the objective of introducing the proposal of an alternative for the development of the subject proposed in the Bachelor's Degree in Physics from a biophysical approach, since it provides increasingly developed visions of scientific-technological activity, that it is necessary to incorporate in the teaching-learning process of Physics. The subject has already been taught in two semesters to physics students with great acceptance and interest.

Keywords: teaching, scientific knowledge, biological systems.

INTRODUCTION

The present work aims to become a pillar for the acquisition of elements of analysis and judgment (from physics). Seeing that in the medium term the student values the critical and objective thinking in the professional performance and develops a new mentality, that without underestimating the accumulated knowledge in the scientific and technological, incorporate in his thought elements that facilitate the understanding of new perspectives and conceptions of life.

Physical knowledge has been the fundamental pillar for understanding the physiological phenomena that are the basis of the functioning of the human organism in a normal and pathological state. Among them we can mention: the reception of external signals by the organism, the transmission of the nervous impulse, the biomechanical processes of balance and displacement of the human organism, the geometric optics of the eye, the transmission of sound to the inner ear and the brain, the mechanics of blood circulation, pulmonary respiration, the process of feeding and sustaining energy of the organism, the

mechanism of action of biologically functional molecules on cellular structures (membranes, organoids, bioenergetics, mechanochemical systems), physical-mathematical models of biological processes, etc.

The establishment of the physical bases of the phenomena mentioned above has been basic for the development of technical devices, devices and meters to obtain bioinformation, autometry equipment and telemetry; that allow a more effective and reliable medical diagnosis. At present, the development of Medicine depends to a great extent on its technological capacity, which is determined by the development of biophysical knowledge supporting Bioengineering.

This paper presents an adaptive approach for the teaching of physics at the undergraduate level, with results implemented from the Universidad de Oriente (UO) and which we hope we can implement in postgraduate studies.

This subject is developed as a motivational "dialogue", conceptualized for second year students, during the second semester in the optional subject VII and part of a block of subjects that they will later see. At the beginning

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a preliminary check is made of what the students understand by Biophysics and its applications. The subject is evaluated through an Integrator laboratory practice, preferably in group discussion mode, based on the applications of Biophysics in each of the subjects studied in the course. Students are encouraged to use formal and non-formal ways of seeking information, with an emphasis on the use of Information and Communication Technologies (ICT), with the support of faculty specialists.

It is a subject with results in the 2015-2016 academic year, since gender preferences were identified in the students when selecting subjects in which they were interested in knowing more in depth from a gender perspective, and that the initial themes of the course were changed.

MATERIALS AND METHODS

The main materials used in the subject were: The programs of the discipline and the subject. *Texts of the subject:*

Frumento A.S, Biophysics, Ed .: Mosby / Doyma, Madrid, 1995, Spain.

Soto del Rey R. Introduction to Biophysics. East, editor. Santiago de Cuba; 1998

Articles related to the topics studied.

Arthur Guyton, John E. Hall. Treaty of Medical Physiology. 12th Edition.

The content distribution, the time background of the subject is 60 hours, distributed in:

- Conferences (C) 20
- Practical classes (CP) 20 hours
- Seminar (S) 10 hours
- Laboratory (Lab) 5 hours
- Independent study (E. Ind) 5 hours

RESULTS AND DISCUSSION

The teaching-learning process is conceived as the space in which the main protagonist is the student and the teacher fulfills a function of facilitator of the learning processes. It is the students who build the knowledge from reading, to contribute their experiences and reflect on them, to exchange their points of view with their classmates and the teacher. In this space, it is intended that the student enjoy learning and commit to lifelong learning.

In coherence with this type of teaching, the strategies are specially oriented to perfect and in

some cases, to develop these competences. From this angle, teaching loses its character of simple teaching to join in the same knot with the research process and become an "active teaching", in self-teaching. The university method is presented as a synthesis of teaching and research in which the second is the basis of the first and the first fluid expression of the latter. The symbiosis of teaching and research is practically presented as an effective way of making an active, functional and progressive education, which allows the teacher to incorporate dynamically in the process of student training. Your role will be to provide and structure the learning situations that allow the student's action in a direct and free way. The teacher motivates and guides it permanently, will make known and understand the scientific method.

Teaching will not be a mechanical repetition of information, it will penetrate the student in science or in technique to understand them in their essence, to rediscover knowledge. Following this criterion the contents of the teaching do not only cover the cognitive aspect, but they develop all the values that integrate the social life of man, considering it as a biopsychosocial unit. In this way, the student is provided with an overall vision of society, so that he or she graduates with a sense of commitment to the community that helps to train and train him or her. The socializing aspect of this methodological conception is very important, so it is essential to face it with the active group work, being able to develop in the students psychosocial skills that facilitate their integration in the work teams.

The competence of solving problems raises the need to guide the student to acquire the right information to solve the situations that will be proposed.

For this, it is essential that the student put into practice their textual comprehension skills by consulting the recommended reference bibliography. The current Physics Degree Program allows the introduction of new themes or ways of thinking as they are imposed in the real scientific world. A fundamental component of the present curriculum to respond to these challenges is the inclusion and expansion of the discipline of Optional Subjects, which constitutes an elastic platform to incorporate into the study plan subjects designed "to measure" the dynamics of the Physics in a given context. This possibility, common to other

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careers such as Biomedical Engineering and related fields, allows students to learn the ability to make decisions and control their graduates' profile, to some extent, during the course of their higher education. The vertiginous development of the applications of Physics in Medicine implies the need to adapt the curricula "in real time". From the above, the possibility of adapting a Medical Physics Block to:

- the characteristics of the cloister,
- sources and employment needs that exist in the territory for graduates
- the interests of the students.

So the subject has as objectives:

Educational Objectives

Explain and apply the concepts, laws and principles involved in physical, biological and physiological processes of the living being, especially the human being. See the human body as an integral unit, understanding the interrelations between the different systems and apparatuses that constitute it. Interpret how the main biological systems behave, recognizing in them their theoretical bases, limitations and applications.

Instructional Objectives

Know and be aware of the physical laws that explain morphophysiological processes of the human body, as part of a different approach to Physiology or Biology.

Develop critical and analytical reasoning skills in front of diverse physical factors that influence the development of the functions of the human body and their state of health.

Topics of the subject:

Topic1. Phenomenological modeling of biological systems.

Topic2. Transportation through the Cell Membrane.

Topic3. Muscular Biophysics.

Topic4. Circulatory Biophysics.

Topic5. Thermodynamics.

Topic6. Other systems.

The evaluation method consisted of class checks, seminars and practical classes of theoretical calculations on existing facilities, with the subsequent comparative analysis, taking into account where possible, social, operational and economic aspects. At the end of the semester, the students were invited to evaluate the subject in general, taking into

account the Positive, the Negative and the Interesting, in order to adapt and improve the successive editions of the subject according to the interests of the students and the instructional and educational objectives conceived.

Criteria of the students In a positive sense: The students perceived that the received contents give them a good preparation for their future profession. They consider that the interactive method used in the lectures allowed them a good understanding and the opportunity to express their points of view. They said they understood the importance of the subject and the knowledge of Physics that this specialty requires. They noticed the broad profile for physicists in society. They learned about physics and its applications to biological systems in the city and about the needs of physicists.

In a negative sense: Little time to assimilate the basic knowledge. They consider the time for the practice activities scarce. However, they recognize that lectures and videos were interesting, as well as the demonstrations made, because they had the opportunity to link theory with practice.

Interesting: The students consider that the subject was useful to them to understand the applications of this in the improvement of the health, to link the theory with the practice and to realize a new profile in which they can work when graduating.

CONCLUSION

As a result of our subject given to the students, they perceived that the received contents give them a good preparation for their future profession. Considering that the interactive method used in the conferences allowed them a good understanding and the opportunity to express their points of view. They said they understood the importance of the subject and the knowledge of Physics that this specialty requires. They noticed the broad profile for physicists in society. They learned about the applications of physics in biological systems and about the needs of physicists in the area of health. So we undertook new strategies, methods and means to persuade the interest and motivation of students towards the study and understanding of the subject Physics of the biological systems of the human body, as it provides the fundamental pillars in the understanding of the biological systems of the human body.

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