

THE LEARNING OF THE SUBJECT BIOLOGY IN A MASTER IN BIOMEDICAL PHYSICS

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Abstract

BIOLOGY is a dynamic and fascinating science. The study of this matter is an amazing trip for all the students that have a first contact with this subject. Here, we present the development of the study and learning experience of this subject belonging to an area of knowledge that is different to the training curriculum of students who have studied Physics during their degree period. We have taken a real example, the “Elements of Biology” subject, which is taught as part of the Official Biomedical Physics Master, at the Physics Faculty, of the Complutense University of Madrid, since the course 2006/07. Its main objective is to give to the student an understanding how the Physics can have numerous applications in the Biomedical Sciences area, giving the basic training to develop a professional, academic or research career. The results obtained when we use new virtual tools combined with the classical learning show that there is a clear increase in the number of persons that make and pass the final exam. On the other hand, this new learning strategy is well received by the students and this is translated to a higher participation and a decrease of the giving the subject up.

Keywords: Biology, Master, e-learning.

1 INTRODUCTION

The fields of biology and physics have long been regarded as being on nearly opposite sides of the scientific field. Biology was regarded by physicists as a science that was mainly devoted to classification, and biologists viewed physicists with well deserved incomprehension. The discoveries that have been made by the Biology have generated a need for new tools, and then the beginning of the interaction between the physics and biologists.

From the educational point of view, one of the main objectives of a professor of either discipline is to provide to the students an Education of great quality that guarantees them a solid training and the possibility to develop a professional career. At this moment, the Higher Education European Space (HEES) is already introduced at the Spanish Universities. This new educational system implies a conceptual and methodological change in the learning structure and all the aspects that are related with the teaching-learning. The adaptation of higher education studies to HEES implies also to do appropriate the teaching to the characteristics of each subject.

Biology is a dynamic and interesting science that connects with, practically, all the others disciplines of the science and, specially, with the Chemistry through its own objects of studies. The chemical reactions between the molecules make possible the maintenance of the LIFE. Study of the Biology can be a stimulating experience for all the students which have a first contact with this matter.

The subject “Elements of Biology” is given in the Master of Biomedical Physics from the course 2006/2007 and its main objective is to allow to the students understand all the virtual applications of the Physics to the Biomedical Science. It provides the basic formation to the students necessary to they develop a professional, researcher or academic career. The subject has 6 ECTS and an obligatory character.

2 TEACHING METHODOLOGY

2.1 The challenge of the learning

To design a strategy to make attractive to the students a subject as the Biology is a little complicated. It must not be forgotten that the Biology is a discipline very dense and general which main objective is to know the function-structure relationship of the chemical molecules that forms the living organisms. The students have to learn the different molecular structures, to identify them and their properties to know the different functions that these molecules can have in the organisms.

Biology is and subject of study very complex and, at this moment, is one of the more dynamic and prosperous sciences. Constantly, this matter raises new questions and gives new perspectives.

Our first challenge was the design and elaboration of all the contents to favour a more interactive, critical and simple leaning. In order to help to the student, we proportionate learning objectives for the whole course and also for the main objectives of each theme. When a theme is over, we offer to the student a collection questions that allow to the student to know its domain in the matter. Secondly, we design all the activities that facilitate the learning using as technical support the educative platform WebCT inside the Virtual Campus of the Complutense University of Madrid (CV-UCM).

2.2 Selection of the contents

To choose the content for a matter included in a Postgraduate course implies a very important task because it is very important the practical aspect that the student have to develop along all the training period. Then, we want to give a special emphasis to develop all the themes that allow to the student a better development of their imminent professional activity, either in companies that need experts in the use of radioactive species for medical instrumentation, or in the health area, because a great number of these student can gain to a post in the Spanish Health System, as a Resident Physic to work in medical services such as Radiology, Nuclear Medicine, etc (Fig.1).

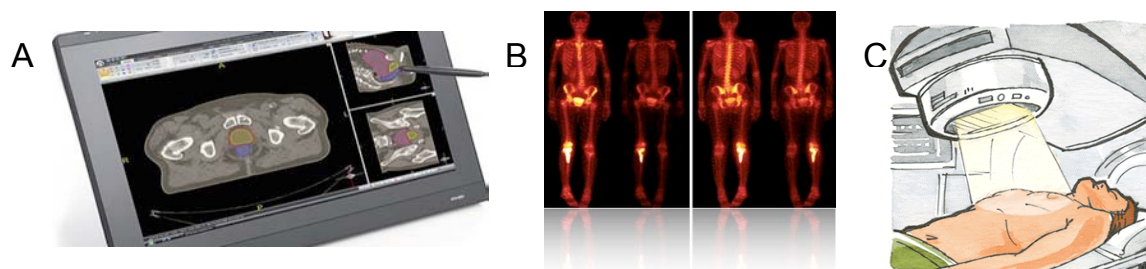


Figure 1. Examples of medical services that can be carried out by a Physician. (A) Imaging diagnostic. (B) Nuclear medicine. (C) Radiotherapy

If we concentrate in the subject Biology, we can say that the characteristics that define the concept of LIFE concept are: the development and growing of the organisms, a self regulated metabolism, the response to different stimulus and the process of the reproduction. Another important aspect is that living organisms are perfectly organized in different levels: molecular, cellular, tissue, system and organism. Then, the proposed contents of the matter have four pillars:

- The chemical molecules that form the living organism.
- How the living organisms regulate the metabolic and energy transference processes.
- Transport processes and cellular communication through the plasma membrane.
- The transference of the information.

2.3 Pedagogical characteristics

The central line of the pedagogical actuation can be summarized as:

- To offer **key concepts** when we start a new chapter that allow to the student to have a general vision of the theme.
- To give **learning objectives**, indeed, all the concepts that the student must know when a chapter has finished.
- To give a batch of **revision questions** to evaluate if the student has understood the explained concepts.
- To see an **application of the concepts** by using explanatory schemes to explore the most important aspects to the students and that offers a possibility to discuss, organize and resume the explained matter in the class by using the *Forum* utility of the Campus Virtual.
- To offer **self evaluation questions** very similar to the questions of the final exam.

2.4 Didactical Resources

Pedagogical innovation consists in modify the existing teaching practices to improve the offered education in a teaching institution. This implies a change in the teaching methodology and in the evaluation process of the students, and to promote the active participation of the student in the process. In our case, we have obtained a higher motivation and participation by using a new tool, the Campus Virtual developed in the Complutense University (CV-UCM). This utility completes the traditional methodology using the INTERNET network. Of course, we must not forget that this new learning model requires changes in the student which becomes an active part of the learning.

For this reasons, the matter "Elements of Biology" is virtualized with the technical support WebCT (CV-UCM). Then, the students have an access to Web pages related with the Biology, and also they can find links to selected web pages to do the search easier and to complete their training. The student is free to use them or not, according to its responsibility and learning self ability.

It is important the selection of animated figures to clearly explain some biological processes and changes that occurs in the time. It is important for the student of this Master, to facilitate them the understanding of molecular structures and their function. An example is the study of the complexity of the nucleic acid DNA: how this molecule can present different conformational changes according to the phase in the cellular cycle in which the cell is, and why DNA is the selected molecule by the nature to carry the genetic information. Another example is to explain the importance of the proteins, molecules that have a high biological activity and are present in all the vital functions. Another important point is the knowledge of transport processes through the plasma membrane and the exhaustive study of the processes to obtain energy by the living organisms. It is important to know that these students have a knowledge on Physic and Thermodynamic that allow them to understand empirically all these processes but the most important thing it is that they will learn how the cell is continuously doing all these processes to maintain the life.

2.5 Virtual tools







The students always will have the access to all the tools of the system CV-UCM. The elaboration of teaching resources and related materials start with the inclusion of the subject "Elements of Biology" in the CV-UCM. All the included information has the lessons given in the class and the material to support the teaching process (the programme with all the lessons, a recommended bibliography, some data bases with access to images and animations, WEB pages addresses, molecular models,...). When the student enters into the virtual campus of "Elements of Biology", he has the following learning tools (Fig. 2). The description of the most important icons is in the Table I. The activities prepare the virtualization of the subject can be resumed in:

- Selection and elaboration of the contents that reflect the *Program* element. The element *Contents of the subject* includes all the Power Point presentations used as support in the class.
- The communication between the professor and the students by the use of the element *Forum*. This element also allows share experiences between the students as the resolutions of exercises or questions.
- The evaluation of the learning of the students.
- A final phase to think about the teaching process.



Figure 2. Contents of *Virtual Campus*

The students have also to make a work that it is exposed in class in company of all their colleagues. This suppose a great enrichment for the student because it possibilities the exchange of opinions. All the elaborated information by the student is incorporated into the Campus virtual, as a resource for other students.

Icono	Description
 CORREO	Electronic courier between the professor and the student to facilitate the teaching-learning process. Then, a bidirectional relationship is established.
 PROGRAMA DE LA ASIGNATURA	Programme of the subject that it is organized in lessons.
 CONTENIDOS DE LA ASIGNATURA	The subject is made up of seven UNITS (A general vision of the Biology; Biological Macromolecules; Cellular structure; Metabolism; Cell cycle and reproduction; Inheritance and chemical bases of the genetic information; Bacteria and virus). Each of these units includes the power point presentation given in the class. They are a basic tool very useful for the student that is always available at the Virtual Campus.
 SEMINARIOS	Seminars: we include a batch of exercises for each unit that can be resolved for the students.
 RECURSOS DE BIOLOGÍA EN LA RED	Biological Web resources: URL addresses on theoretical knowledge, self evaluation exercises,... and animations to reinforce all the explained concepts.
 CALENDARIO BIOLOGÍA	Planning of the course.




	Marks of the students.
	Forum to debate a specific theme as a seminar.
	Presentation of the Works made by the students to hare all their knowledge with the others students.

Table 1. Description of the icons that appear in the Virtual Campus for the subject “Elements of Biology”.

3 RESULTS AND CONCLUSIONS

This subject “Elements of Biology” is given at the Faculty of Physics of UCM from the year 2006/07 with a media of the 10 students by course. Given the different source of the students, there is not a great uniformity according to the level of knowledge. In another hand, this favours the virtual use that allows in any moment that the student was involved in its own learning process. Also, a number of these students have already a working position and for this reason it is more important that they can dispose of this virtual teaching, with a punctual assistance to the classroom only in determinate moments.

By examining student responses, we have elaborated the Fig. 4 where we show the results corresponding to the annual course when the subject has been done. We distinguish between the year 2006/07, when the subject is not virtualized, and the 2008/09 and 2009/10 years, when the virtual platform is working. As it can be observed, there is a clear decrease in the number of non sat students to make the final exam (from 62% to 10%) and an increase in the number of students that pass the exam (from 18% to 40% when the platform is activated). All the showed experiences and results must be considered provisional because they correspond to only two courses by using of the virtual platform. Even so, they show a clear advantage in the use of these new methodologies in a Postgraduate study, because they combine in an appropriate manner the teaching in class and the virtual teaching. More exact results will be given after longer periods.

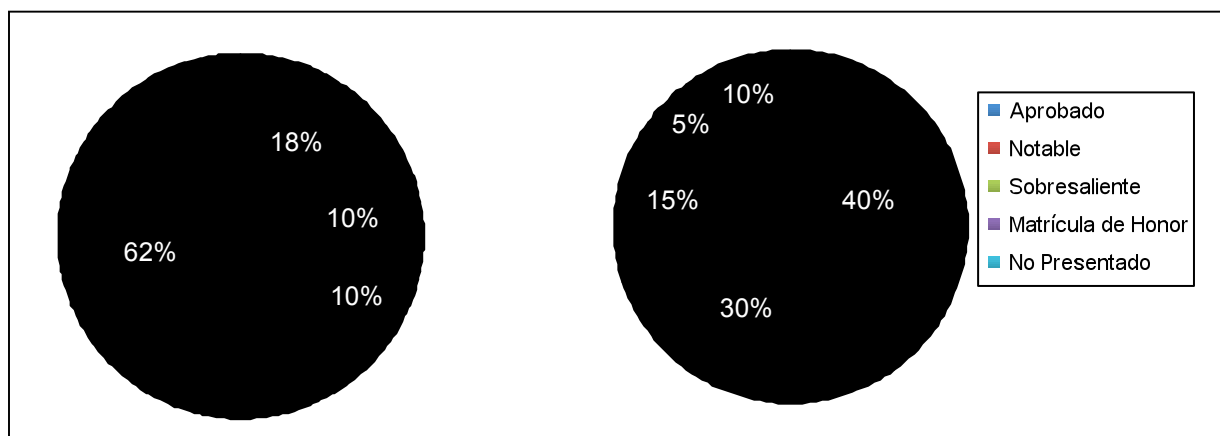


Figure 4. Results obtained by using traditional or new methodological tools. A, Year 2006/07. B, Average results for the years 2008/09 and 2009/10.

On another hand, we have observed that this type of teaching has had a great reception between the students that it is translated into a more participative aptitude and a decrease in the students that leave the subject.

REFERENCES

- [1] Sánchez Delgado P y Gairín Sallán J (2008). Planificar la formación en el EEES. ICE de la Universidad Complutense. ISBN:978-84-608-0707-0
- [2] García Mas I. Muñoz Araujo B., García Moreno A (2008). Aplicación del e-learning y el EEES en licenciaturas experimentales: Adaptación a la asignatura de Parasitología. *Relada*,2(3): 177-182. ISSN: 1988-5822.
- [3] Carabantes, D. (2008). Innovación pedagógica y *e-learning*: La experiencia de la Escuela Universitaria de Enfermería, Fisioterapia y Podología de la Universidad Complutense de Madrid en el Espacio Europeo de Educación Superior. *Relada* 2(1): 1-8.
- [4] Miró M.J., Méndez M.T., Raposo R., Herráez A, Barrero B y Palacios E . (2005) Desarrollo de una asignatura virtual de tercer ciclo como un espacio de enseñanza-aprendizaje que permite la participación activa del alumno. Proyecto Innovación-Mejora Calidad Docente. UCM 2005, nº 551, y UCM 2006, nº 347.
- [5] Margalef L.G (2007). La evaluación como aprendizaje: una tarea aún pendiente. *Relada* 1(1): 11-21
García Joral, F., Sevilla García, P. (2007) Experiencias sobre la participación de los alumnos en el aula virtual de la asignatura de Paleontología General y su repercusión en los resultados académicos. III jornada Campus Virtual UCM: Innovación en el Campus Virtual metodologías y herramientas. Editorial Complutense, Madrid, pp. 157-162. ISBN 978-84-7491-811-3.
- [6] García Joral, F., Sevilla García, P. (2007). Experiencias sobre la participación de los alumnos en el aula virtual de la asignatura de Paleontología General y su repercusión en los resultados académicos. III jornada Campus Virtual UCM: Innovación en el Campus Virtual metodologías y herramientas. Editorial Complutense, Madrid, pp. 157-162. ISBN 978-84-7491-811-3.
- [7] Fig. 1. Image A: <http://www.tecnicosradiologia.com/>
- [8] Fig. 1. Image B: <http://www.ipitimes.com/mnuclear.htm>
- [9] Fig. 1. Image C: http://www.cancerpancreas.es/tratamiento_1.html