XIMET – THE TRANS-UNIVERSITY EDUCATIONAL MATERIALS EXCHANGE-NETWORK WITH A FOCUS ON GENETICS

Ferran Palero[1,5], Javier Sanchez-Escribano[5], Paloma Martinez-Rodriguez[2], Francesc Mestres[3], Marta Pascual[3], Joan Balanyà[3], Nuria Pascual-Seva[4], Lluís Pascual[5]

[1]Unidad Mixta Genómica y Salud CSISP-UVEG (SPAIN)
[2] Departamento de Genética, Universidad Autónoma de Madrid (SPAIN)
[3]Departament de Genètica, Universitat de Barcelona (SPAIN)
[4] ETSIA, Universitat Politècnica de València (SPAIN)
[5]Departament de Genètica, Universitat de València (SPAIN)
fpalero@gmail.com, Javier.Sanchez-Escribano@uv.es, palomichu@gmail.com, fmestres@ub.edu, martapascual@ub.edu, jbalanya@ub.edu, nupasse@prv.upv.es, Luis.Pascual@uv.es

Abstract

XiMET is a network of university teachers working on different aspects of Evolutionary Biology, and which has been established with the aim of promoting the spread of educational innovation partnerships within Spain. The Network is formed by teaching staff belonging to the University of Valencia (UVEG), Polytechnic University of Valencia (UPV), University of Barcelona (UB) and the Autonomous University of Madrid (UAM). Developing activities (e.g. joint meetings) with the support of faculty from multiple universities is an important and necessary step to optimize the efforts of teachers from different centers, but also a key factor in assessing the different skills and concepts that the student receives in each University. Therefore, a fundamental task of XiMET is the creation of a collection of teaching materials and multimedia learning objects (MLOs) designed as a support for teaching. These MLOs will facilitate the work in the classroom for the different modules offered in our universities and will further complement the work carried out within the theory lectures. The collection of MLOs is structured into separate thematic unit, which facilitates the teaching activities and allow students to work independently. Each one of the multimedia learning objects is divided itself into blocks of self-explanatory videos of about 15-20 minutes. Each thematic unit usually contains four problems, starting from a basic problem and then sorted in order of increasing complexity. This contribution will introduce the network and present the steps taken for the implementation of multimedia tutorials. From the making of exercises as Microsoft PowerPoint presentations, to the assembly and the subsequent production of video tutorials using the computer program Camtasia Studio 7. In addition, we will show some of the videos produced by the network, which are available in different repositories such as the RODERIC repository of the University of Valencia (http://roderic.uv.es/) or the website of our group (http://www.uv.es/gemeg/). These units are integrated into the modules taught in the Biology degree at the University of Valencia, but can be used by students from other schools. Hopefully, the material produced will be useful for independent study both of our students and the general community interested in teaching.

Keywords: multimedia learning objects, Genetics, Camtasia, educational technologies.

1 INTRODUCTION

Powered in part by the changes started by the Bologna Plan [1] in the Faculty of Biological Sciencies of different Spanish universities, a new revival of the spirit of teaching and the development of new educational techniques has emerged. Although these changes were received with "heterogeneous" reactions among academics, reaching in some cases the absolute rejection, some nodes of teachers appeared in some of the Schools from which new ideas and new teaching materials are generated to expand the educational side of public universities. The survival and growth of these nodes is directly proportional to their size, so that those nodes consisting of just a small number of teachers are more likely to be exhausted in the short term.

The University of Valencia has been making a significant effort to support educational innovation in university studies since 2003-2004 and helped to improve teaching in the context of the European

Higher Education Area. In order to enhance the growth of teaching innovation teams and increase the stamina of those smaller projects going on at the University of Valencia, the Service for Lifelong Learning and Educational Innovation (SFPIE) has been established. In recent years, and with the aim of promoting the spread of the actions taken by the faculty UV activation and facilitate innovative partnerships between universities, the University of Valencia introduced a new initiative through the SFPIE: the creation and activation of networks of educational innovation and teaching quality with at least ten people and three universities (including UV), so that each university different than the UV must be represented by at least two teachers.

Our team proposed last year 2012 the creation and activation of a network of innovative education and teaching quality which included teachers belonging to the Universities of Valencia (UVEG and Polytechnic University of Valencia), the University of Barcelona and the Autonomous University of Madrid. In this work, we will start off by presenting the structure and distribution of Genetics and Evolutionary Biology course at three of the universities in the network. The main objectives of the network will be introduced next, with the different aspects of the educational task being covered. Tthen, the creation of multimedia learning objects (MLOs) with the use of the privative software Camtasia [2] will be presented. Finally, an overall evaluation of the network and its future perspectives are included.

2 THE TEACHING OF GENETICS AND EVOLUTIONARY BIOLOGY IN SEVERAL SPANISH UNIVERSITIES

The first step in the establishment of “XiMET” (TRANS-UNIVERSITY EDUCATIONAL MATERIALS EXCHANGE-NETWORK) had to go through a review of the teaching structure of Genetics and Evolutionary Biology courses at the different universities included in the network. This research should help with defining a subset of modules which will be of interest at the different centers.

2.1 Teaching Genetics at the University of Barcelona (UB)

As mentioned in the Introduction section, the implementation of the European Space for Higher Education in Spain implied that general Biology had to be taught in all degrees concerning this topic. For this reason, a general Biology was introduced in the Biology, Biotechnology, Biochemistry and Biomedical Sciences degrees of the Universitat de Barcelona. The teaching team there decided to present this topic under an evolutionary view, based on the famous sentence of Th. Dobzhansky “Nothing in biology makes sense except in the light of evolution”. The subject is divided in ten general chapters (30 lectures), from the origin of life to the biodiversity and its conservation. Furthermore, one subject is worked in the format of Problem Based Learning [3,4]. A small group of students prepare a “biological problem” under the supervision of the teacher. In this case, the aim is that students search information related to the proposed problem, analyze this information, get new knowledge and then being able to explain it in an oral presentation to a jury and their class.

With regard to Genetics, the main course is divided in two subjects, Molecular Genetics (first semester of second course) and Genetic Analysis (second semester of the same course). The program of these subjects is common to all four degrees (Biology, Biotechnology, Biochemistry and Biomedical Sciences). There is a different teaching team for each subject and both teams are coordinated in order to give a full view of modern genetics. Both Molecular Genetics and Genetic Analysis are taught using the following methodology: theoretical lectures, problems (including seminars) and laboratory classes. All these aspects will help the student to obtain a comprehensive understanding of molecular and classic genetics.

Finally, Evolution as a subject is only taught in the third course of the Biology degree. It is composed of theoretical lectures, problems, seminars and laboratory classes. It is a multidisciplinary topic, where professors of different departments (e.g. Biology or Geology) teach different parts of the program. Nevertheless, the main body of modules depends on the Dept. of Genetics. The aim here is giving an integrative view of evolution, from genes to macroevolution.

2.2 Teaching Genetics at the Autonomous University of Madrid (UAM)

The current degree of Biology at the Autonomous University of Madrid (UAM) includes several subjects, whose students could benefit particularly of the XIMET project results. This Biology degree includes “History of Biology and evolution” in the 2nd year and “Genetics” in the 3rd year of the degree as compulsory subjects and “molecular genetics”, “evolutionary genetics”, “genomes function and

organization", and the "advance laboratory of genetics" as the optional ones. The last ones usually follow in the last year. In addition, there are other degrees for which the materials available would be of interest, like the Enviromental Science degree (Subject: species conservation, elective in 4th year) or Food science degree (subject: Food Biotechnology, 3rd year).

Some of the objectives of these subjects are to understand (i) the organization, function and transmission of heritable material, (ii) the functioning of the genes which control and contribute to the development of organisms, (iii) the chromosome structure, (iii) mitosis and meiosis processes, (iv) the importance of mutation, (v) population genetics, (vi) the evolution mechanisms, (viii) the new genetic techniques and (vii) the scientific applications of genetics.

Practical lessons is one of the main traits of the biology degree at the UAM. Most subjects consist of theoretical and practical lessons, and activities that include problems or cases seminars. For instance, genetics courses in the last year included 12 problem sessions (50 minutes each) in which the students will learn to solve some cases related with theoretical issues. In addition, the subject included laboratory lessons (20 h) and 2 computer courses (2 hours each) and writing a scientific report. We consider that the interactive problems suggested by XIMET can help students to understand in depth some genetics topics and help them in the problem seminars. For more details on the structure of the subjects go to: http://www.uam.es/ss/Satellite/Ciencias/es/1242654690468/sinContenido/ Guias_y_ programas_docentes.htm.

2.3 Teaching Genetics at the University of Valencia (UV)

At the University of Valencia, the development of theoretical activities for the subject of genetics is done using the expository method or lecture, but by encouraging the participation of students with questions about specific cases or problems. Students receive two or three weekly sessions of lectures lasting an hour, and in total 57 sessions of one hour are required. In addition, there are a weekly practical classes of two hours, which include five laboratory sessions (10 hours), eleven problem sessions (22 hours) and three practical sessions in computer room (bioinformatics) (6 hours).

For practical work, the methodology focuses on problem-solving exercises (exercise, testing and implementation of prior knowledge). It strongly encourages teamwork, both in laboratory activities and in the computer room, practicals are done in groups. The activities of the course are complemented by "Interdisciplinary Seminars" directly focused on the work in competitions. This is a cross-cutting interdisciplinary activity common to all subjects in the second year of the degree in Biology (Cellular and Tissue Biology, Developmental Biology, Biochemistry, Botany, Genetics, molecular biology methods, processes and evolutionary mechanisms and Zoology).

Among the uses of ICT in the subject of Genetics at UV, it emphasizes the development of multimedia materials by GEMEG group (Group for the Development of Teaching materials in Genetics). The group has focused on compiling educational material of special interest within the area of genetics to make it available to students from the UV. The group consists of several professors in the Department of Genetics, and headed by Dr. Lluis Pascual Calaforra (http://www.uv.es/gemeg/).

The materials produced are targeted primarily at students who study the modules offered by the degrees of Biotechnology and Biology, but also the degree of Biochemistry and Biomedical Sciences.

3 THE MAIN OBJECTIVES OF XIMET

Creation of a common repository online which will include resolved problems and key issues to different topics including concepts of genetics, molecular biology and evolution, all of interest to the main programs at three major universities involved in the project. This repository will be used for the development of multimedia learning objects using the proprietary software "Camtasia".

In addition, and to promote interactions between secondary school teachers and university-level teachers, a workshop on the Teaching of Biology was organized in the city of Valencia.

4 THE CREATION OF MULTIMEDIA LEARNING OBJECTS (MLOS) WITH CAMTASIA

The project presented in this study involves the development of a collection of teaching materials and multimedia learning objects (MLOs) designed as a support for teaching. These MLOs will facilitate the work in the classroom for the different modules offered in our universities and will further complement

the work carried out within the theory lectures. The self-explanatory tutorials for learning genetics problems are made in blocks of 15-20 minutes of video each.

We have established a network-based methodology to develop a collection of problems on Genetics and Evolution topics (Table 1). Several working groups are defined to prepare the different tutorials according to different thematic units. These units are designed so that they can be adapted to the peculiarities of each degree or level. All the tutorials are presented with a similar structure and homogeneous environment (as far as possible) in order to facilitate independent work by the student.

Table 1. List of main topics addressed within the MLOs.

Tema 1 => Herencia en un locus génico
Tema 2 => Predicción de la descendencia_binomial_ji-cuadrado
Tema 3 => Complementación y rutas
Tema 4 => Predicción en alelismo y letales
Tema 5 => Epistasia
Tema 6 => Hipótesis de herencia
Tema 7 => Genética cuantitativa
Tema 8 => Genética de poblaciones
Tema 9 => Análisis de genealogías
Tema 10 => Ligamiento
Tema 11 => Recombinación en diploides
Tema 12 => Recombinación en haploides
Tema 13 => Recombinación en virus
Tema 14 => Mapas en bacterias: transformación, conjugación y transducción
Tema 15 => Mapas de deleción
Tema 16 => Mapas de restricción
Tema 17 => Marcadores moleculares
Tema 18 => Citogenética

Each chapter contains four generally the same type of problems, starting from a base problem and sorted in order of increasing complexity. The phases for the implementation of the tutorials are explained in the following.

4.1 Preparation of the problems as slideshows

Based on a series of problems solved within the basic genetic problems, a slide show explaining each problem was created. The program used was Microsoft PowerPoint 97-2003. The first slide is always corresponding with the main statement of the problem and related questions. We tried to maintain uniformity in the font, the title of each problem and the visual structure. The rest of the presentation slides included representative explanations for problem solving, as the teacher would normally do on a blackboard and adding visuals and diagrams to facilitate understanding, as well as written explanations, which differed from the rest of the presentation because they were marked in italics. Each element of the presentation was scheduled to appear in order to click with the mouse. We used a different background for each problem to promote visual transition into the next video.

4.2 Conversion of presentations into video files

After making slideshows of each problem individually, they can be turned into video files using the program Camtasia Studio 7. Through either a "record PowerPoint" from the program menu or the plugin for the Camtasia • Microsoft PowerPoint, we can access the application to capture a screen video of the computer slideshow when maximized (Fig. 1). Among the options selected to perform video recording, you should make sure they are selected appropriately.

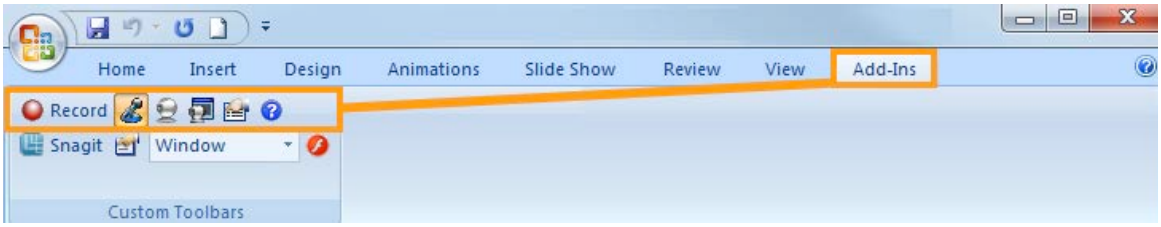

Fig. 1 – The Plugin for video-recording within Microsoft PowerPoint.

The application allows you to advance the presentation by clicking with the mouse, and thus manually set the rate of the same, and thus the length of the final video. The recording was usually made allowing for a slow reading of the information on screen and leaving a little more time in the key moments of the problem. The files were saved in the proper format of Camtasia, *.camrec.

4.3 Assembling the video tutorial

Using the interface and the possibilities that allows Camtasia Studio 7, our team was able to start designing a video tutorial. First we imported all the video files that were part of the learning program, and the final images in which appeared the credits for authorship and the details of it (Fig. 2). These files were sorted and added to the timeline of the program.

The next step was to remove all the unnecessary video segments, such as the icons that appear in the lower left corner of the PowerPoint maximized during the first few seconds. To remove unwanted elements we used the option "split" for the elimination of the corresponding sections obtained.

Then we make transitions smoothly. Using Camtasia options available to the user, transitions were located between the end of one and the beginning of the next problem. The transitions were homogenous and each video tutorial is included to enhance the visual separation between each problem.

Fig. 2 – The credits for authorship and the details of it.

Finally, the markers were added to the video tutorial. That is, a series of marks at the beginning of each problem and the beginning of the credits were added, while being able to put a title to each. Furthermore, it allowed us to add interactive tutorial context menu (table of contents).

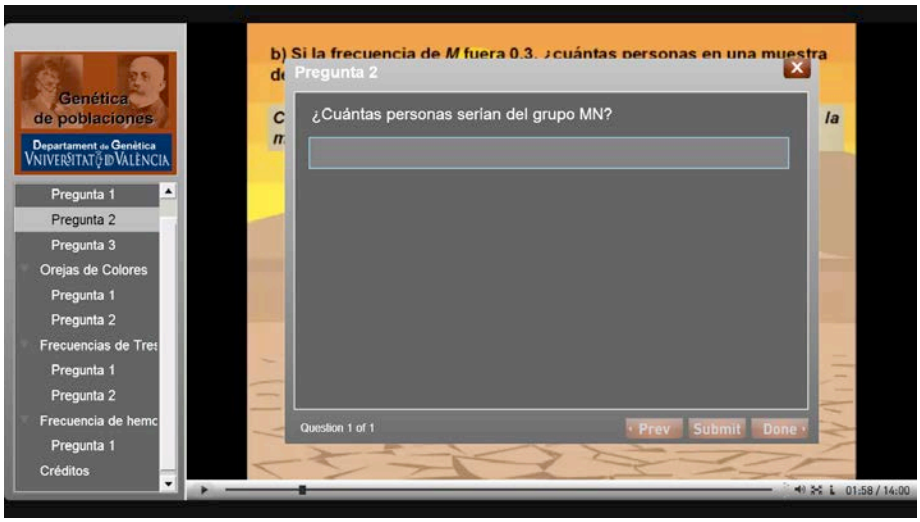

Fig. 3 – Screenshot showing the use of “interactive questions” within the MLOs environment.

After this part, then video with the addition of questions (quizz) was finished (Fig. 3). The additional questions raised the issue with a structure, either to choose for a multiple answer question or question with the answer to fill empty space (usually a specific number). When the student answers the question, it provides information on whether the student has answered well or not and then he is compelled to follow these same explanations in case of error. Questions posed a stopping point in the video and also were automatically considered as markers. Two or three questions are included per problem.

Complementing the multimedia video, a number of "callouts" have appeared while marks are displayed, in our case, arrows, allowing the function to jump through the timeline, move the video to a specific point. These arrows were added at of the tutorial where it was felt that a student in a second viewing of the video could not feel any need to look for the explanation.

4.4 Edition of the video tutorial

Once the assembly is finished, the last step was the production of the tutorial. This was done with the tool "produce and Share" to make it personalized (custom production settings). You can choose the ideal parameters of production to balance the video quality and the weight of the files produced. The output format was mp4 flash output, allowing higher quality full length videos and many interactivities. The option to place a "table of contents" on the left allowed the student to automatically access to every problem. In addition, questions were included in this sub-context menu so that each problem can also directly be accessed. Also a header image on the menu with the title of the types of problems was added. This serves as a link to all the problems of the same tutorial as the image was unchanged although the problem changed. Eventually allow the creation of an html file with the video tutorial "embeded" to play it more quickly and easily.

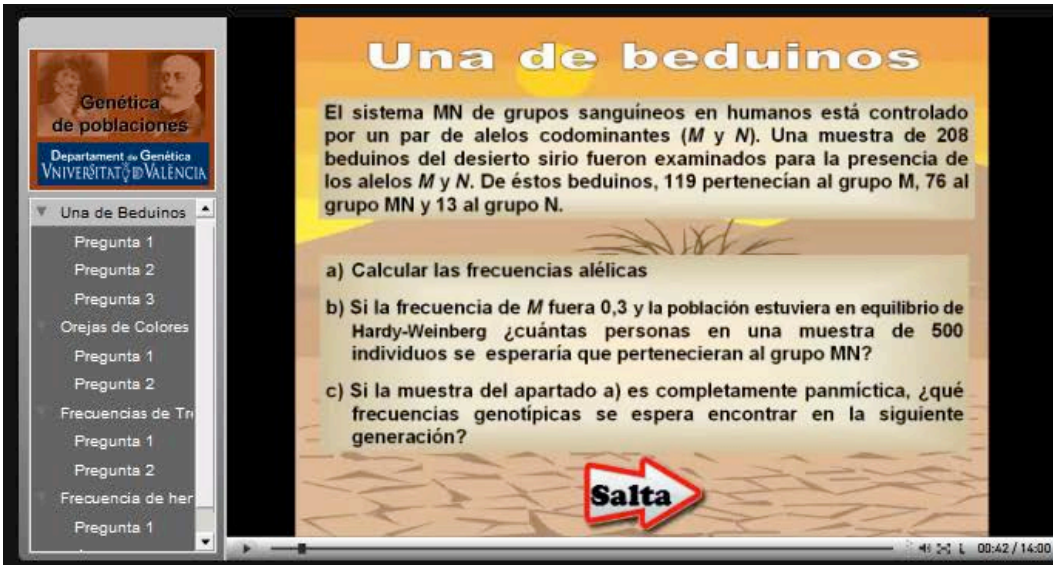

Fig. 4 – Screenshot for the webpage corresponding to the topic: “Population Genetics”.

The files obtained once the video tutorial is produced were as follows: matrix video format mp4, swf format to view interactivity, an html file, and supplemental files. As a final step all these files went up to a web server for public access.

5 SECOND CONFERENCE ON THE TEACHING OF BIOLOGY

On April 20th 2013, the Second Conference on the Teaching of Biology was held at the Auditorio Joan Plaça of the Botanical Garden of the University of Valencia. The XiMET team, in collaboration with the Catalan Biological Society and the University of Valencia, organized the conference with the aim of facilitating the exchange of experiences between high school teachers and university teachers and to propose new tools for teaching biology. Thanks to the organization of the workshop we could bring together teachers of biology from different institutions across the country, both from Catalonia and Valencia, who shared their experiences in the form of oral communication. Thus, the presentation of different classroom activities was provided by teachers of the Department of Ecology at the University of Valencia (R. Ortells) or the Guadalaviar School (B. Garrido and M. Barcia). The introduction of open air field trips throughout the region Tona (I Sirerol - School IVEP) or indoor practical bioinformatics lectures by C. Giménez (San Gabriel C., Vilamoura) showed the large diversity of activities available for students. Throughout the meeting, several activities of various associations (eg BioBlau) or companies (eg bio UVAT * Educational Services) and the availability of Web resources for the use of school teachers, including materials prepared by ZooBot zoology (http://www.uv.es/zoobot/) or genetic problems created by GEMEG-XiMET (http://www.uv.es/~gemeg/).

We also had time to discuss technical aspects of teaching biology through the lectures of P. Martinez (UAM, Madrid) and F.J. Aznar (Dept. Zoology, UV). The talk by Dr. Aznar on identifying students' ethical practices and biodiversity conservation arose a special interest among the participants. Finally, we enjoyed an updated revision of the field by Dr. Luis Serra, who proposed the topics that should be included in a biology program in high school. All in all, the meeting was a real success and encourage the different assistants to continue developing teaching strategies and materials in the near future.

6 CONCLUSIONS

The application of the project outputs into practical teaching is evident given that all university teachers within the network follow the same main objective: to create learning objects that can be used both during the lectures, especially through the active participation of students, and as suitable working environments for autonomous learning. The collection of unit tutorials will help live work sessions scheduled in the different subjects and universities, let alone the additional work of the student, and will facilitate the process of evaluation of knowledge and skills associated with this task by allowing a coordinated effort among the different groups.

REFERENCES

[1] European Comission (2000). http://ec.europa.eu/education/policies/educ/bologna/bologna.pdf.

[2] http://teachingwithcamtasia.blogspot.com.es/ (Accessed on May 16th 2013).

[3] Schmidt HG (1993). "Foundations of problem-based learning: some explanatory notes". Medical Education 27 (5): 422–432. doi:10.1111/j.1365-2923.1993.tb00296.x. PMID 8208146. [15-05-2013]

[4] Schmidt, H.G. (1983). Problem-based learning rationale and description. Medical Education. 17, 11-16 [15-05-2013]