CD-ROM Included

TOWARDS THE EUROPEAN
HIGHER EDUCATION AREA (EHEA)

Innovative teaching experiences at the UAB in experimental and technological sciences and in health sciences

Maite Martínez and Elena Añaños (coord.)

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Unitat d'Innovació Docent
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Prologue

In 1999 the ministries of education from 29 European countries signed the Bologna Declaration, which aspired to create a coherent and cohesive European Higher Education Area (EHEA) by 2012. It was the beginning of a process which aimed to achieve a system of easily readable and transferrable qualifications, the establishment of a common system of credits, the promotion of mobility with Europe without administrative or legal obstacles, and European cooperation for quality assurance. The process would continue with the meetings in Prague (2001), Berlin (2003), Bergen (2005) and London (2007). In short, the whole process aimed to promote a European dimension to higher education.

It therefore consisted of trying to enable the integration of university-qualified people in a unified European labour market and to achieve greater competitiveness for Europe on an international scale. These objectives required a consideration of the different educational systems and the redesigning of their curriculums in terms of skills and learning results.

Within the process different challenges were proposed according to the different systems and traditions in the university cultures of the different countries. In Spain, this meant changing the architecture of higher education qualifications towards a more modular, three-phase structure on the one hand (undergraduate degree, Master, Doctorate), and an opportunity to rethink the teaching activity and methodology within a student-centred model on the other.

In terms of changing the architecture of the qualifications, the first major point to stress is the abandonment of the classic type of credit awarded to date, and the introduction of a new type of credit, the *ECTS* credit, which is a measure of the total work carried out by the student, including both group and individual work, whether supervised or unsupervised, as well as the evaluation activities. Within the European framework an academic year is equivalent to 60 credits, with a quantitative estimate of between 25 and 30 hours per credit. Therefore an academic year involves between 1500 and 1800 hours of work by the student.

In the new European framework, higher education is structured in three phases or cycles: the first cycle counts for between 180 and 240 credits (three or four years) and leads to a *bachelor's degree*, a second cycle of between 60 and 120 credits (one or two years) leads to a *Master*, and a third cycle of variable duration (around three years) leads to the *Doctorate* qualification.

In the spirit of this cyclical or modular structure there are two important aspects: one is flexibility, or the possibility of reorientating the learning experience from one area to another on moving from one cycle to the next. The other is employability, or the willingness to achieve certain levels of knowledge, skills and abilities within each cycle that will enable the qualified person to enter different areas of the labour market.

In terms of the first two cycles, *bachelor's degree and Master*, most European countries have adopted a 3+2 structure consisting of a three-year undergraduate degree worth 180 credits and a two-year Master worth 120. This structure provides a basic, general education at degree level and more specialised training at Masters level, and it means that a large number of graduates continue onto the second cycle. However, it should be pointed out that although the 3+2 structure has been adopted by the majority, it is not unanimous.

The Catalan government initially opted for a 3+2 structure and in 2004 it initiated a number of pilot plans for the adaptation of degree qualifications to the EHEA. The Spanish government initially opted for a framework that left a variable margin of flexibility in terms of the duration of the undergraduate courses (Decree on undergraduate and postgraduate degrees 2004) and later (Decree 2007) it changed to the 4+1 option which, as we have mentioned, is a minority option in Europe.

The UAB had opted for the 3+2 structure from the start – and not always in line with the other Spanish universities. This structure is compatible with the models being adopted by most other universities in Europe, are competitive in terms of the courses on offered in Europe, offering a real possibility for the mobility of university students and staff and integration into the labour market. Notwithstanding, predicting that this would not be the final structure to be adopted by the Spanish government, the UAB prepared its own model consisting of synthesis of the 3+2 structure (the majority structure in Europe and the one preferred by this university) and the 4+1 structure (finally adopted by the Spanish government). Within this model the official four-year undergraduate degree would be structured as a three-year degree, containing the basic nucleus of the undergraduate degree plus a fourth year which would be variable and which students could take according to their own interests: either as a natural continuation of the previous three years, or as a *minor* in a different area of knowledge, as a practicum, a mobility year or as the first year of a *Master*. The last of these options would facilitate mobility in the opposite direction, meaning that foreign students with undergraduate degrees worth 180 credits could come to the UAB for the second cycle (Master). As mentioned above, apart from these changes in the architecture of higher education qualifications, the process of integration in to the EHEA also implies an opportunity to reconsider teaching activities. But first, we need ask ourselves whether our teaching activity needs to be changed.

Teaching, like any other activity, can always be improved and it is a fact that those who teach are not always satisfied with the results of their labour. It is often the case that teachers think their students could learn more or could learn better. The reasons for this are diverse and complex, and some will almost certainly be found beyond the

strictly academic field. However, it is also true that within teaching activities there is a margin for action and creativity.

During the learning process, whatever the methodology used, individual effort by students is indispensable and cannot be substituted. This could lead to the impression that no great changes are necessary because the onus to work is on the student. However, this is not the case. Learning requires effort on the part of the person who wants to learn, and also on the part of the person who wants to teach them. It requires a reflection on content and an adequate design of the activities that are connected to real situations, those that flag up relevant questions and are not restricted to the simple application of algorithms. In short, they need to respond to the question *what do the students need to know how to do?* Rather than *what do they need to do?* This is particularly true in a context like ours where teaching often abuses the purely expositive activity, the simple transfer of concepts, which does not encourage the activity of the learner – in fact quite the opposite.

Reducing expositive activity while planning a correctly balanced activity for students, offering tools for learning, is in general terms, the great challenge for our teaching staff. It is not a simple task and it certainly implied effort on the part of the teachers.

This concern has led to many teachers recognising the need to reflect on their own teaching, to confirm their strong points, explore alternatives and use up all room for manoeuvre – which is often greater than it would appear at first sight – in the teaching activity itself with a view to making it more efficient. This kind of enthusiastic and innovative teacher has taken advantage of the opportunity to go further than structural changes and has sought obvious factors in the teaching task which have enabled improvements in student learning.

This innovative effort has been supported by the Higher Education Teaching Innovation (IDES) unit of the UAB, which has helped to turn a teacher's initiative into a project and in developing the action to make it a quality product. These two volumes bring together the results of this innovative effort carried out over a period of four years. Many of the experiences presented here have received the support of the MQD (Teaching Quality Improvement) programme and AGAUR and the rest have benefitted from the University's own programmes.

A process of change of this kind is always long and complicated. It generates support and enthusiasm at the same time as scepticism and resistance. It requires complicity within the university community and the teaching staff who present their experiences here have therefore provided the germ that has enabled change to grow, and the muscle that bears the collective effort of starting this process of change in our university.

The UAB is very grateful to all of them.

Antoni Méndez

Vice Rector for Academic Studies and Quality Assurance
Universitat Autònoma de Barcelona

Presentation

For the first time, the IDES is publishing a text that has been directed with criteria, care and dedication by Dr. Elena Añaños, head of the area of innovation. I would like to extend to her my gratitude for the effort involved in carrying out this task and for her clear-sighted contribution, which has made it possible for us to understand and describe the project presented here.

This text, which covers *innovations in the classroom* and is aimed at university teaching staff, aims to contribute new information and knowledge to help other teachers design their own innovations in the context of the European Higher Education Area (EHEA) and to encourage them to share the experiences that have clearly obtained quality results.

For several years, the need to adapt our study plans to the European system has led teaching staff, both directly and indirectly, to reflect on their own activity and to experience new or different ways of looking at the teaching-learning environment. In some cases, the teachers have evaluated their own way of working based on their own considerable experience, collecting evidence of clear results and redefining the teaching environment to adapt it to the new situation. In others, they have created different materials and have used information and communication technology (ICT) to ensure that students are able to receive materials that are difficult to work with directly, and in yet others, innovation and creativity have been manifestly reflected in some truly original experiences.

Only a selection of these innovative experiences are reflected in this text, and we have used as selection criteria those that have been recognised and received support for their production from the Generalitat de Catalunya's Agency for Management of University and Research Grants (AGAUR) or from the Vice Rector's Office for Academic Studies and Quality Assurance for the funding of teaching quality improvement between 2004 and 2007. For each completed project, conclusions are presented and these can be considered starting points for understanding what innovation is and how it is applied to the daily teaching and learning tasks in the university setting. All of them provide a basis for subsequent developments, in which the role of the environment is fundamental, and for that reason we have chosen to differentiate production in two different settings, defined by the specific contexts: innovation for experiences in experimental science and technology and health sciences, and innovative experiences in social and human sciences.

Although this is simply a range of different innovative experiences (a total of forty – twenty in each volume) they correspond to 32% of all projects in receipt of grant support. The others are not presented here, not because the teachers in question do not want to see them published, but because, in some cases, it was considered that the project had not reached a point of completion where conclusive results could be presented.

Behind these experiences are groups of teachers carrying out research into their own teaching. This process has not been easy, since it starts with the designing of the project and sometimes with a joint reflection by the teachers of different subjects or groups on the possibilities for creating an innovative design. And the work does not end there. Once the grant has been awarded, and disregarding day-to-day difficulties such as changes in groups, different timetables or different numbers of students per group, the project is launched involving coordination, any revision which has been made and any unplanned changes that need to be implemented. Data is collected, the results are checked and new changes are often introduced for later projects. This group task, which defines the aims, the individual responsibility in the application and the complementary nature of the analysis of the results, is not reflected is this work. However, we are aware that without this shared, group effort, it would not have been possible. The experiences presented here are the result of the work and the effort of 189 teachers. They represent approximately 7% of the total teaching staff of the university, and this is a clear reflection of the concern shared by the teaching staff to build a European Higher Education Area that is relevant to their own needs, analysed from the point of view of learning efficiency and effectiveness, which demonstrates a clear endorsement of quality teaching.

Before I finish this introduction, I would like to mention two points that should be taken into account as a result of their relationship to the subject we are dealing with: internal communication and external projection.

The experiences and products presented have not been conceived for use in a single classroom. The fact that the authors have made the materials in DVD format available to other members both within and off the campus implies that the current time should be seen as a period of challenges in which we have to offer the knowledge that can help them to share, to work together and "generate new knowledge" (an example is the generosity of all the authors in displaying their own understanding of the educational area and its construction). On the other hand, understanding the current situation is an opportunity – and not a threat – for our universities to make a clear pledge for quality.

In terms of exterior projection, the work will be disseminated not only in our own language – Catalan – but also in Spanish and English editions, bearing in mind the fact that both project and innovation can be shared by the university community of the EHEA. This will facilitate real contact between university teachers and colleagues from outside our immediate field who are also carrying out innovations in the classroom.

To conclude, then, through this book and together with the Vice rector's office for Academic Studies and Quality Assurance, and the Academic Planning Office, we have

tried to offer elements of knowledge and reflection on one of the defining themes of our future in the European Higher Education Area: innovation.

We believe that quality is a question that affects everyone, but that it is something that goes beyond our individual capacities and therefore, in our opinion, needs to be worked at jointly, through shared and overlapping experiences. If after reading the projects presented here, doubts, new projects and dialogues emerge, then we will have reached our target. This is a good time for opportunities, and it is also therefore a time for risks, the greatest of which would be inactivity or obstinacy in not wanting to see the path that leads us to work together.

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Acknowledgements

The production of this book has been made possible thanks to the great efforts and participation by different units and professionals. To try to mention all of them here would carry the risk of forgetting those who have also made this task possible from a position of anonymity. Our greatest thanks go to all those who feel part of this publication. We would especially like to thank the Agency for Management of University and Research Grants of the Generalitat de Catalunya and the Vice rector's Office for Academic Studies and Quality Assurance at the UAB, that have provided the grant support that has made it the innovative teaching experiences presented here possible. Also, well aware of the work carried out by the Publications Service of the UAB in producing this book, we would like to offer special thanks to the head of the service, Joan Carles Marset, and also to Pep Sansó and Jaume Brey.

We have received continual support from the Teaching Innovation in Higher Education Unit (IDES). We would particularly like to thank Gisela Rodríguez for her work in organising the content and who, along with Jordi Grau, produced the CD-ROM.

Our biggest thank, however, does to the teachers who have participated in each of the experiences presented here. Their dedication to innovation in university teaching is an example of how innovative, quality teaching can be achieved from the subjects themselves, thereby facilitating the process of adaptation towards the European higher Education Area.

Many thanks to you alls!

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Faculty of Sciences

Creating digital resources for teaching innovation in Structural Geology and Tectonics

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Abstract

This project consisted of developing a series of teaching resources in digital format to teach the subjects of Structural Geology and Tectonics in degree programmes related to the Earth Sciences. The goal was to improve students' training and performance by developing out-of-classroom support activities that foster independent learning and self-regulation on the part of the students. The activities aim to take advantage of the new IT tools available and to foster their access via the Web. The material that was developed in this project consisted of: 1) a documentary collection of images related to Structural Geology and Tectonics with explanations, available on the Web and accessible from specific search engines, 2) a series of exercises and practical case studies, some of them already solved, and 3) virtual field trips to a geological region that enabled us to propose activities prior to a visit to the field or to develop the practice totally independently.

General area of interest of this innovation

«The best geologist is the one who has seen the most rocks»
H. H. Read, 1889-1970.

This project aimed to provide support to teaching of the core subjects on Structural Geology and Tectonics in the Bachelor's in Geology programme at the UAB, although it might also be of interest to university students who are studying these subjects in the Geological or Mining Engineering and Environmental Sciences degree programmes. It is also targeted to the faculty in the field of Geodynamics, both nationally and internationally, for whom it might be useful to have an interactive archive of images and exercises on geological structures.

1. Objectives

Structural Geology and Tectonics are sciences with a heavy visual component which are based on analysing and interpreting geological structures (folds, faults, rock textures, etc.). The first steps in this analysis consist of properly identifying and describing the geometric characteristics of the structures. These skills are not easily acquired by students in traditional classroom teaching, as they mostly require the cumulative experience of observing and synthesising nature's diversity. With these premises, the overall goals of the project can be summarised as:

1. To adapt the format of the graphic material used in teaching to the new technologies by creating databases of digital images with several ways to access them.
2. To develop new teaching materials such as exercises that are available on the Web and virtual field trips.
3. To foster students' capacity for analysis and to augment their experience by means of methodologies based on independent learning

The skills we want the students to develop are the following:

1. The capacity to observe, identify and synthesise the information from natural geological structures.
2. Skill in drawing and portraying the basic geometrical traits of the structures, which will serve as the foundation for later analysing and interpreting them.
3. The ability to progress in their scientific knowledge and experience by means of independent study and self-evaluation.
4. Skill in the use of digital resources linked to the new technologies.

2. Description of the project

This project originally emerged within the context of teaching Structural Geology and Tectonics in the Bachelor's of Geology programme taught by several members of the Internal Geodynamics area within the Faculty of Sciences at the Universitat Autònoma de Barcelona. The specific courses that the team members teach and where the material developed in this project is being applied are the following:

1. Endogenous Geology field camp of (second year in the Bachelor's of Geology)
2. Introduction to Rock Mechanics (second year)
3. Structural Geology II (third year)
4. Geotectonics (fourth year).

The point of departure in terms of how these subjects were taught was a high degree of classroom teaching coupled with professor-led field trips. Currently, the teaching takes place in the traditional way with the support of projections of images and graphs, and using practices based on exercises that are conducted in the laboratory.

When the project started, we had a documentary collection of geological structures from the field that included almost 2,000 photographs, only a tiny fraction of

which was used in the classroom in the form of slides. Part of the teaching innovation consisted of making use of the new information and communication technologies, especially the Web, to make the majority of these photographs available to students.

The working plan of the project included several activities sequenced over time:

- digitalisation of the images from the documentary collection (photographs and graphs)
- development of explanatory materials for the images and graphs
- classification and organisation of the images into different categories and different ways of access them (depending on the type of geological structures, regardless of the context, or grouped into virtual field trip itineraries)
- preparation of exercises or practical case studies that include graphs and photographs of structures
- preparation of a collection of exercises with solutions
- creation of a website where the resources developed would be available

The digital collection is used by both the professors, who have an extensive database from which to draw materials for their classes, and the students, who have at their disposal extensive documentation on natural geological structures that they may use for independent learning activities and studying.

The material is presented in an informative way (the image collection per se), as well as in the guise of exercises and practical case studies to be solved, which may have to be handed in to be evaluated or which students may do independently to evaluate themselves.

With regard to the innovation in the fieldwork, a series of virtual field trips are being developed, meaning an interactive set of geological maps, geological transects and photographs linked to each other. This resource makes possible a geological survey of a specific zone, which may be more or less complete depending on whether it is being used as an exercise prior to a real field trip or whether the aim is to describe a particularly educational field area to be studied just virtually.

3. Methodology

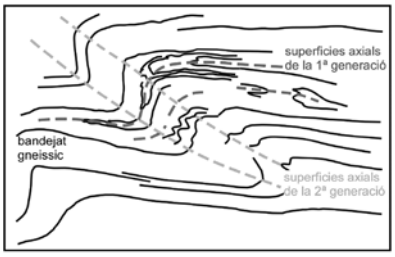
The actions and means used to develop the project are as follows:

1. Digitalisation of the documentary collection on Structural Geology and Tectonics, consisting of 2,000 slides on geological structures from many different regions on the planet which have been amassed by the faculty in the area of Geodynamics over the past 50 years. The collection was digitalised by scanning slides with high image resolution (approx. 2000 ppm). From each of the images we have made a copy with a lower resolution that is accessible on the Web. An explanation has been written for each image, and in some cases supplementary illustrations are also provided.

2. Organisation of the digital collection using a variety of criteria: subjects (type of structures), regions (illustrating the geology of a given region), etc.
3. Development of a search engine for the image collection that can work using several different criteria and used by the faculty/students when doing exercises, studying, etc.
4. Online publication of the image collection with the supplementary illustrations and explanations so that they can be used by the students as an independent learning resource (http://einstein.uab.es/c_geotectonica/reditec/2008). Adaptation of the search engine to the spatial characteristics of the Web. Figure 1 shows an example of a file from the documentary collection, with the image of the geological structure being studied, its explanation and the supplementary illustrations.

Figure 1. Example of a file from the documentary collection with additional explanations and illustrations

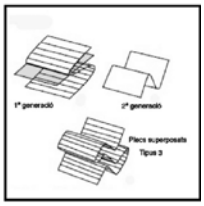
FOLD SUPERIMPOSITION (CARIÑO BEACH, LA CORUÑA)



Observation:
The folds seen in the photograph deformed to so-called Cariño Gneissos formation of metamorphic quartz-feldspathic rock with a compositional banding defined by the alternating psamitic-pelitic layers. These gneisses probably derive from sedimentary rocks, and are therefore paragneisses.

Description of the structures:
In the centre of the image the lighter layers define isoclinal folds appear. If the axial surface of these folds were drawn, it would be seen to be deformed by more open folds.
In the bottom right corner of the image folds with a short vertical limb and a longer horizontal limb can be seen.
If we stretch out the axial surfaces of these open folds we can see that the axial surfaces deform from the isoclinal folds in the centre.

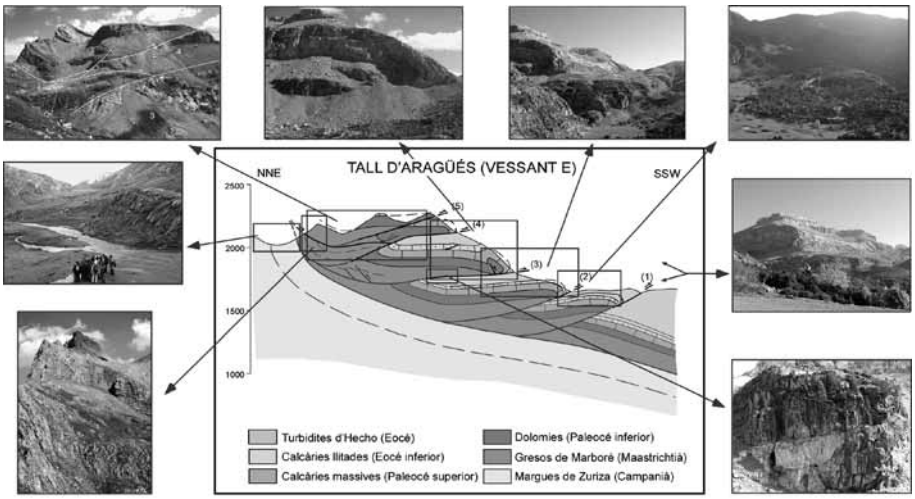
Interpretation:
This is an example of a two-phase fold superimposition. The first generation isoclinal folds are deformed by the asymmetric folds of the second generation. The orientations of the axes of the folds for both generations are close but the axial planes are oblique: this geometry corresponds to type 3 interference of Ramsey's fold classification.



5. The development of a series of practical case studies and exercises to be solved by students. These exercises, which will be distributed online, might contain both the solution and a self-evaluation scale adapted to the level of the course so that students can track their own progress. For this purpose, there is a collection of exercises commonly used by the faculty in non-digital format.

6. Creation of virtual field trips which enable students to observe the structures within their geological setting without having to travel, or as an activity prior to a real field trip. For this reason, they include documentation on a variety of tectonic units in the geological setting, including maps and geological transects, photographs, rock samples, etc. Figure 2 shows an example of this latter activity, corresponding to a geological transect in a sector of the Pyrenees illustrated with a set of images. The complete virtual field trip can be found in the enclosed CD and is part of the core course on Geotectonics in the Bachelor's in Geology at the UAB.

Figure 2. Example from an illustration of a virtual field trip, showing the link between the graphic information (geological transect) and the field images of parts of the transect



The geological section at Puertos de Aragüés (Aragonese Pyrenees) shows an imbricate fan of 5 thrust sheets, affecting sedimentary rocks of late Cretaceous to Eocene age. Each thrust sheet presents fault-related folds, consisting of hanginwall anticlines and footwall synclines. The five imbricate thrust converge in a bedding-parallel basal detachment, and the whole formation is folded by a large-scale syncline, formed later (squares link to field images of different punts of the section).

7. Definition of the monitoring and evaluation mechanisms of the teaching innovations. This consisted of drawing up a series of criteria that enable us to quantify to what extent the students have acquired the target skills. It includes a compilation of the tasks performed by the students in order to record statistics on their progress in subsequent courses.

4. Preliminary results

As this article was being written, this project was in the development stage, so there are not yet any comprehensive results on its application. Nonetheless, it has been put into practice in the course «Endogenous Geology Field camp» during the second term of academic year 2007-08. This course is to a geological camp with the goal of initiating students into practical fieldwork. The material which was drawn up consists of a virtual guide to the fieldwork zone with an explanation of the goals and the geological setting, as well as a series of illustrative photographs on the thrust structures in other areas on Earth, structures that are the main subject of study in this course. In order to make use of the database of images during the fieldwork, a selection of photographs of thrusts were printed and laminated in order to distribute them among the students. Analysing these images should enable students to define the main elements for recognising this type of structure on the ground.

The mechanisms used to analyse the results consisted of: 1) the evaluation of a practical field exercise, and 2) distribution of a survey on the usefulness of the teaching resources in order to assess students' degree of satisfaction.

The practice consisted of an exercise in which students had to interpret a field outcrop by means of drawing a schema that includes its main elements. The practice was conducted in two stages: one prior to distributing the selection of images among the students and another after having distributed and analysed them. The work conducted in each stage was collected to be marked to be able to compare the results and assess the improvements in students' performance. A total of 33 students did the practice, divided into two groups. The results show that the average mark on the exercise rose 91 % after applying the innovation, with a significant drop in the number of interpretation errors considered unacceptable.

An analysis of the survey has shown that students' degree of satisfaction is high: the usefulness of the exercise with the digital resource was rated an average of 7.7 over ten. Among the aspects worth highlighting are the availability of the prior information on the geological setting of the field trip, which helped students to understand the exercise better, clarified concepts and reduced the interpretation time in the field. Among the strong points of using images from outside the working area, the students highlighted their usefulness when interpreting the real structures being studied and as a foundation for extracting the essential aspects to be observed and described. As a point needing improvement, the students pointed out that the images housed online did not yet have additional explanations and illustrations to make it easier to understand them, which shed light on the need to accompany the database of images with explanations of each structure. These results should be viewed as preliminary; however, they do give a positive idea of the usefulness of applying the methodologies being developed in this project.

5. Conclusions

The resources developed by the project will be used in the future in the new courses that are developed upon the remodelling of the curricula following the norms of the European Higher Education Area, a system in which personal study and independent learning have special prominence and for which the teaching innovation we have described has been particularly designed. Likewise, as mentioned before, our aim is for some of the material to be available online for other users outside the UAB.

The use of the digital material developed to date has enabled the classes in Structural Geology and Tectonics to be more participatory, facilitating students' discussion and interpretation of the structures being explained. This has been very positively rated by the students. Likewise, the virtual field trips as preparation for the real field trips on the ground and the pilot use of the database of images are experiences that have notably improved students' performance in the field.

In the future, the project will continue to be developed by drawing up study materials (exercises to be completed and examples that are already interpreted) and increasing the number of virtual field trips, both those linked to real ones and ones that stand on their own as teaching tools.

References

RAMSAY, J.G. and HUBER, M. I. (1983-1987). *The techniques of modern Structural Geology (2 Volumes)*. London: Academic Press.

TEIXELL, A. (1996). «The Ansó transect of the southern Pyrenees: basement and cover thrust geometries». *Journal of the Geological Society of London*, 153, 301-310.

TWISS, R. J. and MOORES, E. M. (1992). *Structural Geology*. New York: W.H. Freeman.

VAN DER PLUIJM, B. and MARSHAK, S. (2003) (2nd edition). *Earth Structure: An Introduction to Structural Geology and Tectonics*. San Francisco: www. Norton & Company.

Interesting links

- Innovation website: http://einstein.uab.es/c_geotectonica/reditec [2008]
- http://www.diogenes.ethz.ch/index.asp [2008]
- http://www.geo.uib.no/struct/index.html [2008]
- http://funnel.sfsu.edu/courses/geol102/ex2.html [2008]
- http://earth.leeds.ac.uk/learnstructure/ [2008]

Keywords

Structural geology, tectonics, digital resources, independent learning.

Financing
This project was financed by the AGAUR programme on Improving the Quality of Teaching at Catalan Universities (MQD) for 2006 (ID number: 2006 MQD 00002).

Supplementary materials on the CD-ROM
Virtual geological field trip, consisting of an itinerary described by images, graphs and digital photographs linked in an html environment.

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Presentation of the working group
The working group is made up of professors and researchers from the Geotectonics Unit of the Department of Geology. The group has extensive experience (more than 20 years in the cases of professors Teixell and Arboleya) in teaching and research in the field of Structural Geology, and it is primarily concerned with studying rock deformations on the Earth's crust at different scales, ranging from the texture at microscopic scale to the joint structure of the mountain ranges and their relationship with plate tectonics. The group's research has been published in the leading specialised journals, both Spanish and international.

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Transversal competences and skills in geology and prehistoric archaeology

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Abstract

This study develops a specific proposal for addressing some of the educational goals of the EHEA such as transversality, teamwork and the need to increase practical knowledge. The perspective from which the study was conducted was interdisciplinary cooperation among university professors who work in two quite different fields of science: geology and prehistoric archaeology.

A pedagogical tool was developed in which students can develop skills and abilities such as the ones mentioned above by pursuing a specific case study: the description and provenance of stone elements used to build the megalithic sepulchre in Puigsesllloses (Osona). The proposal is based on students' following and participating in the entire research process: posing the historical-archaeological problem, defining the specific avenues of study, conducting the study, getting the results and holding an interdisciplinary discussion of these results.

General area of interest of this innovation

The proposal is addressed to students in Bachelor's degree programmes related to geology, the earth sciences in general, archaeology, history and the humanities. On a secondary level, given its cross-disciplinary nature, it might also interest teachers or future teachers of either primary or secondary school, in that they may adapt the proposal to use it for subjects that include the issues and knowledge from the different disciplines involved in this project.

1. Objectives

The project presents a transversal geology and archaeology course that was developed by the faculty and researchers linked to both disciplines from the Universitat Autònoma de Barcelona, plus at given points in the project from the Centre National de Recherches Scientifiques of Lyon, and from the Universidad Complutense de Madrid.

The goals of this project were:

1. To propose a transversal course that involves different areas of knowledge, poses an interdisciplinary research project, and sets the avenues of research needed to address it.
2. To experiment with a more practical and applied teaching methodology while historically and geologically discovering a specific zone.
3. To foster teamwork among the teachers and students involved.
4. To use the new technologies in the teaching of these disciplines.

2. Description of the project and methodology

At first the project consisted specifically of formulating a proposal for restructuring an undergraduate course. Implementing a course of this sort requires adaptation to the new curricula, which obviously exceeds any of our individual competences as it affects two Bachelor's degree that must both be willing to tackle this challenge. Therefore, here we only present the course itself, leaving the issue of its inclusion in the future curriculum to the corresponding bodies.

This project would not be so successful if the UAB had not given us the chance to teach an elective university subject. The proposal was submitted in February 2007, and the course was taught during the first term of academic year 2007-08.

This is a six-credit course called: *Geology and the Megalithic: From Theory to Practice*. Based on the experience of having taught it, we shall explain the results of the project.

2.1. Organisation of the project

The cornerstone around which the proposed subject revolves is a specific case study: the research process to determine the provenance of small stones used to build the megalithic sepulchre of Puigseslloses (Folgueroles, Osona).

For this reason, the project was approached in two different yet logically indissoluble parts:

1. Conducting the research
2. Drawing up a congruent course similar to the research process that provides the elements needed for students to resolve the problem posed.

2.2. The research

The research process was divided into several different parts, namely:

1. General description of the megalithic sepulchre of Puigseslloses, surveying and integrating studies that were already published.
2. Study and individual description of the slabs making up the sepulchre.
3. Geological cartography of the area in the county of Osona that includes materials that might have been from the area that was the source of the slabs.
4. Development of the general stratigraphic column of the mapped materials and detailed columns on the zones where there are outcroppings of materials similar to that of the slabs.
5. A petrologic study of the material of the slabs using the permit by the heads of the restoration of the monument which has been underway while this project was being developed.
6. A petrologic study of the materials in the outcroppings identified as possible source areas and a comparative study with those from the monument (Arribas et al., 2006).

The teamwork among the two groups of professors, archaeologists and geologists, enabled us to witness two different ways of approaching a problem and two kinds of language, as well as the complementariness and opportunity to match these two visions from different vantage points. However, this same situation also arose, writ large, among the students, as in elective courses students come from a wide variety of fields. In our case, students from three different curricular tracks registered in the course.

2.3. Organisation of the subject

The structure and development of the research served to achieve the goals sets:

2.3.1. To propose a transversal course

The course is a basic introduction to both certain historical-archaeological problems related to the use of geological resources by prehistoric communities, and especially the techniques needed to resolve these problems. The aspects that were dealt with were a transversal way of framing questions, such as the discovery of a territory and its resources (in this case, mainly geological) and how they have been used by human communities at some point in history.

In order to achieve this goal, and with the intention of avoiding theoretical discourse as much as possible, the course was organised around a specific focal point or, if you

will, around a specific historical and geo-archaeological problem that needs a specific research strategy to be developed: determining the stone materials used to build the large megalithic sepulchre of Puigseslloses (Folgueroles, Osona) and determining their source-areas of provenance.

In the case of Geology and the Megalithic: From Theory to Practice, the course was for six credits, 1.5 for were theory and 4.5 for practice.

Professors from the Bachelor's in Geology and Archaeology helped to teach this course.

The syllabus (topics and associated workshops) was designed to give students the knowledge and skills they needed to resolve the problem posed. It is shown in Table 1.

Table 1. Syllabus broken down into topics and workshops

TOPICS	WORKSHOPS
Topic 1. Introduction to geo-archaeology	
Topic 2. The use of mineral resources in prehistory and studying them	
Topic 3. The supply of raw materials to build megalithic sepulchres. Introduction to the case study: Puigseslloses (Folgueroles)	
Topic 4. Rocks	Rock recognition workshop
Topic 5. Sedimentary rocks	Workshop on recognising sedimentary rocks
Topic 6. The topographical map	Workshop on topographical maps
Topic 7. The geological map	Workshop on geological maps
Topic 8. Aerial photography	Workshop on interpreting aerial photographs
Topic 9. Forms of managing other mineral resources in prehistory: Ceramics	Ceramics workshop
Topic 10. Forms of managing other mineral resources in prehistory: The stone industry	Stone industry workshop
Topic 11. Anthropology	
Topic 12. Physical properties and the alteration of materials in monuments. Conserving stone monuments.	
Topic 13. Final discussion. Analysis of the results	

The sequence of topics has changed and can change according to the location of the field trip.

The contents that were taught went from more general to more specific and necessary for resolving the problem posed. For example, a theoretical vision of all types of rocks was supplied, stressing the ones that primitive humans mainly used in their activities (siliceous rocks, quartzite, argillaceous, etc.). After this, we moved on to a more specific explanation of sedimentary rocks, which are the ones used to make the dolmen, although the students taking the course are not yet aware of this.

The transversality of this course is clear not just from the diversity of the topics but also from the relationship between geology and archaeology.

2.3.2. To experiment with a more practical, applied methodology

The choice of a specific topic around which the course should revolve constantly led us to deal with a real problem which students need a set of theoretical but also, more importantly, practical knowledge to resolve. It is not enough to have theoretical knowledge of rocks, rather students who might come from different degree programmes also have to touch them and know how to visually recognise them. What is more, this section of the course also includes a study of a thin slice of rocks via a polarised light microscope.

The students have to acquire the abilities and skills that enable them to manipulate the information learned in the theoretical classes. For this reason, the course has a higher number of hours devoted to practical work (4.5 credits versus 1.5 credits for the theory).

Along these lines, we thought it was coherent and necessary, given the fact that both the theoretical and practical sessions revolve around a specific monument located relatively close to campus, that a visit to this monument would be conducted during the course (Figures 1 and 2) in order to discover its geological setting, learn about other possible sites of archaeological interest nearby, etc. In this way, both students an professors could see and discuss the work underway and the working hypotheses formulated *in situ*.

Figures 1 and 2. Field trip: students work at the monument and one of the outcroppings

In order to conduct the fieldwork, a dossier or field guide was drawn up that indicates the stops along the way. At the start of each stop, the goals to be achieved are set forth and then a series of explanations and questions are given to help students achieve the goals.

We should also stress the close relationship between the field and laboratory practices. In this case, the most obvious example is with the topics related to geological mapping: topographical maps, geological maps and the interpretation of aerial photographs. Before the field trip, students were taught the theoretical notions of orientation and topographical maps, and they even got glimpses of the zone of interest via aerial photographs that gave them a stereoscopic vision of it. In the field, GPS was used. Each student carried a topographical map of the zone where they had to pinpoint all the stops and where they started to draw up an incipient map of the materials found in the outcroppings at each stop. Once back in the lab, they continued to complete the geological maps with the aid of the aerial photograph.

The third type of practical task included in the proposal focused on a practical study that the students must conduct. With the help and guidance of the faculty, and at a basic level, they must submit a study on a megalithic monument that is located near them (near their family home, where they live now, etc.). To do this, they are given a sheet with the main points that they must fill in.

If the schedule permits, it is a good idea for them to present their studies to their classmates.

2.3.3. To foster teamwork

We should bear in mind that the students registered in the course come from different fields of study, which at first might seem like an obstacle. Plus, breaking the ice can be difficult at first if there are larger groups from the same field.

We got around these problems in the following ways:

1. By trying to ensure that the students who had prior knowledge on certain topics shared it with the other students who did not have this knowledge. This was captured in the practical laboratory work.
2. By trying to ensure the field trip to had a positive influence on creating closer relationships by car-sharing, lunch time, etc.
3. The proposal of a practical study in which the students chose the monument and had to describe its geological setting required them to try to group together with people from other disciplines

2.3.4. To include new technologies in this study

The course has a website : http://geoarq.uab.cat

The homepage contains the following:

1. Introduction:

Projects: The projects based on which the proposal for this transversal subject got underway are listed, as well as the people who participated in developing the project.
2. Course: Brief description of the course.
3. Faculty: The people who teach the course.
4. Syllabus: A list of the topics dealt with in the course.
5. Materials: In this section, students are given a user name and a password that enables them to enter this space, where the course materials are uploaded.
6. Classrooms and *Timetable: Information on where and when the course is taught.
7. Bibliography: General bibliographic citations are provided. This section also contains an exhaustive list of links with geo-archaeological references on the Web.

Likewise, the News section features information on congresses or activities being held related to the field of geochemistry.

2.4. Evaluation

We suggested ongoing assessments, where the following are taken into account:
1. Turning in the exercises assigned on time.
2. Turning in the exercises done in the laboratory.
3. Turning in a report on the field trip based on the observations and work they conducted during it.

Students who wish to raise their final grade also have the possibility of taking a final exam.

3. Results

Putting the proposed transversal course into practice during the first term of academic year 2007-08 enabled us to state that the students were capable of following and participating in the research process that led them to describe and establish the provenance of the stone elements used to build the megalithic sepulchre of Puigseslloses (Osona). The historical-archaeological problem was framed and the theoretical and primarily practical elements that were to serve as the basic tools for students to follow the research process were introduced from the very start.

The field trip served to illustrate the skills and abilities acquired by students in this course, as they were capable of:
1. Applying the contents from the different theoretical topics at each of the stops.
2. Orienting themselves.
3. Locating Puigseslloses on the topographical map.
4. Pinpointing where each of the stops was using the GPS.
5. Describing the architectural structure of the sepulchre.
6. Identifying and naming the conserved parts of the sepulchre.
7. Identifying the rocks that make up the megalithic sepulchre.
8. Remembering which archaeological materials were recovered from the sepulchre.

9. Drawing up a basic stratigraphic column.
10. Describing and identifying the different rocks observed at the different stops along the route.
11. Arguing at which part of the stratigraphic column they were at in each stop.
12. Describing the sedimentary and tectonic structures.
13. Deducing which type of loose blocks correspond to these structures and arguing what they might be used for.
14. Comparing the materials at the different stops with the ones used in the sepulchre.
15. Working in a group.

3.1. Survey

In order to objectively measure all the subjects dealt with, students were given a survey to evaluate them more precisely. The questions along with the percentages obtained are shown in Table 2.

With regard to the development of the course, students were asked to evaluate the sessions devoted to each topic as excessive, appropriate or too little. In this case, the results enable us to more finely tune the best number of sessions for each topic. The table only shows the results for the field trip.

4. Conclusions

With this proposal, a transversal course was organised between geology and prehistory. It was put into practice as an elective course.

It is a course which poses a specific problem, which students then resolve by developing and practically applying the different study and research methods that are most suitable.

The proposal therefore included a field trip, although it is true that with two field trips the course might be better rounded, despite the fact that the laboratory practices helped us to optimise the time spent on the field trip. In any event, the second proposed field trip would partly be used to get to know the Episcopal Museum of Vic, where the finds discovered during the excavations of the Puigseslloses sepulchre are on display.

The course had an extensive team of professors who did not just ensure that the explanations of the different methods and techniques used were thorough, but also enabled students to be exposed to a wide range of perspectives and proposals. Given the agreement among the professors participating in this experiment, this plurality entailed no difficulties when planning the contents of the workshops or evaluating the students.

Until now, the results have been highly satisfactory, as we believe that the students showed a high degree of involvement once they understood what they were being asked to do and what this entailed.

Table 2. The survey and its results

PROFESSORS				
The number of professors was	excessive	appropriate **88.9 %**	insufficient	blank **11.9 %**
The diversity of the professors was	excessive	appropriate **88.9 %**	insufficient	blank **11.9 %**
The coordination among the professors was	good **22.2 %**	appropriate **66.6 %**	poor	blank **11.1 %**
STUDENTS				
The different backgrounds of the students was an element that was	positive **88 %**	unimportant **12 %**	negative	
DEVELOPMENT OF THE COURSE				
In your opinion, including a field trip was	appropriate **100 %**	doesn't matter	unnecessary	
In your opinion, one day for the field trip was	excessive	appropriate **55.5 %**	too little **44.4 %**	
Your expectations of this course were	exceeded **78 %**	partly met **22 %**	not met	
During the course, your interest in the subject has	increased **87.5 %**	remained the same **12.5 %**	waned	
Do you think that the ratio of theoretical and practical was appropriate?	yes **88 %**	no opinion **12 %**	no	
GOAL OF THE COURSE				
In your opinion, the goal of the course is	interesting **100 %**	no opinion	not very interesting	
In your opinion, the organisation of this course into workshops was	interesting **78 %**	no opinion **12 %**	not very interesting	

It is true that continuing the endeavour with another project would help to improve and increase the digital material available to students and increase the number of possible examples, namely, megalithic sepulchres in Catalonia linked to their geological setting, in order to share them with students, since it is impossible within the normal duration of a course to visit all the sites.

In any event, with regard to the strictly educational aspects, the goal of giving students insight into the problems and working methods of such different disciplines yet ones that together can resolve specific problems was met. In this sense, we believe that the students found the course a very positive experience in terms of concepts like transversality, interdisciplinarity, teamwork and a more practical, applied methodology. The results gleaned from these surveys show widespread acceptance and satisfaction on the part of the students who took this course.

References

ARRIBAS, M.E.; VICENS, E.; ESTRADA, R.; CLOP, X. OMS; O. and MAESTRO, E. (2006). «Estudio de la procedencia de los materiales de construcción del dolmen de Puigseslloses (Folgueroles-Osona, Barcelona)». *Geotemas* vol. 9, pp. 35-39. Salamanca. ISSN: 1567-5172.

ESTRADA, R.; CLOP, X.; VICENS, E.; ARRIBAS, M.E.; OMS, O.; MAESTRO; E., OBRADOR, A.; ALVAREZ, A.; SERRAT, D.; ANFRUNS, J.; BORRELL, F.; GUERRERO, E.; MOLIST, M. and SANÁ, M. (2006*). Propuesta de una asignatura transversal entre Geología y Arqueología***.** Book of proceedings of the XIV Simposio Enseñanza Geología/ Símposio Ibérico do Ensino da Geologia / XXVI Curso de Actualizaçao de Professores de Geociências. Theoria Poiesis Praxis. Universidade de Aveiro. Portugal.

ESTRADA, R.; CLOP, X.; ALVAREZ, A.; ANFRUNS, J.; BORRELL, F.; GUERRERO, E.; MAESTRO, E.; MOLIST, M.; OBRADOR, A.; OMS, O.; SANÁ, M.; VICENS, E.; ARRIBAS, M.E. and SERRAT, D. (2006). *Geología y Arqueología: Propuesta de una assignatura transversal*. Abstract from Papers rom the 3rd Campus Conference on Teaching Innovation. Bellaterra.

Interesting link

- Innovation website: http://geoarq.uab.cat [2008]

Keywords

Prehistoric archaeology, geology, transversality, cultural heritage, dolmen.

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Supplementary materials on the CD-ROM

Demonstration of the GEOLOGY AND MEGALITHISM website: virtual tour of sections of the website and examples of the materials used for this course.

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Presentation of the project leader and the working group

Maria Rita Estrada Aliberas, project leader, is a member along with several other members of the team in the Research Group on Teaching and Disseminating Geology (GREDGEO). She has also participated along with members of this team in other teaching innovation projects financed by the Generalitat de Catalunya revolving around optimising field practices using multimedia.

Internationally, she is participating along with Aureli Álvarez and Xavier Clop in the «TRAINMONHER» project financed by the EC – INCO Programme –(SSA – Multilateral) - VI FP 518697_SSA_20051215154333.CPF

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Workbook of practical exercises in hydrogeology and water resources in an interactive format

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Abstract

In the field of the earth sciences, cartographic material, databases and numerical calculation methods are presented simultaneously. This workbook of practical exercises on the topic of hydrogeology, developed to be interactive, includes maps, texts, images, databases and spreadsheets aimed at enabling students to better perform the proposed exercises, as they have all the documentation they need in a high-quality format. With the purpose of making it more interesting for students in fields related to hydrogeology and water resources, the exercises were developed using real and up-to-date data and problems in Catalonia, enabling us to capture the complexity of water management in the country and assess both its potential and its limitations.

General area of interest of this innovation

This project is targeted to students who aim to interpret hydrological concepts based on real problems. It is organised into a general syllabus in the area of hydrogeology, so that the simpler cartography or data interpretation problems (those from an introductory course) can be resolved with their corresponding calculations by using real data, with all the added value this entails.

1. Objectives

Meaningful learning at universities is facilitated when the contents are interrelated and organised around each other, in addition to when they have points in common with students' past experiences. Along these lines, if activities are planned that start from

what the students already know and with experiments that require both physical and intellectual activity, this contributes to producing meaningful learning. Furthermore, if students are also given activities that require them to apply what they have learned in new situations, this will foster relevant learning (Murillo, 2003).

To this end, the material targeted at classroom problems or practices is a crucial cornerstone for students to grasp the theoretical concepts taught in the theoretical classes, and at the same to for them to learn conceptual and procedural contents that can hardly be acquired without performing practical activities. In courses that deal with the physical environment, such as the earth sciences, a gradual explanation of the concept — from both the theoretical and the practical perspective — is needed, plus it is absolutely essential that they be identified and assessed in the field where real problems exist. Specifically, the hydrogeological aspects that are dealt with in this proposal are an important vector in the field of applied and environmental geology. Given the importance of water resources in the day-to-day management of the environment, an issue that is subjected to political purposes which often have poor scientific and objective underpinnings (in reference to certain aspects of the National Hydrological Plan approved in 2001, as well as other debates on water conveyance), proposing study tasks with real cases and data enables students to also gain awareness of and shape their attitudes towards these problems.

Therefore, in the case of the disciplines related to water resources, the three-phase teaching schema (concept, classroom/laboratory practice and field experiment) is valid and should be used in the curriculum. Nevertheless, for a variety of reasons, field practices in themselves are insufficient and provide neither a comprehensive perspective nor enough experience to train future professionals, whether they be geologists, environmentalists or land engineers. For this reason, we must often replace field experience with classroom practices in which the use of a range of media —— maps, graphs, photographs, data tables and calculation tools— is indispensable. This diversity of material requires complex, exhaustive preparation, which is not very common.

The goal of this project was to draw up a workbook of practices in the field of hydrogeology and water resources that would include all the teaching materials students would need to properly grasp the problem or practice to be resolved, and that would simultaneously include practical aspects that are geographically relevant to the students: in our case, about Catalonia.

In view of the different formats of the materials needed –maps, texts, databases and spreadsheets– the most convenient way of drawing up a workbook of practical exercises was by computer, which would make possible interactive access to the different levels of information and working tools. Planning this workbook as a «website», then, was the most appropriate way to resolve the practice and ultimately ensure that students comprehend and learn the material the best.

2. Description of the project

2.1. Methodology of the workbook

In order to achieve the goals set forth above, the following methodologies were used:

1. Choosing the main concepts that appear in the guidelines for the curricula in Geological Sciences and Environmental Sciences for the students to whom this workbook is targeted, and then developing a set of exercises that enable students to conceptually grasp and resolve real problems within the geographic setting of Catalonia.
2. To draw up a series of conceptual problems that enable students to understand and delve further into the theoretical concept.
3. To document the exercises with maps, images, data and all the supplementary information needed for proper learning to take place. To prepare spreadsheets in MS Excel that help students resolve certain problems.
4. To use computers, in the form of a website (html format) as the best way to present the material so that students can interact with all the documentation they might need to resolve the exercises.

3. Results

The contents of the project in its final phase consisted of a compendium of exercises in a website which constituted the Workbook of Practical Exercises on Hydrogeology. This web-based environment is broken down into the following sections, which are reached from an initial portal:

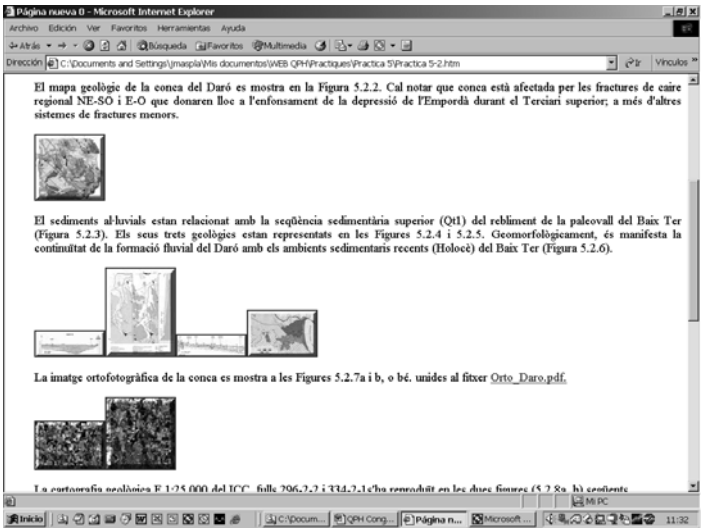
1. Introduction to the workbook: Purposes, goals and contents.
2. Practical exercises: A total of six topics developed as the syllabus (Figure 1):
   a) Introduction to water resources in Catalonia
   b) The hydrological cycle and the water balance
   c) Infiltration
   d) Surface hydrology
   e) Aquifers and geology
   f) Hydrogeology: Piezometry
   g) Hydrogeology: Catchment
   h) Seawater intrusion
   i) Hydrochemistry
   j) Transport of solutes in subterranean waters.
3. Glossary: A definition of the most important geological terms that appear in the practices and their translation into English.
4. Bibliography: References to the most important reference books as well as maps, articles and laws.
5. Links: Electronic addresses of state and international websites in the field of hydrogeology.

In terms of the website format, this format offers the following possibilities, which can be divided into the strong and weak points of this teaching proposal:

3.1. Strong points

- The possibility of accessing any part of the general contents from the homepage or any of the sections.
- Each practice includes a brief theoretical explanation, a selection of problems and the exercises based on the real hydrogeological properties of Catalonia. From each part, users may interactively access figure, maps, orthophotomaps, text documents, databases and templates in MS Excel. Figure 1 shows an example of how the images/maps are presented, which users can then expand or copy.

Figure 1. Example of a map query



- All the databases and spreadsheet templates are in MS Excel, so they are easy to use. The templates enable users to see the programming used in the different cells to solve numerical problems. These templates are appropriate for making routine calculations such as the real and potential evapotranspiration (Thornthwaite method), studying maximum flow using the Gumbel method, analysing standard pump tests, representing hydrochemical graphs and resolving equations on the transport of pollutants, among others.

- There are links to other websites that might be interesting for getting more data or expanding on certain aspects of the problem.
- The real databases for a given exercise help students to do a practice with cases that are geographically more familiar to them and therefore more engaging. One example is the study of the flows of the Ebro river in light of the proposals set forth in the 2001 National Hydrological Plan.
- Having more comprehensive material enables students to learn more about the subject of the exercise and therefore increase the total time they spend on the individual work.
- The students have favourably rated the possibility of connecting to selected websites related to the subject and the savings on costs on photocopying that this has entailed.

3.2. Weak points

- Some types of materials are difficult to check. Specifically, the exercises only contain fragments of the maps that need to be checked, which were previously scanned from the paper publications. This makes it impossible to check the entire map and, more importantly, its legend. In this sense, the general opinion is that having the information digitalised is a step forward compared to having to share a paper map among several students, although perhaps keeping one copy of the original map in the school library to be checked is also a good idea. The use of the cartographic resources (topography, orthophotoimages and geological map) from the Cartographic Institute of Catalonia (website: http://www.icc.cat) makes this task easier, despite the fact that the legends are always more extensive on the paper maps, especially geological maps at a scale of 1:25,000 which are not available interactively.
- The use of real data was appealing, although in some cases it meant an added difficulty given the fact that they represented more complex hydrogeological behaviours and dynamics than the kind found in the synthetic cases that usually appear in textbooks. In this sense, the general opinion is that solving generic problems in the classroom with a teacher's guidance before analysing real cases is both necessary and profitable.

With regard to the time students spent on individual work, completing all the exercises contained in the workshop required more hours than if the credits for the course were evaluated according to the ECTS calculations. In this sense, a hierarchy of exercises and problems should be set at the teacher's discretion, such as between obligatory and optional exercises, according to the length of the course and the most important topics to be covered.

4. Conclusions

Developing the Workbook of Practical Exercises on Hydrogeology has made it easier to integrate all the documentation needed to resolve practical exercises on this topic, bringing classroom practice closer to reality. The effort to complement maps and orthophotoimages is reflected in students' heightened grasp of the hydrogeological problem, which enhances their training.

The experience enabled us to assess the strong and weak points of the teaching proposal, concluding that it is useful as an efficient individual work tool that is appropriate for distance learning.

References

DOMÉNECH, F. (1999). «El diseño de instrucción». In DOMÉNECH, F. (ed.). *Proceso de enseñanza/aprendizaje universitario*. Universitas, pp. 63-94.

LÓPEZ, F. (2005). «Cómo desarrollar clases participativas: claves para el éxito». In *Metodología participativa en la enseñanza universitaria*. Madrid. Narcea. Chapter 7, pp. 125-149.

MURILLO, P. (2003). «Formas de entender el aprendizaje de los estudiantes universitarios: teorías y modelos de aprendizaje adulto». In C. MAYOR RUIZ and C. MARCELO (Eds.). *Enseñanza y aprendizaje en la educación superior*. Barcelona. Octaedro-EUB, pp. 49-82.

Keywords

Hydrogeology, water resources, interactive format, new technologies.

Financing

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Supplementary materials on the CD-ROM

Demonstration of content of an interactive Hydrology field notebook and virtual tour of the practical components of the subject (includes maps, data bases, etc.).

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Presentation of the working group

The working group on innovation in research into hydrogeology is made up of the professors teaching this course at two universities, UAB and UdG. They teach courses on this subject in the Bachelor's in Environmental Sciences and the Master's programmes at both universities. Their research focuses on different aspects of hydrogeological dynamics and their environmental repercussions, from which part of the data compiled in the workbook of practical exercises was taken.

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Higher School of Engineering

Experiment applying a learning methodology for projects in computer engineering classes that better adapts to ECTS credits and the EHEA

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Abstract

This article presents an experiment performed in academic years 2005-06, 2006-07 and 2007-08 on Project Based learning (PBL) as one of the tracks for students in Computer Graphics 2, an elective course in the third year of Computer Engineering, a degree offered at the Higher School of Engineering (ETSE) at the Universidad Autónoma de Barcelona (UAB).

To manage the documentation that was generated in the class, we used an LMS (Learning Management System) platform based on Moodle, which we have used in PBL and which enabled us to more easily manage the indicators and surveys to evaluate the students.

General area of interest of this innovation

This project involved adapting the PBL to a course which might give guidelines to professors on how to apply this methodology in their own course, regardless of the size of the groups. Likewise, an LMS platform based on Moodle was presented that makes it easier to manage documents (surveys, turning in homework assignments, teaching materials, posting marks) and generate evaluation indicators without the processing of this material being too much effort. The platform is available to any UAB professors who want to try it, regardless of whether or not they use PBL.

1. Objectives

1. The quest for new teaching methodologies in the realm of higher education is a recent topic of discussion at universities. The changes being experienced in the

information society have conditioned the students attending universities, leading us to believe that the profile of students today is neither better nor worse than in the past, rather it is different. Society demands professionals with not just knowledge but also abilities and skills. This has spurred an open debate in universities about the quest for new methodologies to convey information and motivate students' learning, with the overarching goal of educating professionals who are adapted to this new society. One of the methodologies that has appeared in recent years at universities is project based learning (PBL).

2. PBL is a cooperative learning strategy that focuses on the student as an individual member of a group, and it views learning as a communication process. In PBL, the project guides the entire process; it is vehicle that enables the students to acquire the skills needed to learn. The students are in charge of their own progress, and the professors mentor their work.
3. The PBL methodology fosters the following professional competences in students: teamwork, the group shouldering the responsibility, critical thinking, initiative and searching for information, organisation and handling of structured information, oral and written communication.
4. There are many reasons justifying the adoption of the PBL methodology (Font 2004):
   a) **Practical reasons:** PBL fosters teamwork, thus promoting student initiative and the quest for information. PBL encourages knowledge to be learned by understanding it, not memorising it.
   b) **Pedagogical reasons:** It enhances students' learning through research, which encourages students to use all the resources at their disposal.
   c) **Student-centred learning:** Students are active agents in their learning and in resolving the project. They have to learn how to manipulate unstructured information. There is also the potential for innovation.
   d) **Conceptual value:** PBL facilitates interdisciplinarity.
   e) **Formative as opposed to punitive assessment:** Students have to learn from their errors. Either the professor, classmates or the students themselves evaluate their own learning.

Bearing all of this in mind, the goals of the project are:

1. To study the PBL methodology in order to adapt it in courses in the Computer Engineering programme to see whether this methodology improves students' performance in terms of their level of knowledge and skills, following the guidelines of the EHEA.
2. To make this adaptation with a minimum (or better yet, zero) cost, so that it is not an excessive effort for either professors or students.
3. To define and implement an LMS (Learning Management System) platform to manage the documents electronically (homework, surveys, teaching materials, etc.).

Below is an outline of the specific experience with a course: Computer Graphics 2.

2. Description of the project

2.1. Point of departure

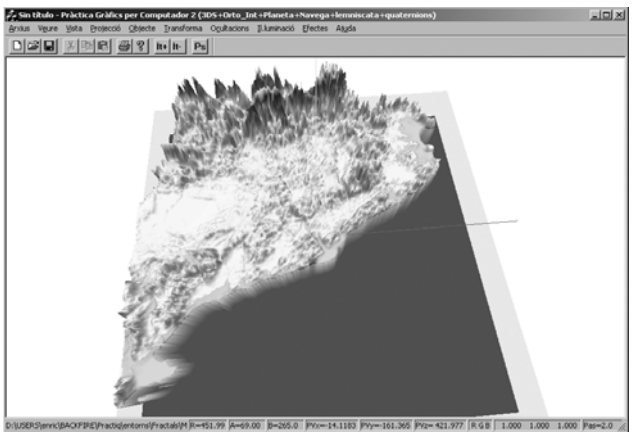
Computer Graphics 2 is an elective subject taught in the third year of the Computer Engineering degree programme taught at the Higher School of Engineering of the Universitat Autònoma de Barcelona. It is a class organised around 30 hours of theory, 15 hours of problems and 15 hours of practices. There are two groups of theory and problems (morning and afternoon) and six groups of practices, for a total of 150 students.

The students have already taken Computer Graphics 1, in which they learned the basic concepts of the subject. This course takes a deeper look at subjects related to modelling 3D objects, realism techniques and computer animation (Foley et al. 1993).

In the theoretical part, the course is organised as teacher-led classes (two hours per week). The problem part (one hour per week) is taught using Open Graphics Library, which is very often used in the world of graphic visualisation and videogames. Exercises are proposed to build objects based on primitive graphs, illumination exercises, textures, etc. The movement of rigid objects and articulated objects is also modelled within the part on computer animation.

The practices part of the class is organised into four laboratory sessions lasting 2.5 hours each. A graphic programming environment with minimal functionalities (Figure 1) is provide, based on which students add their graphic works gradually. At the end of the course, they turn in a single application with all their work.

Figure 1. Graphic programming setting with a topographic visualisation practice



The LMS platform (Caront 2008) and the website (GC2 2008) provide all the documentation: transparencies on the theory, documentation on OpenGL, instructions for the practices, the graphic programming environment, demos and corrected exams.

Based on the experience of teaching the course and the surveys administered to the students, we can reach the following conclusions:.

1. **Attendance at the theoretical classes drops over the course of the semester**. We believe that the fact of having provided all the teaching materials made attendance fall off. Nevertheless, this means that the students who do attend class are motivated.
2. **Attendance in the problems class did not drop so steeply**. The students consider posing, doing and resolving problems and the help with the practices in class useful and positive, which encourages attendance.
3. Each academic year, we notice that approximately **25 % of the practice groups show a significant interest in the course** and do more work than what is asked of them. These contributions enrich the course for the following academic years.
4. We can distinguish **different student profiles:** those who strictly want to *pass* the class because they are working or don't want to spend too much time on it, and those who want to *learn* and show a high level of interest in the course, as they are more highly motivated.
5. This is an elective course with many students (around 150), which can be taken in the third, fourth or fifth year of the degree programme, so the **students' knowledge and level of maturity fluctuate**.

2.2. Proposed tracks

In order to combine both student profiles, the course is defined into two different tracks: the TPPE (theory-problems-practices-exam) and the PBL track.

- **TPPE Track:** There are no teacher-led classes, so students only have to attend the problems classes (one hour per week) and the practice sessions (four 2.5 hour sessions). A term-long schedule of the topics to study is drawn up, students do the problems, attend tutorials to resolve their queries and take an exam at the end of the term.
- **PBL Track:** Two hours of the former teacher-led class are spent on tutorials for the PBL groups. Four groups of 30 students are organised (five sub-groups of at most six students). Each group has to sign up for one of the four timetables (M1, M2, T1, T2), in which M1 corresponds to the morning sessions of the odd weeks and M2 to the morning sessions of the even weeks. T1 and T2 follow the same pattern for the afternoon sessions. Therefore, each group of students has a tutorial with the professor every 15 days. This means that the PBL track can tutor up to 120 students (4 x 30) out of the total of 150 signed up for the course. The students pursuing this track attend the problems class but not the practice

sessions, and they do not take the final exam as their project is evaluated instead. In Section 3 we explain how this track works.

As can be seen, this double track does not mean a heavier teaching load for the professor compared to the previous course organisation. It does, however, mean a little more work in the tutorials and follow-up with the PBL groups, which is offset by fewer exams to correct, as the students on the PBL track do not take the final exam. Figure 2 shows the materials and activities for both tracks in the Caront platform.

Figure 2. Materials and activities in the Caront LMS platform for the courses two tracks: TPPE (left) and PBL (right)

3. Methodology

In this section we describe the methodology used with the students who took part in the PBL track. The students wishing to pursue the PBL track have to assemble into groups of four to six people – the students make their own groups. They sign up for one of the timetables (M1, M2, T1, T2), which corresponds to a tutorial with a professor every two weeks.

In the first group session, students are offered three projects, from which they have to choose the one they would like to do during the term. The explanation of each project is four to eight lines long. The proposal is generic, not very detailed and is followed by the learning goals that the professors want the students to deduce and use to resolve the problem.

Once they have chosen the project, the students have to consider and divvy up the goals and tasks among the groups members, also in the first session. Minutes must be taken at each meeting the groups holds (either with or without the professor), which should include the group's ideas, discussions and any agreements reached. These minutes must be handed in to the professor, which will enable them to keep track of the group work and how the individual students work as a group.

During the last week of class in the term, all the groups from the morning timetables meet in the morning session, and the same for the afternoon session, in order to defend their projects and hand in the documentation, which must include:

1. **Portfolio.** A report on the project which includes the goals, information checked, work performed and a small manual on the application developed. Students are given a template with a possible index at the start of the course.
2. **Presentation.** A document that contains the transparencies (at most 12) for the presentation. Students are given a template the start of the course.
3. **Computer application,** which corresponds to the solution to the project devised by the group. All the source files are turned in, and a demo version is made.

All of this documentation must be handed in electronically via the LMS platform (Caront 2008), and the portfolio is handed in on paper. The students make a 15-minute presentation for each project. The professor will have already drawn up an evaluation sheet where they rate the complexity of the project proposed by the group, their work capacity and the quality of the documentation, the presentation and the computer application. As a type of peer evaluation, the groups in the audience must also rank the best presentations by their classmates, without any points-based evaluation.

Twenty projects were posed, two of which are shown below. Other project explanations can be found in Martí et al. (2006).

3.1. Examples of projects

In this section we shall show two examples of proposed projects. In each example, the project explanations and teaching goals are shown. These goals are not shown to the students so that they do not condition their work. In the tutorial, the professor must fully encourage the group and only intervene or guide it when they see that the students are deviating far from the goals set in the project (Moust and Schmidt 1994).

The projects proposed by the professor aim to cover 60% or 70% of the syllabus of the course. There are 20 projects, including games, robot movement, airport simulations, amusement park rides, planets in the solar system and racetracks. Below, as examples, are the chess project and the simulation of an urban intersection with traffic lights and cars.

3.1.1. Project 1. Chess

1. Instructions:
   The Catalan Chess Federation hires you to make a graphic application that would visualise a chess match as realistically as possible, so that a match can be viewed like a film: in a continuous sequence or play-by-play forwards or backwards.
2. Learning goals:
   - **3D visualisation:** Definition of the board and the coordinates of each square on the board. Definition of different vantage points where the match can be watched.
   - **Modelling:** Modelling the pieces and the structure of the data to portray a configuration of pieces on the board.

- **Illumination:** Illumination of the scene, textures (pieces, board).
- **Movement:** Movements of the pieces on the board, resolving collisions in the tracks. How to eliminate pieces.

Figure 3. Design of the chess pieces. Board by a group of PBL students for Project 1

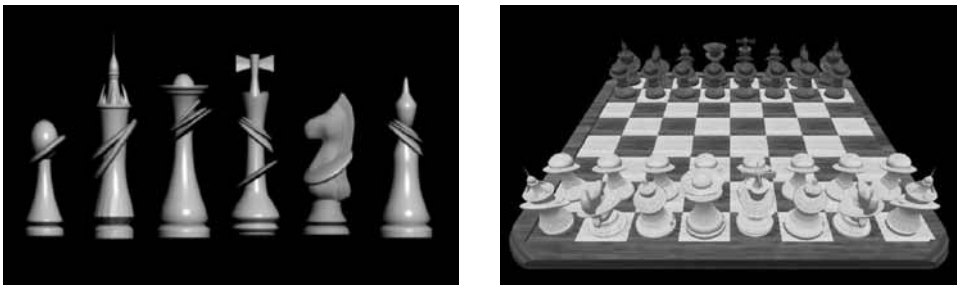


Figure 3 shows a sample from a PBL group from academic year 2005-06. In addition to achieving the goals, they made a personalised design for the pieces. In order to avoid collisions in movement, the pieces sink into one square and emerge in another one.

3.1.2. Project 2. Intersection

1. Instructions:
   The Barcelona Traffic Service asks you to develop a graphic application that enables them to simulate the interaction of roads with traffic lights so they can set the light times at each traffic light and the arrival of cars at the intersection. They want the scene to be portrayed as realistically as possible, visually speaking. The goal of this graphic tool is to verify that the traffic light timing is appropriate with regard to the frequency with which the cars arrive at the intersection in order to avoid congestion.
2. Learning goals:
   - **3D visualisation:** Definition of the types of cameras and their location.
   - **Modelling:** Modelling of cars and the intersection, valuing the fact that it can be configured.
   - **Illumination:** Illumination of the scene, ambient light, spotlights, sky.
   - **Movement:** Definition of the path of the cars and their arrival to the intersection.
   - **Additional concepts:** Queuing theory, arrival frequencies and service.

Figure 4 shows a project by a PBL group from academic year 2004-05, which enables the number of lanes at each stretch of the intersection to be set. The application defines different levels of detail of the scene. At the end of the simulation, statistics are drawn up.

Figure 4. Image of the application proposed by the students doing the «Intersection» project

3.2. Educational effort

For the TPPE track, the study effort for students is quantified in Table 1. It takes into account a 13-week term with one additional hour of individual study per hour of theory with a teacher, one additional hour for each hour of classroom problems, as well as two additional hours for each hour of practices with the professors, according to the evaluation of the Computer Engineering degree in the pilot project. Eighteen hours of study are added for the exam and 13 weeks. All of this yields a total of 141 hours, that is, 5.6 ECTS.

The PBL track uses project work. The effort for each student is shown in Table 2. It includes seven two-hour tutorials with the professor over the entire term, plus three hours per week of work searching for information, programming, etc. Attendance at the problems class is the same. As there is no exam, the hours to study for it are not included, and time is added to prepare the documentation.

In the PBL track, the students' educational effort in terms of the number of hours is lower, but we believe that it is higher quality time and effort on the part of the student. One of the additional advantages of the PBL track is that the work is done during the term without a final exam.

4. Results

In recent years, we have conducted anonymous surveys to assess students' opinion of the course, with a scale from one to ten points in three sections of the course: tuto-

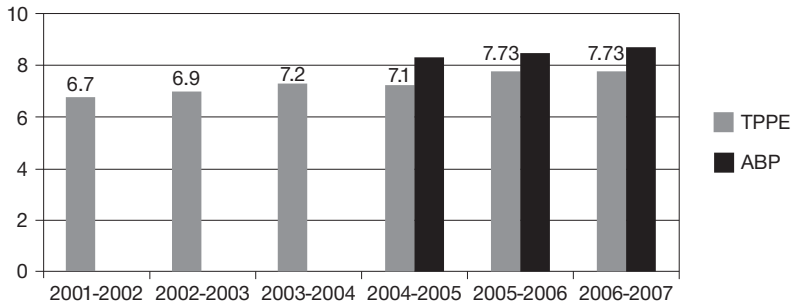
Table 1. Educational effort by students pursuing the TPPE track

	Professor-led class	Student study	Exam	TOTAL
Theory		4h x 13 = 52h	14h	66h
Problems	1h x 13 = 13h	1h x 13 = 13h	8h	34h
Practices	2,5h x 4 = 10h	5h x 4 = 20h		30h
			Total:	**130h (5.2 ECTS)**

Table 2. Educational effort by students pursuing the PBL track

	Professor-led class	Student study	Document	TOTAL
Theory	2h x 7 = 14h	4h x 13 = 52h	1h x 13 = 13h	66h
Problems	1h x 13 = 13h	1h x 13 = 13h		26h
Practices	2,5h x 1 = 2,5h			10h
			Total:	**102h (4.08 ECTS)**

Graph 1. Results of the surveys to rate the course (averages over 10)



rials with the professor, methodology and overall rating. The first surveys were administered minutes before the exam was to begin, which gave us a high number of samples. However, since academic year 2005-06, this survey has been conducted via the Caront platform [Car] and the students freely and anonymously responded after the end of the term. The results are shown in Graph 1.

For academic years 2004-05, 2005-06 and 2006-07, the students in the TPPE track were given the same survey as the previous years, while the PBL students were administered a different survey, although both had several questions in common.

We can see that the PBL students positively rated the experience, with scores over 7.5 out of 10. In the three years of this course, the ratings of students pursuing the TPPE track also rose. We can see a major drop in the number of responses from academic year 2006-07, because the course shifted from the third to the fourth year of the programme, and this led to a brief dip of 100 students (the students in the fourth year had already taken the class the previous year) and the elimination of the afternoon group.

5. Conclusions

Based on the proposal for a double track including PBL methodology in the course Computer Graphics 2, we can draw the following conclusions:

1. The choice of two tracks has prevented the professors from being overwhelmed, as might happened had all the students chosen the PBL track. Of the total of 150 students, between 50% and 75% chose the PBL track, and the others the TPPE track. We think it was positive to offer both tracks, as it has rewarded the initiative of the students pursuing the PBL track.
2. The lack of theoretical classes was not harshly criticised, given the fact that all the documentation was housed in the Caront LMS platform and the professors' availability in office hours was sufficient and appropriate.
3. Few PBL groups dissolved, and those that did so was because of a lack of time and commitment on the part of the members. These students joined the TPPE track without any problems.
4. The PBL students had a very positive perception of the figure of the professor. We believe that this class dynamic is more gratifying for the teachers and gives students more contact with them than in teacher-led classes.
5. We have noticed that the current evaluation system using marks quantifies knowledge but is not an evaluation of the skills developed in PBL. The students' files should also include an explicit assessment of the skills they developed, given the fact that the EHEA wants to foster these skills and competences.

Obviously, we believe that this experience cannot be extrapolated to all courses, classes and degree programmes. The professors must be familiar with the methodologies and experiences, as it is up to them to assess which are more appropriate for their course and to know how to adapt them. There is no unique or optimal methodology for everyone. In our course, PBL is positive for both professors and students. This experience, which can be improved on in the future, is our modest contribution to improving university teaching.

References

BRANDA, L.A. (2004). «El aprendizaje basado en problemas en la formación en Ciencias de la Salud». In *El aprendizaje basado en problemas: una herramienta para toda la vida*. Madrid: Agencia Laín.

FOLEY, J.D.; VAN DAM, A.; FEINER, S.K.; HUGHES, J.F. and PHILLIPS R. (1993). *Introduction to Computer Graphics*. Addison-Wesley.

MARTÍ, E.; GIL, D. and JULIÀ, C. (2006). «A PBL experience in the teaching Computer Graphics». In *Computer Graphics Forum,* 25(1):95-103.

MOUST, J.H.C. and SCHMIDT, H. (1994). «Effects of staff and student tutors in student achievement», *Higher Education,* 28:471-482.

Interesting links

- Innovation web site: http://caronte.uab.cat [2008]
- http://interact.bton.ac.uk/pbl/index.php: Index of universities, centres and subjects using PBL. [2008]
- http://dcc.uab.es/teach/a25011/c25011.htm: Website of the Computer Graphics 2 course. [2008]
- http://www.vidar.dk/vidar/vidpubre.nsf/: Master's in PBL applied to engineering problems taught at the University of Aalborg (Denmark). [2008]

Keywords

Project based learning, cooperative learning, LMS platforms, Moodle.

Financing

This project was financed by the AGAUR programme on Improving the Quality of Teaching at Catalan Universities (MQD) for 2005 (ID number 2005 MDQ 00246).

Supplementary materials on the CD-ROM

Demonstration of the CARONT website: virtual tour of TPPE (theory, problems, practice, exam) and PBL (project-based learning) teaching methods for the Computer Graphics 2 course.

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Presentation of the project leader

Lecturer at the UAB since 1992, with 22 years of experience as an educator. His areas of interest are graphic and interactive visualisation, computer animation and virtual and mixed reality, all applied to research and teaching. He is the coordinator of three elective courses: modelling and animation using Blender, basic and advanced courses on videogames and computer science and cinema, a cinema forum activity about social and ethical questions in computer science. The head of two teaching innovation projects (MQD2005 and UAB) and in the past three years, he has authored educational publications at national and international conferences and one publication in a major international journal.

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The virtual calendar of learning activities as an educational tool

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Abstract

The teaching methodology being promoted via the creation of a common European Higher Education Area means taking the student's work into account. In this sense, and in order to support students' learning process, a procedure was developed that involved drawing up calendars of activities based on teaching guides for courses that are already expressed in ECTS, that is, in which information is provided on how much time students should spend on both classroom and independent learning tasks. This article presents this process of transformation and the first experiences in using the learning activities calendars as a tool to help students adapt to the new teaching methodologies, foster the development of transversal skills such as time management and taking responsibility, improving aspects of specific competences, and, in short, make students active agents in their learning.

General area of interest of this innovation

The method of drawing up activity calendars that is presented herein might be useful for any professor who has to overhaul syllabi in accordance with ECTS to ensure that it is comprehensive and universally understandable. It might also be of interest as an example of the use of calendars, in view of using them as a tool for developing certain student skills.

1. Objectives

The ultimate goal of the study presented in this article is an educational environment in which ICT is used to support students' learning, and in which professors are in charge of guiding students in this process. The project's mission is to offer whatever is needed to draw up learning guides for courses around which the educational environment described above is organised.

Given the fact that this environment is more difficult to create in large groups where the professor/student ratio is lower, the study has striven to resolve the problems of creating learning guides for large classes. For example, the course Fundamentals of Computers from the Technical Computer Management and Systems degree was taken as the course used in this study, which is taken in the first year of the degree programme and in recent years has had an average of 200 students per class.

This project is addressed to students in the first few years of their degree programmes, because they are the ones that are likely to have the most difficulties learning how to manage their own time and take responsibility for their learning process, as well as because they are the ones that receive the least personalised attention. The ultimate goal is to achieve as easier transition between a more guided and directed educational system and one that requires a higher level of maturity.

The main goal is thus to offer students in large classes a learning guide that facilitates this process, as mentioned by Ribas and Velasco (2007). This goal can be divided into two partial goals in two different realms: developing the guide and developing specific, transversal skills in students. All of this is ultimately aimed at attaining a higher teaching level, which in turn translates into more effective learning by students, as well as into a rise in academic performance.

In terms of developing the learning guide, the goal is to create a procedure for generating calendars of learning activities (learning guides) based on the teaching guides in ECTS, and designing the «views» that are presented to the professors and students.

With regard to the students' goals, the idea is to give them more personalised attention, to improve the development of specific abilities that are related to practical skills and to make it easier for them to develop transversal skills that involve time management and taking responsibility and that foster a proactive attitude towards the learning process.

Therefore, the overarching goal is for students to take a proactive role in their learning, that is, for them to take action when they notice that their development is not following the guidelines set in the guide or when they have not done the activities they should have. In the end, the goal is for them to be aware of how their learning is evolving and to take actions that help them to keep progressing properly. With this, they will also take responsibility for the learning process and develop a commitment to achieving the milestones set for them.

In order to get students to adopt this attitude, it is a good idea to turn teaching guides into learning guides. This transformation means adapting the contents of the teaching guides and, ultimately, synchronising the learning activities and the resources needed to perform them.

2. Description of the project

With the introduction of teaching methodologies based on student work, we have had to adapt the teaching guides to the courses. In the Computer Engineering and Technical Computer Engineering degree programmes, these guides must include the goals, skills, syllabus and evaluation systems. Plus, this information must be complemented by additional information, such as the workload of each activity, the calendar of classroom activities, the professors and references to materials that are available for students.

The study that has been conducted took advantage of the teaching guides to draw up calendars of activities that students must complete. The calendars should make it easier for students to follow a given course, and they should also help them to organise their time accordingly.

The contents of the teaching guides are classified into those related to teaching and learning and those related to resources (professors, places and times, materials, etc.). Therefore, a way of synchronising activities with resources is presented in order to yield a calendar of activities for the corresponding course.

During the first term of academic year 2007-08, the calendar of classroom activities was used in the course Fundamentals of Computers from the Technical Computer Management and Systems degree. Taking advantage of this experience, a computer programme was developed to synchronise the activities on the teaching guides with the resources that are available for students of a given course in a given year. The hope is that for the forthcoming terms, each student can have an individualised calendar of classroom activities for each course they are taking.

2.1. Background

This study was based on a previous study conducted in academic year 2005-06 in which the model of a teaching guide for courses in the first few years of the Computer Engineering degree programme was analysed in order to determine whether it contained enough information for students to be able to draw up their own learning calendar. It is worth mentioning that, based on the fact that this degree was part of the pilot DURSI project on adapting the degree programmes to the EHEA, the teaching guides were already written in ECTS terms.

What is more, in certain courses with few students (fewer than 40), trials involving publishing the dates and times of all the classroom activities for the students had already been successfully run.

2.2. Implementation

With these experiences as the backdrop, a project aimed at improving teaching quality was launched with the goal of increasing the degree of individualised attention to students in the first year of the degree programme in order to get them to become more aware of their own learning process and make it easier for them to adapt to the new teaching methods.

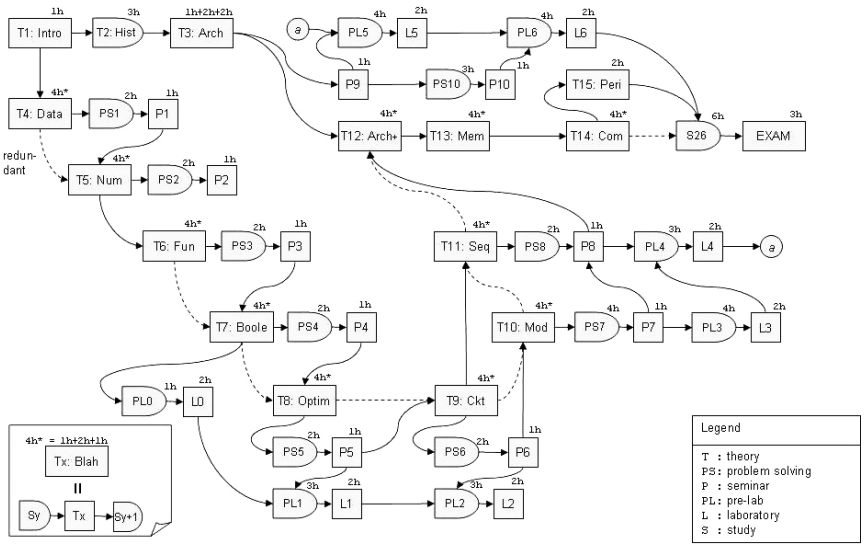
In the first year this project was applied, a series of tasks was begun, all of them aimed at offering students enough mechanisms for them to be able to easily track their own evolution during the course.

Therefore, efforts got underway to systematise the generation of learning calendars with views to future automation, as well as a preliminary trial as part of the course entitled Fundamentals of Computers.

Generating the learning calendars (Ribas *et al*. 2006) was organised so that first the information on the ECTS teaching guides would be studied and classified. Then, with the model extracted from this, a computer application would be developed that would try to synchronise activities and resources.

The division into learning activities and the resources needed to perform them resulted from the first stage. This separation enables professors to concentrate on designing a solid learning plan for students rather than on related details. This plan can be illustrated with a graph of activities in which the relationship (dependency) among the activities can be shown visually. Making the resources independent also means that it is a relatively constant element throughout the terms when the course is being taught.

Figure 1. Graph of learning activities in the Fundamentals of Computers course



Plus, all guides include «tables of resources» which indicate the resources available in a given term for a given course. These tables usually include a variety of resources of given lengths and times, such as the weekly timetables, which also shows the classroom and type of activity (theory, problems, lab practices, etc.). There are also tables showing a list of the professors with the type of classes they teach and their office hours, or others with links to the support material, such as Internet links and bibliographic references.

In the ECTS teaching guides, it is common to indicate a sort of «weekly learning cycle» which shows a timetable indicating not just the classroom activities but also independent learning activities. In this way, students have a clear reference to the work they are expected to accomplish.

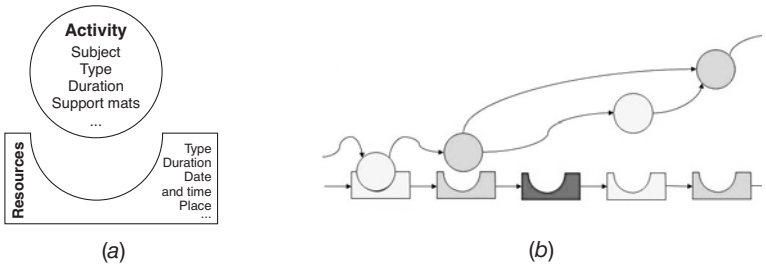
In short, the resources are grouped according to the type of activity. Unfortunately, the information is rarely presented in an integrated fashion, that is, in such a way that a single timetable includes the type of activity, the time it starts and finishes, the venue, the link to the support material and the professor in charge of it for each table entry. It should be said that this type of table could only be valid for a given set of students or, if independent learning activities are included, for each individual student.

The addition problem with the use of timetables is that they tend to be weekly. That is, they may vary throughout the academic year either because some activity may be held with a certain frequency (such as biweekly lab sessions) or because there are holidays, or indeed any other reason.

In this sense, when preparing the learning activities, it is a good idea to draw up a list of groupings of resources throughout the entire academic term in which a course is being offered.

Synchronising each of these groupings and the learning activities consists of associating each activity with the resources needed to perform it. This assignment can only be done if the group of resources is for an activity of the same kind, if the length of the activity is less than or equal to the amount of time available in the resources, and

Figure 2. The synchronisation between activities and resources (a) can leave some groups of resources idle (*b*)



(*a*) (*b*)

finally if this assignment does not break the sequences between the activities shown on the corresponding graph. (There might be more restrictions, but these are the basic ones.)

Formalising the synchronisation procedure has enabled it to be partially automated, as explained in the article by Pérez and Ribas (2007). The computer application that was developed does not take into account the independent learning activities, because this would mean having to include individual information for each student. That is, in order to achieve full synchronisation, we must take into account the groupings of resources that affect independent learning activities and that therefore depend on, among other factors, the students' extracurricular schedule.

Still, the synchronisation of activities and groupings of resources was manually systematised for the course Fundamentals of Computers in the Technical Computer Engineering (Management and Systems) degree programme. Additionally, the students' visualisation of the calendar was examined, using both ad hoc systems and virtual learning environments, such as set forth in the article by Moncada and Ribas (2007). The following section describes the methodology used in further detail.

3. Methodology

The goal was to increase the degree of individualisation for students in Fundamentals of Computers as a way of getting them to become more aware of their own learning process and help them adapt to the new teaching methodologies

In academic year 2006-07, this course, which is taught at the School of Computer Studies of Sabadell, was adapted to the ECTS teaching methodology, as were all the first-year courses. In addition to changes in the teaching style and students' way of learning, this also meant the chance to seek mechanisms that would enable students to better adapt to this kind of learning.

Since there was no automatic synchronisation system among groups of resources and activities, and since it was not feasible to synchronise them manually because around 200 students take this course, the decision was taken to make a calendar of classroom activities.

To ensure that the students would follow this calendar, we decided to publish all the support material on the calendar. In this way, the students had to go look for the presentations from the teacher-led classes, the lists of problems and the scripts for the lab sessions on the calendar. The goal was to make students more aware of their learning process. The other factor that was developed was the gradual creation of links. With this, in addition to contributing to the first goal mentioned above, the second goal was for students to also have a guideline that would clearly describe the independent learning activities. For example, before a problems seminar they had to download the corresponding list of problems and solve them. (These lists included the solutions, which the students could use as a guide.)

Finally, the calendar would appear as a table in which each row corresponds to a week and each column to a type of activity. Unfortunately, this is not the best solution, but it is the most feasible given the fact that it must be drawn up manually. Additionally, it is simple to interpret and easy for students to understand.

Figure 3. Start of the table that contains the calendar of classroom activities

Set-mana		Dies: Activitat	Tema		Seminaris	Laboratoris + projecte
1	24 09 07	25: T1-T3 27: T4 (I) 25: T1 (I) 26: T3	**T1. Introducció**. Història dels computadors.	**T3. Arquitectura dels computadors**. Organització general d'un computador. Arquitectura de Von Neumann. Estructura d'un processador: Memòria i CPU.		(Organització grups.)
2	02 10 07	04: P1 03: T4	**T4. Representació de la informació**. Tipus de dades. Nombres naturals i nombres fraccionaris. Canvis de base.		Problemari P1.	Oferta dels grups.
3	08 10 07	09: T5 11: P2 09: P1 10: T5	**T5. Representació de nombres**. Nombres binaris enters.		Problemari P2.	
4	15 10 07	16: T6 18: P3 16: P2 17: T6	**T6. Funcions lògiques.** Portes bàsiques. Expressions lògiques.		Problemari P3.	Assignació d'alumnes a grups.
5	22 10 07	23: T7 25: P4 23: P3 24: T7	**T7. Àlgebra de Boole.** Definició, propietats i teoremes derivats. Lleis de DeMorgan.		Problemari P4.	1. Presentació del projecte i eines.
6	29 10 07	30: T8 30: P4 31: T8	**T8. Optimització de funcions.** Maxtermes i mintermes. Representacions canòniques. Mapes de Karnaugh.		Problemari P5.	

In order to make the calendar, first we had to design the graph of learning activities, without the assigned resources, and then we had to assign days and times to each one according to the weekly timetable of the course.

In parallel, small applications were developed to synchronise activities and resources and to show the calendar with a module integrated in Moodle (www.moodle.org). In any event, this development only aimed to be an initial step towards a feasibility study for the end product, which in fact remained outside the scope of the project to improve teaching quality.

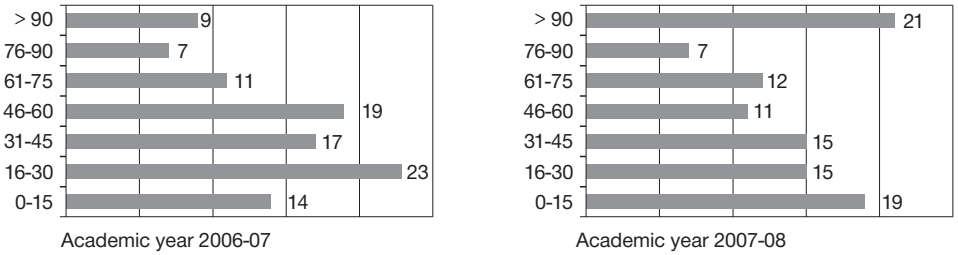
4. Results

Developing the synchronisation and visualisation tools for the learning calendars contributed a great deal towards organising the information that is provided in the ECTS teaching guides, and it has enable a set of XML files to be designed that can store all of the data involved in the learning process.

The calendar of classroom-based learning activities in the guise of a table was used in academic years 2006-07 and 2007-08. The students could check it via the area set aside for the course on the UAB's virtual campus. Students' tracking of the calendar was more than satisfactory. In both academic years, more than 60 % of the students checked the calendar three or more times per week on average. This means that they regularly downloaded the support material as it was activated. Unfortunately, no

figures were gathered that could serve as indicators of whether or not the independent learning activities were pursued. The professors' impression was that indeed the vast majority of students attended the classroom activities with the support material printed out, but that only a minority did the previous independent learning activities using the material provided.

Figure 4. Percentages of students according to number of hits on the calendar



However, the notable improvement in teaching was seen in the lower number of incidences and queries as to how the system works. Still, this was not due so much to the exhaustive planning as to the fact that it was in calendar format.

Finally, the positive news is the academic performance. In academic year 2006-07 5 % more students passed the course, and in academic year 2007-08 an additional 5 % passed, with one examination period still pending.

5. Conclusions

This study presents a systematic way of synchronising learning activities with the resources needed to perform them. To following this procedure properly, the information in the ECTS teaching guide should be suitably organised. In fact, what we achieved was to formalise both the structure of the information and the process of synchronising it, in an effort to present students with a learning calendar. Formalising the organisation of the teaching guide meant defining a series of XML files. However, even more importantly it meant being able to show the professors in charge of the teaching guides a coherent organisation which many of them already used intuitively.

Separating the learning activities from the resources needed to perform them also allows professors to focus on designing the learning instead of squandering time in details about the resources. Obviously, when preparing the learning guide for the students, professors must take into account the restrictions based on the groupings of resources they can make.

A small application to automatically synchronise activities and resources was developed, which obeys the principles of assigning resources to the activities that were

mentioned previously; that is, the association is made as long as the sequences among activities are not broken and the type and length are compatible. Unfortunately, the starting point of this application is XML files, which yield other XML files. Since this is a format designed to represent data and transfer them among applications, more than to interact with humans, one thing that must be done is to develop user interface programmes. With this purpose in mind, there is also a small application integrated with the virtual learning environment Moodle to show the calendar of activities.

Parallel to these efforts, a case study in the use of the learning calendars was also prepared and applied in the course entitled Fundamentals of Computers in the Technical Computer Engineering degree programme during academic years 2006-07 and 2007-08. Drawing up these calendars served to set the basic mechanisms for systematising them, which was then used to develop the applications mentioned above.
The overall goal of the project to improve teaching quality is to make it easier for students to adapt to the first few years of their university degree by offering them individualised attention. Especially in the case of courses with many students, such as Fundamentals of Computers, the mechanism that we tried to use is the learning calendar.

In academic year 2006-07, dovetailing with the first experience using a teaching guide, the result was positive in terms of students' academic achievement, as well as because the calendars contributed to lowering the number of questions on how it works. However, there was a great deal of inertia among the students who were repeating the course. In the following academic year, however, this did not take place and there were practically no incidents in terms of following the learning guide. What is more, academic performance improved a little more, and compared to previous years this improvement is significant.

In the forthcoming academic year, we hope to consolidate the good results of this experience. Efforts will also be made to improve the "visualisation" of students' learning process, most likely using a system of files containing activities with further detail that are as personalised as possible. We are confident that this new action will further strengthen this teaching tool, which, judging from the results to date, significantly helps students to achieve the goals of the course.

Full individualisation, with resources that will depend on each student, requires the synchronisation to be automatic. Even though this goes beyond the scope of the project aimed at improving teaching, it would highly desirable to be able to fully individualise these calendars in the near future.

References

DEPARTAMENT OF EDUCATION AND UNIVERSITIES (2006). *Pla pilot d'adaptació de titulacions l'espai europeu d'educació superior*. Barcelona: Autor. 14th of January. [website: http://www10.gencat.net/dursi/ca/un/eees_pla_pilot.htm]

MONCADA, J. L. and RIBAS, Ll. (director). (2007). *Adaptació d'un gestor de continguts per a agendes d'aprenentatge*. End-of-degree project in Computer Engineering. Bellaterra: UAB.

PÉREZ, M. I. and RIBAS, Ll. (director). (2007). *Agendas de actividades de aprendizaje*. End-of-degree project in Computer Engineering. Bellaterra: UAB.

RIBAS, Ll.; OLIVER, J.; TOLEDO, R.; VELASCO, A. J.; FERRER, C. and VALDERRAMA, E. (2006) *Del calendari de la planificació docent a l'agenda d'aprenentatge*. 4th International Congress on University Teaching and Innovation (Abstracts of papers). Vol. 2, pp. 632. Barcelona, 5th–7th of July.

RIBAS, Ll. and VELASCO, A. J. (2007). *La agenda de aprendizaje como herramienta de adaptación a la metodología educativa en ECTS del EEES*, XIII Jornadas de Enseñanza Universitaria de la Informática (JENUI). Teruel, 16th-18th of July.

Currently, learning calendars have been used for the courses Fundamentals of Computers in the Technical Computer Management and Systems degree, and students have access to the calendars via the UAB's virtual campus. On the website http://microlec.uab.es/ribas/edu/fc_euis, you can find the teaching guide for the course, with the calendar of classroom activities and the schema of a graph showing the learning activities that the students in this course must complete.

Interesting links

- http://microelec.uab.es/ribas/edu/fc_euis/ [2008]

Keywords

Teaching scheduling, student guides, time management, learning calendars.

Financing

This project was financed by the AGAUR programme on Improving the Quality of Teaching at Catalan Universities (MQD) for 2006-08 (ID number 2006 MQD 00105).

Supplementary materials on the CD-ROM

Demonstration of activity files for Basic Computing subject.

Project leader

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Presentation of the project leader

Lluís Ribas has been involved in issued related to organising teaching since 1997, especially on the issue of the use of ICT to facilitate students' learning. Based on the experience of the UOC (Open University of Catalonia), he worked on the concept of the calendar of learning activities, which for now has culminated in this article. He has also participated along with other professors on the working groups of the two teaching innovation projects mentioned above, on the first courses that were developed following ECTS criteria for the degree programme in Computer Engineering, as part of the DURSI pilot plan to adapt the degree programmes to the EHEA. Additionally, the author is the teaching coordinator of the first year in the Computer Engineering (2005-) and Technical Computer Management and Systems (2007) degree programmes.

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Developing virtual and interactive problems for learning microbiology

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Abstract

The Interactive Microbiology website promotes the learning of microbiology by resolving theoretical and/or practical problems. The material was designed to be used in the classroom, as well as for independent learning. The most noteworthy innovation is the integration of the theoretical and practical aspects, thanks to the fact that in addition to theoretical contents the website also includes a virtual microbiology laboratory where students can practice a variety of basic microbiology techniques with a simulation of the results. The website is targeted to students who are entering into contact with the invisible world of micro-organisms for the first time, that is, to students in their first or second year of the university degree programme that covers this material.

A prototype of this new tool was implemented as a pilot during academic year 2007-08 in the Microbiology course (Biology degree programme) and the Microbiology I course (Biotechnology degree programme). The evaluations from this first term show a high degree of acceptance by both the students and the professors who have implemented it. This evaluation also identified certain dysfunctions of the website which have already been corrected in the final version, which was also simplified and contains a variety of help resources. This tool, which is considered unique, will serve as the foundation for the development of future websites dealing with learning microbiology at a more advanced level.

General area of interest of this innovation

The development of this tool is interesting for both university professors and for teachers at other levels (secondary, baccalaureate and vocational education) who are involved in teaching microbiology. What is more, the idea of a virtual lab, as it has been developed in this project, may be applicable to learning any other discipline within the life sciences and other experimental sciences.

1. Objectives

The overarching goal was to develop a virtual space for learning microbiology where students could learn independently by resolving theoretical and/or practical problems, as well as to integrate theoretical and practical factors.

2. Description of the project

In order to accomplish the project, the work was divided into two phases:

2.1. Constructing the Interactive Microbiology website

This phase of the project was conducted from January to September 2007 in order to have the prototype of a website ready at the start of academic year 2007-08 and be able to conclude the definitive website from September 2007 to February 2008. Below is a summarised description of the steps:

2.1.1. Defining the formal spaces on the website

The thematic spaces on the website that correspond to the different parts of a course on microbiology were defined. Therefore, there is a space on the website for each of the following teaching units:

1. Introduction to microbiology techniques
2. Structure and function of the microbial cell
3. Microbial growth and control
4. Molecular microbiology of micro-organisms
5. Microbial physiology and metabolism
6. Virology
7. Microbial ecology
8. Microbial diversity

Plus, it was determined that each teaching unit would contain the following windows:

1. Problems
2. Laboratory
3. Resources
4. Multimedia
5. Gallery of images

In the Problems window, students begin their learning with problems, by working and resolving the theoretical and/or practical questions that are posed. In order to achieve these goals, students have at their disposal a microbiology lab equipped with the materials and apparatuses needed, with the content they will find in the Resources, Multimedia and Gallery of Images windows.

2.1.2. Defining the skills and contents of each teaching unit

In view of the type of student to which the website is targeted, the specific skills and content of each teaching unit were defined.

2.1.3. Devising problems and designing the microbiology laboratory

According to the skill to be developed, a variety of kinds of problem were drawn up. The website offers the following:

1. Practical problems that require an experiment in the virtual lab
2. Theoretical problems requiring chained logical reasoning
3. Theoretical problems that have to be solved by consulting the information provided in the Multimedia and Gallery of Images windows.

This type of resource came from the faculty who have participated in the project, or from the educational resources available from the American Society for Microbiology, the Centres for Disease Control and Prevention (USA) and other websites for educational purposes. In contrast, the material made available in the Resources window includes pdf documents drawn up by the faculty participating in the project and must be consulted by the students to solve the problems posed.

Likewise, the microbiology lab was also designed. It consists of a work station, a store of samples and a record on the manipulations that the student has done at the work station. Furthermore, the following windows were defined that contain all the materials, solutions and instruments needed for the experiments:

- Tools
- Apparatuses
- Material
- Pipettes
- Dilution solutions
- Liquid solutions
- Solid solutions
- Semi-solid solutions
- Tinctures
- Supplements

Finally, there is also an option to clean the laboratory when the student finish their experiments.

In order for the virtual experiment in the lab to be as realistic as possible, we had to assign a given specification to each type of material, solution, tool or equipment. For example, for a 1 ml pipette, the virtual pipette had to be able to measure out volumes of liquids between 0.1 and 1 ml. Another example, if you want to visualise microbial growth in a dish containing a nutritious solution which was previously inoculated with a microorganism, colonies will only be visible if the student has incubated the dish at the right temperature and for a given amount of time. Therefore, this part of the laboratory design was crucial for ensuring that the experiment proposed in the problems is feasible.

On this point, it was necessary to define which samples and which micro-organisms would be used in the virtual lab, and once chosen, to introduce into the programme all the characteristics and parameters needed for each micro-organism so that the simulated experiment could be as realistic as possible.

2.1.4. Developing aids and tutorials

In order to make it easier for students to use this tool, a variety of aids were developed that consist of explanatory tags about the use of some of the tools and materials in the microbiology lab. Tutorials were also included on how to perform the most basic microbiology procedures in the virtual lab.

2.1.5. Editor for adding new problems

One characteristics that makes this tool dynamic is the fact that the faculty can enter an editor and add new problems or to modify the existing problems. This enables each professor to adapt the website to the characteristics of the degree programme the students are in and to further emphasise a given type of concept.

You can see the Plana supplementary materials at plana.pdf and a demo of the website at: http://microbiologia.uab.cat/microbiologiainteractiva/(2008).

2.2. Introduction to the Interactive Microbiology website for microbiology learning

The second phase of the project consisted of applying the prototype website for learning microbiology. In academic year 2007-08 the students in the Microbiology course (Biology degree programme) and the Microbiology I course (Biotechnology degree programme) were chosen for the pilot test. Both courses are required and are taught in the second year of the first cycle of the degree programme. The Microbiology course is yearlong, and its syllabus includes all the teaching units on the Interactive Microbiology website, while the Microbiology I course lasts one term and covers five of the eight teaching units on the website.

Given the fact that the students to whom the Interactive Microbiology website is targeted are not familiar with the area of microbiology, the website was planned to be used in the classroom to gradually introduce the material, while also teaching students the basic microbiology techniques in the virtual lab. Later, as the course went on, the students had to use the website on their own as an independent learning tool. Provisions were made so that professor could activate or deactivate the different teaching units on the website, so students may only enter the space(s) that are relevant to the theoretical and practical topics being covered in the class.

Finally, in this phase we are currently evaluating the use of the website by both faculty and students in order to find out how useful it is for microbiology learning.

3. Methodology

The website was made using Macromedia Flash® v8. The images were processed using Adobe Photoshop CS, the web screens were edited using Macromedia Dreamweaver® v8, and the video capture was done using Autoscreen Recorder Free (Wisdom-soft).

4. Results

4.1. Introduction of the new tool in teaching

During the first term, the Interactive Microbiology website was accessible to a total of 381 students (82 from the Microbiology course and 299 from the Microbiology I course), and it was used in four theoretical groups and two classroom practice groups.

The introduction of the new tool in the learning process was a clear support for the professors when explaining what a microbiology laboratory is and for explaining the most basic microbiology methodologies and how they are used. In fact, the use of the website in the classroom, as well as independently by students, has gone a great deal to pave the way for the first lab practices, as well as for understanding them. Likewise, the professors of both courses have included in their presentations the different problems that are proposed on the website for each topic or teaching unit, which helps students to achieve the goals through a not just passive but also active learning procedure based on solving the problems posed on the website.

During this pilot test, several dysfunctions in the website were noticed, which have already been corrected on the final website that is currently available. What is more, help tags and tutorials were also including, following students' suggestions.

4.2. Evaluation of the website

In mid-December a voluntary questionnaire was administered to the students involved in this pilot test. The survey was conducted anonymously in the classroom, and 142 students in the Microbiology course and 53 in the Microbiology I course responded, which accounts for 47.5 % and 64.6 % of the students in each course, respectively. The results of both surveys are shown in the supplementary materials (Enquesta_Microbiologia 1.ppt and Enquesta_Microbiologia.ppt). In these documents, we can see that the opinion of the majority of students was that the website was a very useful or necessary tool to supplement the classes (80 % in Microbiology and 57 % in Microbiology I). The difference in percentages between the two groups of students was due to the fact that 26 % of the students in Microbiology I chose the option Other in response to this question, indicating that the website was useful. Despite the fact that the majority of students believed that the website was a good learning tool, only 26 % from Microbiology and

23 % from Microbiology I said that they used it more than six times. The main reason stated by many students to justify why they did not use the website as much as they wanted was a lack of time. There was also a high degree of agreement that the website helped them to better understand the concepts explained in the theoretical classes (74 % for Microbiology and 71 % for Microbiology I), the practical classes (79 % for Microbiology and 68 % for Microbiology I) and the classroom problems (58 % for Microbiology I). There is also a high level of agreement among the students with regard to the fact that the website developed is a good independent learning tool and that it should not be used to conduct online evaluations (75 % Microbiology and 81% Microbiology I). The students in Microbiology (53 %) found it more intuitive and user-friendly than the students in Microbiology I (42 %). Fifty-one percent of the students in Microbiology found the problems difficult, while 40 % consider their level to be appropriate. With regard to the students in Microbiology I, 42 % found the problems difficult and 48 % found them appropriate. Almost 50 % of the students experienced some sort of technical glitch (51 % in Microbiology and 43 % in Microbiology 1), while 20 % from Microbiology and 25 % from Microbiology I had no problems. When asked about the technical problems, the majority of responses referred to problems with the network but not with the website itself.

The results of the survey also revealed a series of areas that needed improvement on the website, as well as the need to provide help, such as the help tags that were designed for the definitive version.

Finally, it is also worth stating that the opinions of the professors involved in this experience were very positive, as the tool is attractive for students, easy to use and allows them to learn independently and practise in the virtual microbiology lab as much as they want. Worth highlighting is the opinion of the professors who teach the practice classes, as they stated that the use of the virtual laboratory before the students did the lab practices helped them to attain their goals and skills much better in the practical part of the course. This could be seen in the evaluation conducted on the last day of practices, as only three students doing the practices in the courses Microbiology and Microbiology I failed.

5. Conclusions

From the results from the pilot test implementing the Interactive Microbiology website in learning microbiology, we can conclude that the tool developed is attractive for the students, who rated it quite highly. In the final version of the website, the dysfunctions that were identified in the first few months that this resource was implemented were resolved, and the elements that students requested the most in the surveys, namely explanatory tags and tutorials, were added.

This problem-based learning experience, which combines theoretical with practical aspects thanks to the design of a virtual laboratory and simulations of experimental results, should serve as the foundation for developing new projects targeted at

students in more advanced microbiology courses. Furthermore, the experience may also be useful for learning other disciplines within the life sciences and other experimental sciences.

Interesting links

Innovation website: http://microbiologia.uab.cat/microbiologiainteractiva [2008]

Keywords

Website, microbiology, problems, virtual laboratory.

Financing

This project was financed by the AGAUR programme on Improving the Quality of Teaching at Catalan Universities (MQD) for 2006 (ID number 2006 MQD 00027).

Supplementary materials on the CD-ROM

Demonstration of the INTERACTIVE MICROBIOLOGY website: virtual laboratory in which experiments can be carried out.

Project leader

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Presentation of the working group

The majority of members of the team of professors participating in this project, as well as the professor in charge of it, have been teaching microbiology in different degree programmes at the UAB for more than 20 years. Furthermore, this faculty is also involved and in charge of the Microbiology specialisation track offered by the Biology degree programme in the Faculty of Biosciences. This specialty offers 112.5 elective credits, the majority of which correspond to the specific contents of microbiology and include credits for practices in companies and institutions in the field of microbiology. This faculty also coordinates and participates in teaching the Master's in Microbiology and the Doctorate in Microbiology offered at the UAB, which has earned a distinction for quality since academic year 2003-2004.

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Updating the teaching methods in animal and plant biology. Adapting to the EHEA

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Abstract

Until academic year 2004-05 the courses in the first cycle of Animal and Plant Biology (APB) in the Veterinary Medicine program, Biology III: Animal Life from the Environmental Sciences degree programme, and APB from the Biotechnology degree programme were taught using a methodology based primarily on teacher-led classes. Teaching these classes was considered complicated because of the size of the classes (the number of students per class oscillated between 90 and 120). Starting in academic years 2005-06 and 2006-07, a project got underway to improve the learning conditions and students' performance by updating the teaching methods, applying a new teaching model for APB and developing new teaching and audiovisual materials. The results show that the goals were amply reached, the students have very highly rated this new approach, and the number of students who both sat for and passed the courses has also risen considerably.

General area of interest of this innovation

The innovation presented in this article can be applied for teaching undergraduate courses that require students to memorise a great many concepts and that are taught in large groups. In particular, it might be of interest for any course related to the fields of Zoology and Botany, based on the success of the new materials and the virtual tools.

1. Objectives

The purpose of this project was to improve the learning conditions and students' performance by updating the teaching methods, applying a new teaching model for Animal

and Plant Biology and developing new teaching and audiovisual materials. The goal was to motivate students in the subject of APB and encourage their autonomy by developing the tools needed to improve the learning conditions in APB. In this way, the students could attain the skills needed for training in Animal and Plant Biology, namely:

- Getting to know the structure and organisation of the main groups of animals and plants and their diversity from the evolutionary standpoint, as well as the zoological and botanical taxonomy needed in the training of a veterinarian, and environmentalist or a biotechnologist.
- Applying this zoological and botanical knowledge in other courses in the degree programme by properly applying the taxonomical nomenclature learned and developing the manual skill of dissecting both invertebrates and vertebrates, and by recognising the different anatomical structures in the different animal groups.

2. Description of the project

The Zoology and Botany Units teach the courses on Animal and Plant Biology (APB) in the Veterinary Medicine program, Biology III: Animal Life in the Environmental Sciences degree programme, and APB in the Biotechnology degree programme, using a teaching methodology primarily based on teacher-led classes. Teaching these classes was further complicated by the large number of students (in teacher-led classes the number oscillated between 90 and 120). The students' largest stumbling block consists of the need to memorise a vast number of concepts and specific terminology. Until academic year 2004-05, the academic performance for the APB course in the Veterinary Medicine programme was that 40 % of the students FAILED the course (20 % of them did not sit for the final exam); for the Biology III course in the Environmental Sciences degree programme 54 % did NOT pass (18 % of them did not sit for the final exam); and for the APB course in the Biotechnology degree programme, 13 % of students failed.

With large groups, only a careful selection of guided activities for students to do, solid virtual support and an evaluation system backed by IT can help to overcome these stumbling blocks.

The need to achieve certain educational goals that involve acquiring not just knowledge but also academic and professional skills (Dochy and Moerkerke, 1977; Segers et al., 1999) led to the need to create new documents and teaching materials that could complement the ones that already existed. To this end, innovative APB teaching material was developed to foster independent learning processes and self-directed management of one's studies, which in turn involved implementing new methodological resources. However, the need to improve students' performance also meant that new learning tools and new teaching strategies applied to teaching APB had to be developed.

3. Methodology

During academic years 2005-06 and 2006-07, the following actions were taken:

1. Drawing up and purchasing audiovisual teaching materials that could be associated in a remote network: 14 DVDs on animal and plant groups transcribed in English and translated into Catalan (in classes, seminars and practices).
2. Using the virtual campus in the course to make specific teaching materials available to the students (calendar, bibliography, syllabus, specific information on specific topics, etc.). Updating the documentation handed out with new audiovisual material. Using the forum.
3. Planning ten theoretical-practical seminars on Animal and Plant biology for the Veterinary Science programme in order to set up active discussion sessions in the class: eight one-hour Animal Biology seminars and two two-hour Plant Biology seminars. Planning four theoretical-practical seminars on Biology III for the Environmental Sciences programme with questions and other activities to be done in groups and individually.
4. Developing a database of multiple choice questions to evaluate each subject or unit independently, as well as a final exam (Boud and Falchikov, 1989, Boud, 1995). The self-evaluation questionnaire was uploaded onto the virtual campus, and it consists of two types of 952 closed questions: true/false and multiple choice (10 %), in which only one option is correct. The questions were activated after the subject was taught and the corresponding seminar had been held (to ensure that they were used as a reinforcement and revision tool once the entire subject had been covered in class). They were offered as a reinforcement tool for students' knowledge acquisition.
5. Drawing up specific materials that have made guided teamwork possible (preparing basic material, guide to how to find information, supervision of the teamwork process, etc.): a glossary of 300 scientific terms was developed, the scripts of the videos and DVDs were transcribed to Catalan and/or English, as were the questionnaires for revising the videos; questions were drawn up to stimulate students' interest in each topic.
6. Fostering cooperative work in small groups under the guidance of the professor by performing a group task and helping each other. In each classroom practice session or seminar, the students worked in groups of four, bringing and handing out the glossary of scientific terms corresponding to the subject being examined in that session. The topics had previously been explained in the theoretical classes. The list of the terms for each topic was available from the start of the class on Virtual Veterinary Medicine Campus and/or the university-wide virtual campus. Likewise, the videos/DVDs were shown along with questions on the topics.

4. Results

The assessment of the results included a measurement of student performance as well as comparison systems between different methodologies and students' degree of satisfaction, which is revealed through surveys and other tools.

The results were:

1. The quality of the teaching materials improved, mainly due to a better use of IT, but also due to the adaptation and improvement of the traditional resources. Likewise, these materials were given a common use for both professors and students.
2. New teaching materials to support the courses were created:
   a) DVDs on animal and plant groups (14 lasting 45') transcribed in English and translated into Catalan (in classes, seminars and practices).
   b) Re-edition of the topics with the inclusion of the new digital materials acquired.
   c) Subject-based glossary for the AB part (300 terms in Catalan/Spanish to be defined by students in groups of four).
   d) 952 closed questions (true/false and 10 % multiple choice) on 32 topics, to be self-administered and self-evaluated.
3. A major impetus was given to teamwork techniques in the course by designing collective projects, guided activities and seminars. The collective activities which were alternated in the classroom practices/seminars included:
   a) Each group (four students) had to draw up a list of ten T/F questions on the topic or topics that were explained in the theoretical class with the correct answer circled. Time needed: 20 minutes. Each group's work was collected.
   b) Video screening: Each student was given a list of T/F questions on the video, which they had to answer as it was being shown. Time needed: fluctuated depending on video, calculating at most 30 minutes.
   c) In-class discussion on the glossary items, the questions drawn up by the other groups and/or the questions on the videos. Time needed: 20 minutes.
   d) The last part of the class was used for an individual evaluative test: students had to define two terms chosen randomly and respond to 10-12 T/F questions which the students had written or coming from the videos (one question per group chosen randomly).
4. Higher student motivation with regard to the contents and better understanding of the goals and methods of Animal and Plant Biology were confirmed.
5. The students' study environment was improved through digital self-evaluation materials and more personalised attention.
6. Sound independent learning practices were encouraged. Thanks to the self-evaluation questionnaire on the virtual campus, the students were able to practice and check on their knowledge in the subject, as well as revise the areas that needed more work. The students' ratings of the digital independent learning materials

were VERY POSITIVE (96 % of the 161 students surveyed gave them this rating).

7. Ongoing assessment of all the teaching activities was conducted. For example, for the APB class in the Veterinary Medicine programme, assessment was conducted as follows: (1) Assessment of lab and field practices: attendance at the lab and field practices and performance (the last 20 minutes of each practice the students had to individually answer a questionnaire about the practice which was used to continually assess their performance in the practice sessions) which accounted for 15 % of the final mark in the course. (2) Assessment of the seminars/classroom practices: assessment of attendance at the classroom practices and performance (individual assessments of each and classroom practice session), which accounted for 10 % of the final mark in the course. (3) Performance in the theoretical classes (evaluations on all three thematic sections of the course), which accounted for 75 % of the final mark in the course (each part accounting for 25 % of the final mark).

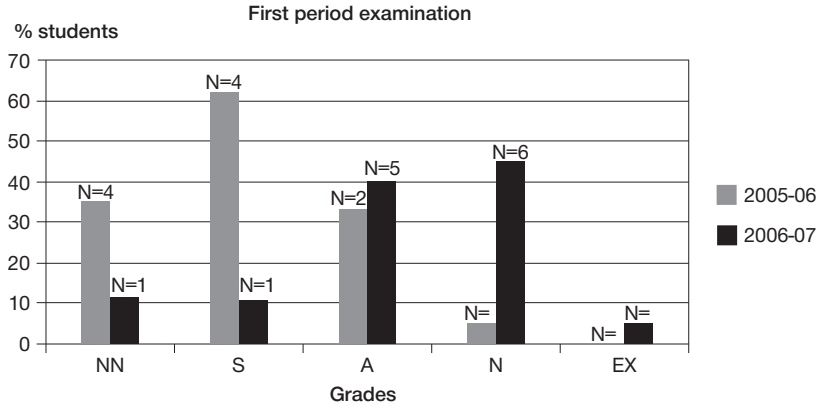
We managed to see a substantial improvement in academic performance in the APB courses in Veterinary Medicine and Biology III in Environmental Sciences. For APB, the percentage of students passing the course was 84 % for academic year 2005-06 and 93 % for academic year 2006-07, almost 24 % higher than in the previous three years. The percentage of students who did not sit for the exams also dropped considerably (from an average of 20 % in the previous three years to 13 % in academic year 2005-06) (Table 1). For the Biology III class in Environmental Sciences, the innovative experiment conducted in 2006-07 also yielded many fewer students who did not sit for the exams or who failed the class, and a significant rise in the number of students passing (Figure 1).

The coordination and fluidity of contact among the professors in charge of teaching Animal and Plant Biology also improved (from the fields of Zoology and Botany).

Table 1. Academic performance in the course on Animal and Plan Biology in the Veterinary Medicine programme during the last five academic years (2002-03 to 2006-07)

Grade	2002-03 %	2003-04 %	2004-05 %	2005-06 %	2006-07 %
MH (Distinction)	0.8	1.2	1.9	4.4	4.7
EX (Excellent)	2.4	2.5	4.7	9.8	5.4
N (Good)	13.5	11.5	14.4	37.6	58.1
Ap (Pass)	39.4	46.9	40.9	32.21	25
Superen assignatura	56.2	62.1	61.9	84	93.2
SS (Fail)	25.9	14.8	18.1	2.9	3.4
NP (Absent)	17.9	23	20	13.1	3.4

Figure. 1. Academic performance in the Biology III course taught in the Environmental Sciences degree programme during academic year 2005-06 using the methodology of teacher-led classes and in academic year 2006-07 using an innovative teaching methodology



The students' degree of satisfaction rose. The survey conducted to assess the teaching activities used in the course and the students' degree of satisfaction showed a VERY HIGH degree of satisfaction with the organisation and methodology of the course in 89 % of the students surveyed (169). Ninety-four percent of the students in both degree programmes surveyed stated that the ongoing evaluation enabled them to assimilate the knowledge and acquire the skills in the course much more effectively.

5. Conclusions

From these results, we can draw the following conclusions:

1. The real results far exceeded the expected results.
2. Students very positively rated the organisation and methodology used in the course.
3. The professors had a higher workload throughout the entire correction process in continuous assessment.

References

BOUD, D. (1995). *Enhanced learning through self-assessment*. London. Kogan Page.

BOUD, D. and FALCHIKOV, N. (1989). «Quantitative studies of self-assessment in higher education: A critical analysis of findings». *Higher Education*, 18(5), 529-549.

DOCHY, F. and MOERKERKE, G. (1977). «The present, the past and the future of achievement testing and performance assessment». *International Journal of Educational Research*, 27, 415-432.

SEGERS, M.; DOCHY, F., and DE CORTE, E. (1999). «Assessment practices and student's knowledge profiles in a problem-based curriculum». *Learning Environments Research*, 2, 191-213.

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New teaching methodologies, independent learning, Animal and Plant Biology.

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Supplementary materials on the CD-ROM
Demonstration of the Virtual Campus self-assessment tool applied to Animal and Plant Biology courses.

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Presentation of the project leader and the working group
All of the members of the group have extensive university teaching experience for more than 15 years (and up to 30 years in some cases). Maite Carrassón has participated in activities aimed at improving the quality of teaching since 1996 and has extensive experience coordinating teachers for both practices and theoretical classes. She has also organised activities on new teaching methodologies targeted to professors in her department. Fernando García del Pino, Sílvia Crespo and Sergi Santamaria have extensive experience in coordinating the Bachelor's and Master's programmes and developing virtual teaching materials in zoology and botany, among other fields.

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Design and application of a proposal for cooperative learning for the contents in the field of ecology through case studies

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Abstract

This article presents a web-based platform (http://www.creaf.uab.es/AprenEcologia/) containing 13 case studies with the goal of improving the learning of contents related to ecology in a variety of university degree programmes. The case studies can be chosen from the website based on their subject, although they are also categorised according to eight different educational criteria that can help each user chose the right case study depending on their goals, and allowing the professors who have used them to add their assessment. The case studies can be downloaded freely from the website by any user, and there is also the option of adding suggestions or assessments of how they work, as well as the ability to generate new case studies using a template. Most of these case studies have already been used in teaching Biology and Environmental Sciences at the UAB, and from the perspective of both faculty and students, they have been useful for learning the contents, both conceptual and methodological, of the different courses.

General area of interest of this innovation

In addition to the different areas of study that involve issues related to ecology in the organisation and approach of the project, this innovation might be useful in general for many different university courses on the sciences, as well as for baccalaureate programmes.

1. Objectives

The general goals of the project were:

1. To design a series of case studies that would bolster the efficiency of the learning of the contents and skills related to ecology for university students at a variety of levels and from different degree programmes.
2. To present the case studies on a web-based platform that would enable users, mainly professors, to get all the material they needed, as well as an implementation guide for using the case study in their teaching.

The skills that are honed in the different case studies are not always the same, plus they can fluctuate in each case depending on how each teacher decides to use the case studies. For this reason, the information on each case study outlines the different skills that are meant to be practised in each specific case.

2. Description of the project

2.1. Background of the innovation

The need for this innovation emerged from the response by a group of professors in the Ecology Unit at the Universitat Autònoma de Barcelona to a series of shortcomings detected in our students' learning of the ecology contents in the Biology and Environmental Sciences programmes. We noticed how often the successive courses in this field of knowledge repeated the same syllabus with increasing degrees of complexity, but leading students to lose motivation when faced with concepts that they did not identify as new. The field of ecology is particularly sensitive to this due to its conceptual load. One alternative to this situation is the gradual acquisition of knowledge and skills using practical tools that are familiar to the students, taking advantage of some of the qualities of the young generations (Internet, visual communication, languages, etc.).

For years, the Ecology Unit in the Department of Animal Biology, Plant Biology and Ecology at the UAB has been conducting experiments with the goal of increasing students' active, practical learning. However, despite the positive results of many of these experiments, certain problems also came to light:

1. A great deal of time must be invested in acquiring the information.
2. It is difficult to share the professionals' vision.
3. Evaluation is difficult unless it is performed based on pre-established cases.
4. There is an overall lack of planning of the goals, methods and evaluation.

This series of problems could be improved via the proposal described herein, that is, by ensuring that part of the teaching practice of ecology revolves around case studies with different levels of specificity and methodologies. The case study methodology seemed appropriate because it is a practice that in many different settings has demonstrated its vast educational potential, especially because of its ability to foster reflective learning and to facilitate the understanding of complex issues. Case stud-

ies enable students to not just recall information and methods, rather it also helps them to know how to apply them within a specific context: «students have to know not just the "what" but also the "when", "where" and "how"» (Dochy, Segers and Dierick, 2002). Its main characteristic as a teaching method does not lie in the fact that it uses cases, rather in how these cases are dealt with. The core of this methodology is discussion, the possibility of developing questions, comparing positions and putting into practice theoretical and practical concepts using dialogue. Therefore, as a method it does not work in itself, rather it depends on teachers who know how to use it in all its potential, professors who are capable of generating an interesting, reflexive educational atmosphere (Blythe, 1999).

2.2. Characteristics of the innovation

In this field, we consider that learning in ecology based on the globalising approach provided by the case study method allows for: cooperative work, active learning, realism, application of the knowledge in different contexts, transversality with other disciplines and the integration of knowledge and skills. Therefore, the content of this innovation involves the development of working techniques based on case studies in order to gradually organise the acquisition of knowledge and skills in the field of ecology within the Biology and Environmental Sciences degree programmes. Each case study has a description that includes its goals, a proposed guide for conducting the case study and all the materials (maps, databases, diverse documents) for conducting it in the classroom. The case studies can be chosen from the website based on their subject, although they are also categorised according to eight different educational criteria that can help each user choose the right case study depending on their goals. The case studies can be downloaded freely from the website by any user, and there is also the option of adding suggestions or assessments of how they work, as well as the ability to generate new case studies using a template.

3. Methodology

Thirteen case studies were designed focusing on the contents of ecology that were to be resolved by students in different degree programmes and at different university levels. The case studies are presented on a website: http://www.creaf.uab.es/Apren Ecologia/2008.

Each case study has a guide sheet for conducting it that contains the following sections:

1. *Title of the case study*: This refers to its content.
2. *General introduction*: This tells for what type of students and class/group the case study was designed, and some defining element is highlighted.
3. *Description of the case study*: The case study is categorised according to eight strands or characteristics related to their contents or the skills they hone. Each character-

istic has a variety of alternatives, which are indicated for each case study and are not necessarily mutually exclusive, as shown in Table 1.

Table 1. Characteristics used to define each case study

Characteristic	Possibilities of each characteristics
Type of course	Compulsory – elective
Conceptual complexity	Abstract or concrete
Applicability of the concepts	Basic or applied
Information management	Acquisition, critical analysis or transmission of information
Type of skills	Transversal, scientific or specific to ecology
Professionalisation	From low to hight
Analysis of dynamics	Pattern interpretation, process modelling, prediction
Degree of formalisation of problems	Qualitative, semi-quantitative or quantitative

4. *Goals*: The learning goals for the case study are explained.
5. *How to conduct the case study*: A proposal is offered for how to conduct the case studies indicating the different associated materials for examining it (these materials can be gotten by clicking on the name). In some cases, these materials are for the professors themselves, but the majority are there to help the students solve the case study.
6. *Evaluation*: Each case study proposes the evaluation system used in our classes as well as other possible systems. The goal was to offer different evaluation tools with special attention to formative evaluation, self-evaluation and peer evaluation as a sound complement to traditional evaluation systems (Brown and Glasner, 2003).
7. *Time*: This indicates the amount of time needed by both professors and students, specifying in-class work or individual independent study or group work.
8. *Notes*: This includes possible difficulties or factors to bear in mind, often based on the experience of having used the case studies in our classes.
9. *Supplementary activities*: Suggestions for supplementary activities or possible modifications in how the case study is conducted that might help to improve the learning of certain aspects dealt with in the case study.

The website is designed so that the professors can freely download each case study and apply them to the class without having to make virtually any changes. Table 2 lists the case studies, and Table 3 shows their categorisation according to Table 1.

Table 2. Titles of the 13 case studies generated

Case	Title
1	The ecological foundations of ecological agriculture
2	Atmospheric CO_2, global warming and effects on the biosphere
3	Proposal for forest management
4	Effects of herbivore behaviour on plant species and communities
5	Population dynamics of the forests in Collserola
6	Proposal for a plan to biomonitor atmospheric pollution
7	Analysis of factors that influence infections on the leaves of holm oak trees
8	The plasticity of the leaves of holm oak trees
9	Hydraulic properties of the xylem of different woody Mediterranean species
10	Readings on conservation biology
11	Endocrine disruptors: «new» water pollutants
12	Proposal for post-fire forest management
13	The sludge from waste water treatment stations

Figure 1. General appearance of the http://www.creaf.uab.es/AprenEcologia/ website showing the catalogue of titles of the different case studies on the left

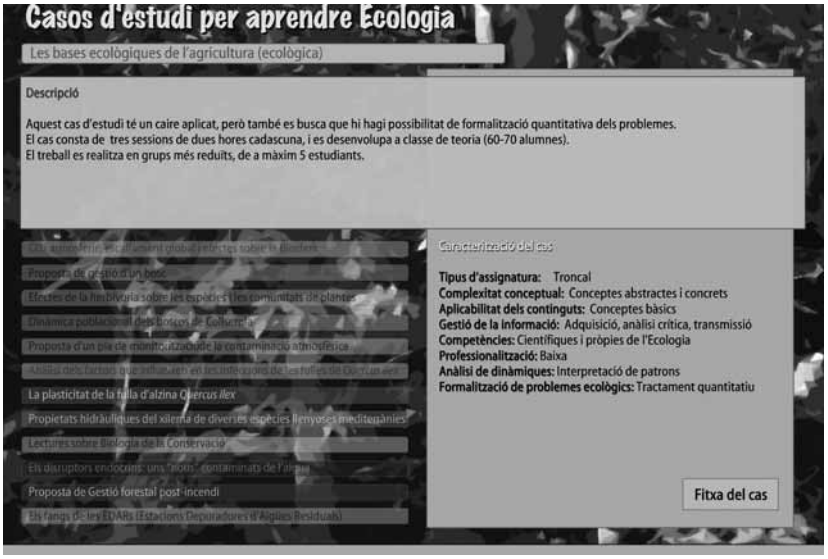


Table 3. Main characteristics of the 13 case studies designed according to the classification on Table 1 (case study number according to Table 2).

Case	Course	Concepts	Application	Information	Competences	Prof.	Analysis	Formalisation
1	Compulsory	Abstract and concrete	Applied and some basic	Analysis	Ecology	Average	Interpretation and modelling	Quantitative
2	Compulsory	Abstract	Basic and some applied	Analysis	Ecology	Low	Interpretation, modelling and prediction	Quantitative
3	Compulsory	Concrete	Applied	Analysis and transmission	Ecology and transversal	High	Interpretation and prediction	Quantitative and qualitative
4	Compulsory	Abstract	Basic	Analysis and transmission	Ecology scientific and transversal	Average	Interpretation	Quantitative
5	Compulsory	Abstract and concrete	Basic	Analysis and transmission	Ecology scientific and transversal	Average	Interpretation	Quantitative
6	Compulsory	Concrete	Applied	Analysis and transmission	Ecology and transversal	High	Interpretation	Quantitative
7	Compulsory	Abstract	Basic	Analysis and transmission	Ecology and transversal	Low	Interpretation	Quantitative

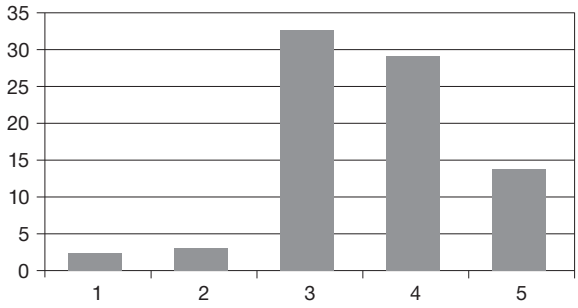
	Cours	Concepts	Application	Information	Competences	Prof.	Analysis	Formalisation
8	Compulsory	Abstract	Basic	Analysis and transmission	Ecology and transversal	Low	Interpretation	Quantitative
9	Compulsory	Abstract	Basic	Analysis and transmission	Ecology and transversal	Low	Interpretation and modelling	Quantitative
10	Elective	Concrete	Applied	Analysis	Ecology and scientific	High	Interpretation	Qualitative
11	Compulsory	Concrete	Applied	Analysis	Ecology and scientific	High	Interpretation	Qualitative
12	Compulsory	Concrete	Applied	Analysis and transmission	Ecology	High	Interpretation and prediction	Semi-quantitative and qualitative
13	Compulsory	Concrete	Applied	Analysis	Ecology and scientific	High	Interpretation	Qualitative

4. Results

4.1. of case studies in the practices on General Ecology in the Biology and Environmental Sciences programmes

Case studies 4, 5, 7, 8 and 9 (Table 2) have been used in the practical classes of the General Ecology course in both Biology and Environmental Sciences programmes. However, in this case data that the students themselves gathered in the field were used instead of the databases presented on the website. In fact, this type of field trip in groups of 20-25 students and lasting an entire week has been part of this course for many years. The students' assessment of the usefulness of these practical experiences in learning ecology is quite positive (Figure 2).

Figure 2. Number of responses from students in the fourth year of the Environmental Sciences programme according to their degree of agreement (1 - not at all to 5- totally) with the statement «The second-year ecology practices were useful for my learning of ecology».

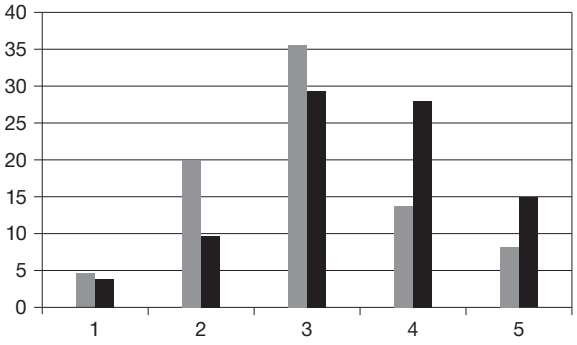


Likewise, the type of formative evaluation proposed in these case studies helps students to attain different competences related to ecology and scientific learning in general (Rodrigo and Ecology Unit, 2006).

4.2. Application of case studies in the theoretical classes on General Ecology in the Biology and Environmental Sciences programmes

Case studies 1 and 2 (Table 2) were used in academic year 2005-06 in the theoretical classes on General Ecology in the Environmental Sciences programme. These case studies are meant to be used in theoretical classes (60-70 students) with the primary goal of supporting the learning in the theoretical syllabus of the course. As shown in Figure 3, in this course, too, the students viewed these case studies as useful for helping them to understand the theoretical contents of the class, as well as to see the usefulness of the course and, therefore most likely to increase their motivation.

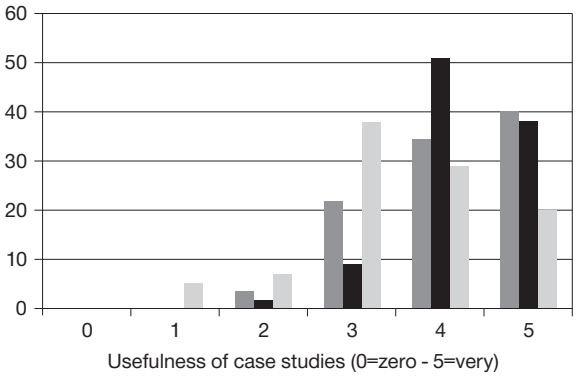
Figure 3. Number of responses from students in the second year of the Environmental Sciences programme in academic year 2005-06 according to their degree of agreement with the statement «The case studies have helped me to more clearly see the usefulness of the course» (black bars)



4.3. Application of case studies in the theoretical classes on Applied Ecology in the Environmental Sciences programme

Case studies 3, 6 and 12 have been used since academic year 2005-06 in the theoretical classes of Applied Ecology in the Environmental Sciences programme. Their goal is to apply the contents and methodologies taught in a specific class, as well as to guide students in doing a project in the course that consists of resolving a similar case, but one that they have to pose and resolve independently. In order to analyse the result of this case study, we rated the students' perceptions. According to them, the three main

Figure 4. Number of responses from students in the fourth year of the Environmental Sciences programme in academic year 2007-08 according to their degree of agreement with the statement «The case studies are useful for helping me understanding the conceptual contents of the course» (grey bars); the statement «Case studies are useful for tackling the project you have to do independently» (black bars); and the statement «The case studies might be useful for my future professional activity» (soft grey bars)



goals were fulfilled: the cases were useful for helping them to understand the concepts, for knowing how to use the process in another real case, and even, though to a lesser degree, for their future professional activity, an important goal for a course in the fourth year of the degree programme that aims to be applied (Figure 4).

A comparison among the courses in terms of numerical results of the final marks is quite difficult, especially in this course. For example, we could compare the marks earned for the independent project in the course in which the case study was not done in class and in those in which it was done in class, but the problem is that the project itself was altered. However, one figure that might be illustrative is the percentage of students who did not do the project, that is, those who received an incomplete in the class. Before doing the case study in class, the proportion was 17 % and 14 % in academic years 2003-04 and 2004-05, respectively, whilst after doing the case study in class there is a now solid trend in which practically all the students do the project, with incomplete rates of 9.8 %, 5 % and 5 % in academic years 2005-06, 2006-07 and 2007-08, respectively.

5. Conclusions

The main conclusion is that working based on resolving the case studies proposed improved attainment of both the specific Ecology skills and the general scientific and transversal skills. We can say that the exercise of applying the different knowledge and skills involved in resolving these case studies has enhanced the consolidation of these contents by students, while it has also improved their perception of their competence in Ecology.

Specifically, in the teaching of Ecology in the Biology and Environmental Sciences programmes at the UAB, we can claim that working with the case studies included in the project:

1. Has reinforced the students' knowledge about basic aspects of the syllabus.
2. Has consolidated more general scientific skills such as: resolving scientific questions based on rigorous discussions, which are in turn based on data, logical reasoning, formulating hypotheses and analysing statistical results.
3. Has been useful for working on transversal skills related especially to writing reports and doing oral presentations, as well as the skills involved in group work and taking joint decisions.
4. Has improved students' overall attitude towards the course.

From the teaching standpoint, the case studies designed are useful for the professors because:

1. They improve the monitoring of the learning process and students' understanding of the material.
2. They make it easier to implement different types of evaluation, including self-evaluation and peer evaluation. This way of evaluating enables teachers to detect gaps in students' knowledge or misunderstood ideas in order to correct them during the learning process itself.

3. They make it easier to including small-group tutorials; in the cases when these sessions have been added, they have proven to be a powerful learning tool for students.
   In terms of the case studies themselves, when applying them we have detected the following two needs:
   a) There need to be more case studies that involve modelling and predicting instead of just analysing the information. These would most likely be cases designed for small groups in elective courses.
   b) There need to be more cases based on animal populations in aquatic and marine environments.

References

BLYTHE, T. (1999) *La Enseñ anza para la Comprensió n*. Buenos Aires: Paidós Editores.

BROWN, S and GLASNER A. (2003) *Evaluar en la Universidad. Problemas y nuevos enfoques*. Madrid: Narcea, S.A.

DOCHY, F.; SEGERS, M. and DIERICK, S. (2002) «Nuevas vías de aprendizaje y enseñanza y sus consecuencias. Una nueva era de Evaluación». *Boletí n de la red estatal de Docencia Universitaria* 2(2): 13-29.

RODRIGO, A. (2006) *El treball de les competè ncies científiques en les prà ctiques de camp d'Ecologia.* Paper presented at the 3rd Campus Conference on Teaching Innovation at the Universitat Autònoma de Barcelona, September, Bellaterra (Barcelona).

Interesting links

- Innovation website: http://www.creaf.uab.es/AprenEcologia/ [under construction]

Keywords

Case studies, ecology, formative evaluation.

Financing

This project was conducted with AGAUR financing for projects aimed at Improving the Quality of Teaching at Catalan Universities (MQD) for 2005 (ID number 2005 MQD 00170).

Supplementary materials on the CD-ROM

Demonstration of the website *CASE STUDIES FOR LEARNING ECOLOGY*: virtual tour of materials for "Atmospheric CO_2, global warming and effects on the biosphere".

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Presentation of the working group

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The subject «Human Body and Health» in teacher training

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Abstract

The reason why we decided to conduct this project on teaching innovation in the training of future education professionals is because they are the ones who have to tend to the new realities among our children, over which factors that determine health play a role, such as lifestyles and social influences associated with the fact that the childhood development years are a key point for the acquisition of habits and attitudes.

This project acts on the need to provide in pre-service teacher training knowledge on how the body works and help to promote and protect health as well as to prevent health risk factors.

Through a variety of innovative actions in the teaching methodology, we try to empower participants to manage their own health as well as to gain better knowledge and use of the health resources in our environment.

General area of interest of this innovation

This innovation could be of interest to all students in their pre-service teacher training in the different specialities, as well as in the diploma programme on social education and the Bachelor's in Education. It could also be part of the continuing education of teachers aimed at augmenting their capacity for innovation and adapting to changes.

1. Objectives

The goals of the project correspond to actions aimed at teaching innovations in the course Human Body and Health which are needed to resolve aspects of the current situation, such as:

1. The time of generational change. That is, «How to convey the experience acquired?» The teachers have to reach an agreement on how to work in class.

2. To foster an increase in the level of scientific training of students in the teacher training speciality programmes in the Faculty of Education. This knowledge is quite lacking, especially knowledge that would could be included in the realm of biohealth. There are around 200 students in this course divided into several different groups.
3. To ensure that the educational proposals in this realm are the result of cooperation among professionals in the fields of education and health, taking the following criteria into account: Knowing how to make the teachers the main agents in the school classroom, providing the means so they can share experiences with health professionals, giving more knowledge to make the education in habits and values linked to healthy lifestyles, and finally seeking a balance between school life and specific, occasional and evaluated programmes.

The overarching goal of the project is to view the culture of health in terms of the capacity to control one's own health based on studying how the body works as well as knowledge of the resources around us in order to make rational use of them.

This general objective is based on the following specific goals of the contents and teaching methodology:

1. With regard to the contents:
   a) To produce teaching materials aimed at improving the training and performance of students in their knowledge of how the body works.
   b) To raise students' awareness of their control over their own health.
   c) To train students for knowledge and rational use of the health resources around them, such as healthcare services.
2. With regard to the teaching methodology:
   a) To use and foster the use of the UAB's virtual campus.
   b) To train students to manipulate apparatuses and use tools in an educational experimental sciences laboratory.
   c) To stimulate teamwork as a skill that is needed in order to work with other professionals in the fields of education and health.
   d) To foster students' participation and creativity in making sure that education in habits and values tied to a healthy lifestyle.

2. Description of the project

In order to describe the innovative actions, we shall present the background and justification for the course Human Body and Health. This course is compulsory in the Primary School Teacher Education degree programme and elective for other specialities within the Faculty of Education at the UAB.

1. Background. The course Human Body and Health got underway in academic year 1992-93 in the Faculty of Education at the UAB in the speciality of Primary School Teacher Education as a compulsory course. In the following academic year, 1993-94 it was included as an elective course in the curriculum for earning

the teaching degree in other specialities. This course was the result of the transformation of the course on Human Biology which was introduced from academic year 1981-82 until academic year 1991-92 in the Primary School Teacher Education degree programme as a compulsory course.

2. Justification. The legal provisions and laws in force call for a course on the Human Body and Health Education in the educational system, which is why it was included as a course in the curriculum for earning the teaching degree in a variety of specialities.
3. The legal provisions and institutional guidelines include the following:
   a) The 1978 Spanish constitution, article 43.3.
   b) The Organic Law organising the educational system (LOGSE), 1990, articles 8 and 13.
   c) Royal Decree 1006/1991 (Official State Gazette 26.6.91) on «Minimum teaching in primary education» and in Royal Decree 1007/1991 (Official State Gazette 26.6.91) on «Minimum teaching in secondary education»...
   d) In the development of its competences in the realm of education, the Generalitat de Catalunya has issued:
      - Decree 79/1990 dated the 20th of March 1990 (Official Catalonian State Gazette 1280 from 18.4.1990), approval and application of the Health Education Programme at school, stressing its introduction in pre-service and continuing teacher training.
      - The legislative texts that refer to the organisation of the educational system, Decree 94/1992 and Decree 95/1992 dated 28th of April 1992 (Official Catalonian State Gazette 1593 from 13.5.1992) establishing the curricular organisation of Early Childhood Education and Primary Education.
      - Law 15/1990 on Health Organisation in Catalonia (LOSC) from July 1990 includes provisions stating that schools must be a top priority area for introducing healthy habits.
      - Currently the draft of the Law on Public Health in Catalonia contains the need to promote and protect health and prevent health risk factors
4. Likewise, we can list the following guidelines from international bodies:
   a) The mixed WHO/UNESCO committee in the WHO's technical report no. 193 (1969).
   b) WHO's goals for «Health for Everyone» since 2000 have pointed to the education of children and young adults to ensure that they have knowledge, skills and aptitudes that enable them to live a healthy life.
   c) Article 129 of the Treaty of the European Union (1986) states that education and information on health matters are a top priority in European Community action. A number of resolutions and provisions have implemented this, including:
      - The resolution of the Council of Ministers of Education dated the 23rd of November 1988 on health education at schools.

- The proposal for the Community programme to Promote Health D. O . n .C 252 from 9.9.1994. And the creation of the «European Network of Health-Promoting Schools» (ENHPS).

In this teaching innovation project, the goal was to contribute to improving the training of education professionals to adapt them to the ever more diverse requirements of the job of educating.

To this end, the changes were primarily in the teaching methodology as well as in starting a new evaluation system.

3. Methodology

The methodology developed in the teaching innovation was marked by the three actions outlined below:

3.1. Actions to articulate the course based on more knowledge in order to promote and protect health as well as prevent health risk factors

The innovative actions described below were targeted at improving the learning conditions of students from the first to last day of the course.

The first innovative action was in the presentation of the course itself. The start of the course is the first contact between the professor and the class, which generates first impressions that are difficult to erase. In the dynamic of the first class, the four following factors were taken into account:

1. Informing students about how the course was organised. Commenting on each of the sections in the course such as the content of the theoretical classes, the practices, the library and the use of the folders on the virtual campus. There were also several particular requirements, and students were encouraged to participate by asking questions.
2. Trying to generate students' interest in pursuing this course. For this to happen, students had to get to know the professor a bit. This was the time to give an exciting account of the professor's training and experience, as well as their area of research.
3. Gathering information on the students, especially on their prior knowledge about how the human body works as well as on their consumer habits and their perception of their health.
4. Creating a climate that is favourable for interpersonal relations throughout the course. For this reason, the story «The children were alone» (Bucay, J. 2003) were prepared, so that the students could read it out loud and participation could be facilitated from the start through students' oral comments.

Another action that took place on the last day of class was giving each student the poem «The Teacher» (Jou, D. 2004), encouraging students to evaluate the teaching profession based on this poem and mentioning that the author is a specialist in physics and poetry.

In the development of the course, the innovation lay in a programme of coherent theoretical classes as well as promoting a programme of practical laboratory classes and assembling a folder that included the scripts to the practical classes. These practices were held in the experimental sciences teaching labs at the Faculty of Education (Figure 1) and they will be the only ones that these students will be able to conduct throughout their entire degree programme.

Figure 1. Practice of a dissection in the laboratory at the Faculty of Education. UAB

Each student wrote a report on the lab practices. This enabled us to assemble an initial collection of CDs of the lab practices for academic years 2005-06 and 2006-07.

During the month of February, an exhibition of all the practice reports was held that was open to other students from the Faculty of Education. This exhibition was compiled on a DVD.

3.2. More active involvement of students in the learning process

The students have participated in many ways, one of them being by suggesting subjects they were interested in. Based on these ideas, the lecture programme was developed in the four following areas, which covered the following contents:

1. Genetics: Down's Syndrome. Twins.
2. Practical contributions. Basic contents of a school medicine chest. Controlling diabetes in children. Measuring glucose. Airway obstruction (Heimlich manoeuvre). Tattoos and piercings.
3. Health at school in early childhood education: Ages 0 to 3 as the period to promote healthy habits or lifestyles. Family-school relations. Health aspects in

the everyday organisation of schools. The child as the centre and focus of the educational actions at the nursery school. The ill child at school.

4. Immigration: Old causes and new challenges. Documenting cases of child abuse.

All the students were given the contents of the lectures in PowerPoint.

3.3. Development of individual and group work

A basic feature of this development was using and promoting the use of the UAB's virtual campus.

In short, this new methodology encouraged not just knowledge to be learned but also skills to be acquired, namely: understanding and managing knowledge, teamwork, manipulating observation apparatuses, use of experimental lab tools and broader knowledge of the teaching profession.

3.4. Means and resources

In order to implement the new teaching methodology in both group classroom activities and in group or individual work, different spaces in the Faculty of Education have been used: classrooms, experimental sciences teaching lab, computer room, library, etc.

The working plan was deployed over 14 weeks in 28 sessions. A calendar of the working plan for 14 weeks was drawn up in agreement with the working calendar. We began the week of the 12th to 15th of September and went until the 11th to 15th of December. The week of the 18th to 21st of December was a review of the contents. The 8th to the 12th of January was the study and consultation week for students, and the 15th to the 19th of January was exam week.

Efforts were made for the work to be diversified throughout the 14 weeks with two sessions per week.

Resources

We have achieved the goals of the project thanks to the aid received by the Vice-Rectorate for Academic Regulations.

4. Results

The results are based on an assessment of the new teaching methodology and on the evaluation, which are generally satisfactory in the students' opinion.

In the teaching innovation we have managed to study how the human body works as well as generate interest in promoting both individual and collective health and illness prevention. Below we describe some of the activities conducted.

4.1. Production of teaching material aimed at improving students' training and performance. With teaching examples for use at school

1. Improvement in the quality of the teaching materials and group work in all the sessions, both laboratory practices and in a simulation of a situation or a case study.
2. Publishing the subjects with the activities and procedures for doing them. All the students have a copy of all the material.
3. Materials for promoting health at school were developed that reflect knowledge and options and that help to:
   a) Develop and increase personal autonomy with respect to managing one's own health.
   b) Get to know the health system: services, main players, organisation and functioning; use the healthcare services responsibly and respectfully.
   c) Understand and value the rights and responsibilities associated with the use of healthcare services.
4. Real questions on nutrition, accidents, hygiene, vaccines and others referring to health education at schools was gathered and bound.

Finally, we tried not only to ensure access to the information gathered in the course documents but also to generate a debate on the evidence of being able to teach health education at school.

4.2. The classroom studies were improved with independent study actions

The implementation and use of the UAB's virtual campus enabled students to use it as a support to complement the classroom methodology.

The virtual campus gave rise to an exchange with the students that was much more fluid, based on frequent updates of the materials in the folders on the virtual campus and making certain text and representative manuals available for school work. Students, too, participated by adding digital educational resources that they thought might be useful.

However, it is true that there are differences in the use of the virtual campus and there are three types of students: those who used it a lot, those who used it somewhat, and those who used it very little. In one group the use of the virtual campus was made a priority, and this is why they used it the most. All the groups used email to formulate the questions and send notices.

The most representative images of each of the theoretical and practical activities, as well as two main types of documents were made available online: the lessons and the descriptions of certain cases to analyse.

A iconographic base in digital format was gathered after having chosen a series of images and adapting them for publication on the virtual campus.

4.3. Health and education professionals were put into direct contact with each other

This direct contact took place with professionals from different departments at the UAB who explained timely issues with regard to health in the four fields chosen. They demonstrated an extremely cooperative attitude. Plus, it was quite interesting because it clearly showed the interdisciplinary role of health.

1. Genetics. Faculty of Genetics from the Department of Animal Biology, Plant Biology and Ecology in the Faculty of Biosciences in the UAB.
2. Practical contributions. Nursing. Head of the Healthcare and Health Service at the UAB.
3. Health in early childhood education schools. Educator. Director of Nursery School.
4. Immigration. Paediatrician. Head of the Paediatrics Service at Barcelona's Hospital del Mar from the Paediatrics Department at the UAB.

4.4. Students' competences and creativity were fostered

The project fostered the field of scientific competence based on the scientific mastery of methodological tools for educational activities in the realm of health with children and families.

We focused on both laboratory work and computer work in the communication skills, as well as in the practice of oral expression, intellectual skills like formulating questions and resolving problems, and methodological skills like organising time and space, as well as personal and social skills in students' claiming their personal identity.

4.5. The methodology helped to integrate theory and practice

Teaching to gather and compile certain questions referring to health education to resolve in the schools based on erroneous concepts related to children's health, such as: growth of teeth, saliva, worms, indigestion, etc.

The goal was to promote the attitude of resolving questions on health and trying to identify the difficulties in resolving them.

In brief, all the activities aimed at training in aspects of health education and the current situation in early childhood education that the educators must be aware of when working with children and their families, such as: children's health status and their needs, developing contents that enable them to acquire knowledge on health and improving their lifestyle habits while perfecting the motor skills. Likewise, drawing up effective intervention strategies with the purpose of fostering the acquisition of healthy habits.

4.6. A new evaluation methodology

The goal of the evaluation was different in each of the sections: the theoretical, practical and in the educational realm.

It was necessary to hold the practices in a classroom setting. Attendance was required and students had to turn in an individual report on the work they had done. Knowing how to respect, listen and participate in the group work was also evaluated.

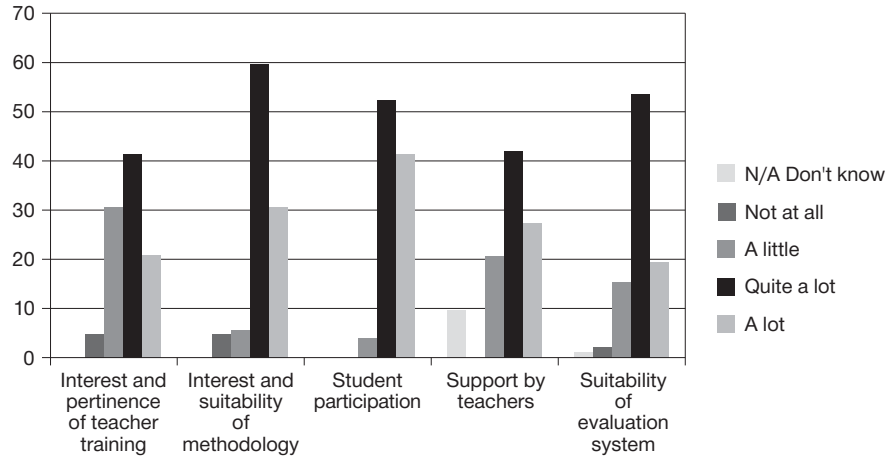
In the theoretical part, students were evaluated on the knowledge acquired as well as their satisfaction with the course through a written exam based on open-ended and closed questions and solving exercises and situations. The final mark was a sum of 30 % for everything related to the practical work and 70 % for the theoretical work.

At the start of the course, we also set out to evaluate students' prior knowledge on their drug consumption habits, specifically alcohol and cannabis. Their percep-

Table 1. Scale of follow-up of the course. Total number of students surveyed: 74

(Results in %)	NO ANSWER / DON'T KNOW	NOT AT ALL	A LITTLE	QUITE A BIT	A LOT
Interest and relevance of the course with respect to the training as an early childhood teacher in accordance with your expectations	0	4.1	31.1	41.9	23
Interest and usefulness of the methodology used	0	4	5.4	59.5	31.1
Evaluate your participation in the course	0	0	4	54	41.9
Do you think that you received enough support (tutoring, backing, etc.) from the professor?	8.1	0	21.6	43.2	27
Usefulness of the evaluation system	1.3	2.7	16.2	54	18.9

Graph 1. Student satisfaction in different areas



tion on the concepts of illness, health and disorders were also quite useful for personal reflection.

A well-established questionnaire should be implemented that can be used to comparatively evaluate the knowledge at the beginning and end of the course.

5. Conclusions

The results were highly satisfactory, and we can clearly predict that this project helps us to prepare the training of education professionals in the fields of health and education. These professionals will affect a sector of the population over which factors that determine their health act, such as lifestyles and social influences.

When implementing this innovation, we saw that it is effective to have the list of skills, actions or activities and the evaluation criteria to be used available from the start of the course. In that way, students have their own learning and knowledge needs in the area of health common to their age, and they also need knowledge to teach to school-aged children and deal with the children's families. Training, educational and professional knowledge must be provided to the future teachers.

In this sense, this innovation is a contribution to the training of new teaching professionals and should continue keeping up the dynamic of the innovation in both the teaching methodology and in evaluation in the fields of health and education.

We also believe that it is timely to make this teaching innovation in this realm at this time, when immigration is a structural fact in our country and therefore is where it can affect the human variability and the concept of health and illness from different cultures (Figure 2).

Figura 2. Children from a variety of countries

References

BUCAY, J (2003). *Cuentos para Pensar*. Barcelona: RBA Integral.

GENERALITAT de CATALUNYA (1984). *Educació per a la salut a l'escola. Orientacions i programes*. Barcelona: Generalitat de Catalunya.

FUNDACIÓ D'ENCICLOPÈDIA CATALANA (1991). *Enciclopè dia de Medicina i Salut*. Barcelona.

FUSTER, V. (2006). *La ciè ncia de la salut*. Barcelona: Columna.

JOU, D (2004). *L'è xtasi i el cà lcul*. Barcelona: Columna.

LISSAUER,T and CLAYDEN, G. (2002). *Texto ilustrado de Pediatria* (2nd ed.). Madrid: Elsevier.

VALLS LLOBET, C. (1994). *Mujeres y hombres. Salud y diferencias*. Barcelona: Folio.

TRESGUERRES, J.A. (1993). *Fisiologia Humana.* Madrid: McGraw-Hill Interamericana.

Interesting links

- http://www.who.int [2008]
- http://www.gencat.net/salut/depsan/units/sanitat/htlm/ca/infantil [2008]
- http://www.gencat.net/benestar [2008]
- http://www.adps.com [2008]
- http:// www.portalcomunicacion.com [2008] (section on the Observatory of Communication and Health).

Keywords

Health, human biology, education for health, promoting health. Teacher training.

Financing

UAB convocation of aids in 2005 for projects of teaching innovation. Length of the project: November 2005 – December 2006.

Supplementary materials on the CD -ROM

Images of dissection practical session carried out in the Experimental Science laboratory.

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Presentation of the project leader

Rosa Carrió holds a doctorate in biology. She is a full professor in the Faculty of Biosciences and Education at the UAB. She has taught in the Teacher Training programme since 1972. She is a member of the founding team of the «Teacher's School of Sant Cugat", which was continued in the Faculty of Education. She is a member of the Biological Anthropology Unit in the Department of Animal Biology, Plant Biology and Ecology. She has participated in research studies in auxology and educational issues. This interdisciplinary group also includes two professors from the Biological Anthropology Unit, the nurse in charge of Health Care at the UAB and the specialist in early childhood education with experience at numerous nursery schools. Other contributors are Dr M. Rosa Caballin from the Department of Animal Biology, Plant Biology and Ecology and Dr Oriol Valls from the Department of Paediatrics.

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Morphology and function of the immune system: An example of integrated teaching

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Abstract

The multidisciplinarity of areas of knowledge means that there is some degree of overlap between courses in educational programmes. Generally speaking, professors plan their courses in line with the point of view of their own discipline. The teaching innovation proposed consisted of using integrated teaching by teaching the practical class of a subject by one professor from each course so that that one expert from each subject participates in the student's learning, furnishing an integrated vision of the subject as a whole. This activity is logical if both professors of the different courses are present simultaneously in the classroom, as a motivating dynamic arises between them that is conveyed to the students. The students participating in this experience have always rated it quite highly, stressing that this type of action helps them to understand the concepts better.

General area of interest of this innovation

The teaching innovation proposed can be applied to courses in which part of the syllabus is shared and the professor wishes to teach the class in a more flexible way. The end result is extremely positive because students perceive that the courses are not isolated and, much more importantly, because they learn by interrelating concepts rather than studying them independently (Poblete and Garcia Dalla, 2006).

1. Objectives

1. The main goal was to do shared teaching in the practical classes on Immunology and Histology so that the students could learn about the lymphoid tissue integrated into the knowledge of Immunology and Histology.
2. The goals related to the innovation proposed in the project are:
   a) To avoid duplicating information and the lack of integration of shared knowledge and getting the students used to multidisciplinary knowledge.
   b) To improve the teaching materials and have a set of optimal microscope slides of several different organs so that students have at their disposal slides of different organs.
   c) To familiarise students with the fact that the teaching profession needs professionals from other disciplines in order to get a better grasp of processes.
3. The learning goals proposed in the project are:
   a) To describe where the different structural and cellular elements in the lymphoid tissue are.
   b) To learn how to relate structure and function in an integrated fashion.
   c) To associate the changes that take place in the anatomy with the function these elements perform during the immune system's response to a pathogen.

2. Description of the project

2.1. Background of the innovation

When the syllabi in courses are planned, there is often a degree of overlap in the subjects dealt with by the different areas of knowledge. Teachers plan these subjects dovetailing with the point of view of their own discipline. Often, faculty are somehow reluctant to unify the material, perhaps because teaching integration is extremely laborious and is rarely satisfactorily achieved in curricula (Chamarro et al., 2006).

There is not always consensus when explaining the common factors of the different courses, which negatively influences students' learning:

1. It often creates confusion as there is no uniformity when they explain functions, nomenclatures, etc.
2. It leads students to see the organism not as a coordinated system but as a group of isolated systems.
3. The students do not see the concepts as integrated, rather for them they are simply repeated. Therefore, cooperation among professors is important when designing the teaching goals (Fernández et al., 2006).

One example of this overlap of subjects arises when studying the anatomy of the immune system taught in the first and second terms of the second year of the Bach-

elor's in Veterinary Medicine in the courses on Histology and Immunology, but from two very distinct vantage points: the structural and the functional. Despite this, the vast interdependence between these two concepts means that they are always explained together and therefore students receive the same information twice in the same course. Aware of the repetition in the syllabus within the same academic year, the professors in charge of each course decided to include an explanation of the structure of the lymphoid organs within the course on Immunology, which primarily explains their function. This was possible thanks to the Histology professors' availability to teach the number of hours needed for this subject in the second term instead of the first, thus making it possible for there to be one professor for each subject in the classroom at the same time. The type of methodology applied in the practical class already makes for a more dynamic class and more contact with the students. The funding received enabled us to launch this action and develop a set of microscope slides of slices from different organs with two types of tinctures: a) hematoxylin-eosin, which enables the anatomy to be studied, and b) a immunohistochemical stain for analysing the function and distribution of the cellular elements within the organ.

2.2. References of the innovation

The Immunology Unit participated in the teaching innovation included in the previous curriculum for the Bachelor's in Medicine at the UAB, which was designed based on the opinion that integrated, multidisciplinary learning was necessary for future physicians. Immunology was taught in the first term of the second year of the programme by learning the apparatuses and systems and within the course on »Development, Structure and Function of the Apparatuses and Systems in a Healthy State I». In this first part of the course, students simultaneously studied the circulatory system, the respiratory system, the digestive system, the immune system, blood and the hematopoietic organs. The Immunology Unit, in conjunction with the Histology Unit in Medicine, had the initiative to conduct an integrated teaching project in the practice classes, where the explanation of the morphology and function of the lympoid organs would be delivered jointly by a professor from each discipline.

The main goal was for the students to view the morphology of an organ as tied to its function. The professors rated this experience very highly, as it enabled them to reaffirm (reinforce) their own learning process. The students were at once surprised and satisfied with the type of interactive teaching used by both professors. This project, financed by the Histology and Immunology teaching units, lasted until the Medicine curriculum changed and Immunology started to be taught in the third year in the Educational Hospital Units. This experience was the point of departure in which the teaching innovation described in this article was based. The Faculty of Veterinary Medicine is part of DURSI's Pilot Plan for applying the Bologna Plan in the European Higher Education Area (EHEA), which is spurring us to seek new and different methodologies to help students learn better.

2.3. Characteristics and methodology of the project

This teaching innovation was put into practice in academic year 2005-06. The first year, the integrated teaching was divided into six practices in two 2.5-hour sessions on different days of the teaching calendar. Both sessions were held once all the theoretical classes on the morphology of the immune system had already been taught. The teaching of the classes was organised into a theoretical explanation delivered by the professor leading the practice with the support of the professor from the other course, followed by a period of observation of slides of the organs being discussed under the microscope, along with comments and questions. There are approximately 15 students per class, a small enough number to enable the students and professor to work closely together, as it is an excellent student-teacher ratio that is hard to find in core courses like this one.

The first practice session consisted of learning the microscopic morphology of the immune system. In this case, the Histology professors led the practice and the Immunology professors supported the former by referring to the functions of the organs and cells. The materials used in this session were the slides stained with hematoxylin and eosin.

The second session was scheduled after the theoretical class explained the activation of the immune response when faced with a pathogen. This session focused on learning the distribution of the elements of the immune system within the organ and the changes in the morphological structure when the organ is developing an immune response. The professor leading the session was the one from Immunology, and the Histology professor was present at the practice to remind students of the anatomy of the immune system. The material used in this session included the immunohistochemical slides.

Since academic year 2006-07, another step has been taken in this teaching integration by scheduling both practices consecutively, turning them into one five-hour workshop on the Morphology and Function of the Immune System. The merger of both sessions meant that the learning could take place jointly and that there was more time for questions and comments, more chances to delve deeper, reason through and analyse the concepts from both the morphological and functional standpoint. The students in both courses in which the two integrated were scheduled rated the teaching innovation very highly.

3. Methodology

Based on the individual materials from the Histology and Immunology practices, a joint set of materials was developed (Appendix 1). The materials were organised based on the different organs examined. First comes a theoretical part on the morphology and its function in the guise of a schema, and then a series of questions that students have to answer while observing the hematoxylin-eosin and immunohistochemical slides of each organ under the microscope. In the end there is a survey to gather students' opinions on the integrated practice. The presentation used by the professors is in Power-

Point (Appendix 2), following the same organisation as the written materials. The images used in the presentation are photographs of the same slides that the students will see under the microscope.

The practice uses several different types of teaching methodologies. Part of the class is explanatory: the Histology professor explains the morphology-structure of each organ and then the Immunology professor explains the function of the tissue that is linked to each of the characteristic parts of the organ. The students tend to take notes during these explanations. Afterwards there is a part focused on observation and analysis of the slides in which students are asked to look for the morphological and functional elements that the professors have explained, to draw them and to answer questions related to the materials. This part of the practice makes it possible for there to be direct student-professor contact, and for reasoning questions to be raised to encourage debate among students and even between the professors.

The last 30 minutes are used for the evaluation, which is conducted with a two-question test, one from each area, which students have to answer individually. The question on morphology consists of an image of one of the organs the students have seen during the practice, and the students have to comment on the image based on the structures pointed out. As they do this, students can use the information they have gathered during the practice (teaching materials handed out and notes). This test accounts for 10% of the final mark in the course on Immunology.

In addition, students are given an assessment sheet for them to express their opinions on four questions and write in comments, suggestions, etc., so that they can also participate directly in this initiative.

4. Results

The results have always been quite positive, and generally speaking this integrated teaching experience has been very highly rated by students. In the first two years, a survey was conducted that asked them to express their opinions on the practice, and in general the comments were positive.

This year a survey with four specific questions was administered to the 170 students who took part in the integrated practice, which enabled us to quantify the results, as seen in Figure 1. The questions on this survey are:

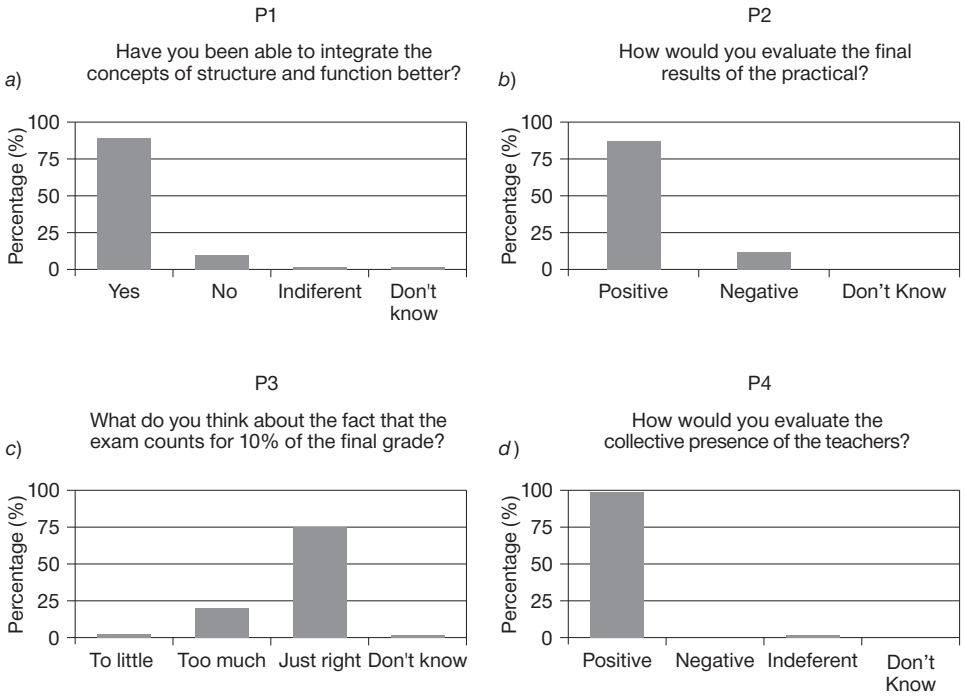
1. Question 1 (P1): Do you think you have better integrated the concepts of the structure and function of the immune system than if you had studied the structure and function separately, that is, the morphology in the first term as part of the Histology course and the function in the second as part of the Immunology course?
2. Question 2 (P2): How would you assess the evaluation that was administered at the end of the practice?
3. Question 3 (P3): How do you rate the fact that this test accounts for 10 % of the final mark in the course on Immunology?

4. Question 4 (P4): How do you rate the joint presence of both professors during the practice?

To the first question (Figure 1a), 90 % of the students replied that integrated teaching is an effective tool, while only 8.8 % answered negatively. A full 87 % of the students answered the second question (Figure 1b) positively. With regard to the third question (Figure 1c), 76 % of the students considered the weighing of the mark from the practice to be fair, but 21 % felt that it was too much for the test to count one point over ten, which is the maximum mark in the course on Immunology. Finally, in response to question four (Figure 1d), 99 % of the students were in favour of having both professors in class.

Only 52 % of the students added comments. The majority of the comments were positive; however, some asked that the initiative be applied in more courses. The complaints revolved around the length of the practice, as students suggested that it be divided into two 2.5-hour sessions. The scheduling into two sessions, as was done in the first year, was resumed in this practice, and we saw that part of the second session became a revision of the first session.

Figure 1. Positive response on cognitive learning, the type of assessment and its weight in the final mark, and the joint presence of both professors



4.1. Assessment of the integrated practice: Student performance

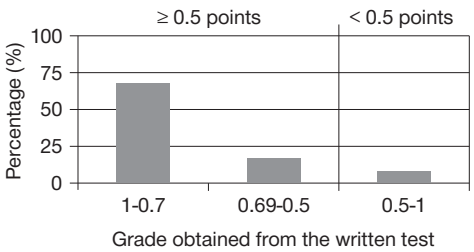
4.1.1. Evaluation of the pack of teaching materials handed out

During the first two years, the questions included in the pack of teaching materials were evaluated. This method of evaluation was very popular with students: it was the same type of work done in Histology during the first term, and they did not agree with having to draw (65 % of the comments were against having to draw the slides).

4.1.2. Evaluation of doing a test at the end of the class

This academic year, the type of evaluation was changed; we now administer a test at the end of the practice that is worth one point and counts as 10 % of the final mark in the course on Immunology. The change was popular with students (Figure 1B and C). The results indicate that 89 % of the students passed the test, of which 68 % got a passing mark and 70 % earned the top score (Figure 2).

Figure 2. Results of the mark on the exam taken at the end of the integrated practice on Morphology and Function of the Immune System.



5. Conclusions

1. Students have very favourably accepted the teaching integration.
   This project has been underway for three years. The last year enabled us to make a thorough evaluation of this teaching innovation, as discussed in the Results section. The integrated teaching is very popular with the students, and their written comments show that it should be proposed in other courses as well.
2. The concepts were explained more dynamically in the practice classes and served to reinforce the theoretical classes related to each topic.
3. The teachers standardised the nomenclature and concepts in the learning of a common subject/case.
   Familiarising students with the fact that teaching professionals needs professionals from other disciplines to gain better knowledge of processes is a transversal skill that should be included in the planning of higher education degrees. The profes-

sors of both courses also questioned each other, something that the students liked and made them participate in the class.

4. Students learned about the interrelation between the morphological changes in the anatomy of given structures of the lymphoid organs and the response and function of the immune system in a more comprehensible fashion.
   The result of the test, which 89% of the students passed (Figure 2) shows that the target concept were very easily attained by the majority of the students.

References

POBLETE RUIZ, M. and GARCÍA OLALLA A. (2006). *¿Cómo vencer las barreras para la convergencia? Una experiencia interdisciplinar de innovación para diseñar y desarrollar las asignaturas por Competencias*. 4th International Congress on University Teaching and Innovation. Barcelona.

CHAMARRO, A., GUTIERREZ, T., CAMINAL, J., ARADILLA, A.; MARTÍNEZ A. and CONSUL, M. (2006). *La salut des d'una perspectiva multidisciplinar: avaluació de dos anys d'experiència.* 3rd Campu Workshop on Teaching Innovation. UAB. Barcelona.

FERNÁNDEZ CAVIA, J. and SÁEZ E (2006). El *Programa EMPRENDO de la Universidad de Concepción: una herramienta multidisciplinar de renovación pedagógica.* 4th International Congress on University Teaching and Innovation. Barcelona.

Keywords

Integrated teaching, interdisciplinary teaching.

Financing

This project was conducted with AGAUR financing for projects aimed at Improving the Quality of Teaching at Catalan Universities (MQD) for 2005 (ID number 2005 MQD 00064).

Supplementary materials on the CD-ROM

Portfolio of integrated practical sessions in Histology and Immunology in pdf format.

Project leader

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Presentation of the working group

The working group is made up of professors from the Faculty of Veterinary Medicine, which is one of the experimental sciences faculties that is participating in the Pilot Plan that DURSI launched in academic year 2004-05. From 1995 to 1997, the project leader participated in a similar initiative taught in the second year of the Bachelor's in Medicine. The experience was positive and enriching for both the professors and students. This teaching action was designed by the professors in charge of teaching the courses on Histology and Immunology, adapted for the Bachelor's in Veterinary Medicine.

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Production of a photographic atlas for independent learning of the anatomy of the mouse

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Abstract

The resemblance between the genomes of the mouse and the human being and the development of mutagenic techniques, have made the mouse the basic pre-clinical research tool for understanding the physiopathology and treatment of human diseases. The main objective of this project is to produce a high quality photographic atlas of the anatomy of the mouse, as there is no book of this type available on the international market. The teaching tool we are producing must enable independent learning by graduate and postgraduate students in the health and biomedical sciences and improve their education and achievement. This atlas must also enable the anatomical changes in genetically modified mice to be included.

General area of interest of this innovation

The photographic atlas of the anatomy of the mouse will be of great interest for graduate and postgraduate students in the Biomedical sciences (Biochemistry, Genetics, Medicine, Biology, Veterinary Medicine, Pharmacy, etc). It will also be very useful for researchers using the mouse as a model, which occurs in the majority of research laboratories working in biomedicine.

1. Objectives

The main objective of the project is to produce a high quality photographic atlas of the anatomy of the mouse, which enables independent learning by graduate and postgraduate students working in the health and biomedical sciences and improves their education and achievement. This objective entails providing them with the skills to recognise and understand the anatomical structures of the body of the mouse and to interpret the images obtained using some of the latest imaging techniques (CAT, NMR, Ultrasound Scanning).

2. Description of the project

Human beings and mice are very similar in their development, physiology and biochemistry. This means that the mouse is a key model for research in human medicine. Identification of all the genes in the mouse and humans (the Mouse and Human Genome Project, respectively) has showed that around 99% of the mouse's genes have an equivalent gene (or counterpart) in humans. This is very important, because 5,000 diseases have so far been proven to be the result of a genetic error; examples of these are cystic fibrosis and Down syndrome. Furthermore, in many other diseases, an error in the genome may make a significant contribution to their appearance, as is the case with diabetes. The resemblance between the genome of the mouse and that of human beings enables the genes associated with diseases to be researched in mouse models.

While the potential for generating transgenic mice is increasing very rapidly, the ability of scientists to analyse the morphological changes that can be detected in transgenic mice is very limited. The first transgenic mouse was obtained in 1982 and over 18,000 new transgenic mice have been produced to date. In general, each transgenic mouse is a «new» animal and must be considered as a candidate for presenting anatomical variations. Our graduate and postgraduate studies in health and biomedical sciences place a great deal of emphasis on these animal models. Unfortunately, there are very few books about the anatomy of the mouse (see attached bibliography) and furthermore, they are incomplete and mostly show drawings rather than real images. An atlas of the anatomy of the mouse is essential for complete morphological phenotyping of genetically manipulated mice, which will help in understanding the function of genes and to improve the scientific skills of our students and future researchers. In this article, we present some of the anatomical images of the mouse (Figs. 1-9) which are included in the atlas, which will consist of over 680 original images.

3. Methodology

The techniques used to obtain the images of the mouse's anatomy were: Conventional dissection, which enables the organs making up the various mechanisms and systems to be viewed; the preparation of bones by soaking in pancreatin, which enables each

item in the skeleton to be isolated; moulds of blood vessels, which enable the complex distribution of the blood vessels in the various organs to be understood; cross-sections, which provide an understanding of the spatial relationship between the various organs of the body; histological sections, which provide an understanding of the cellular constitution of the tissues and organs; scanning and confocal electron microscopy, which enable understanding of cellular and subcellular organisation in tissues; radiography and computed axial tomography (CATs), which use X-rays to show the skeleton; nuclear magnetic resonance (NMR), which uses high intensity magnetic fields to observe the distribution of new tissues, and finally, ultrasound scanning, which uses ultrasound waves to view some specific internal organs.

4. Results

While the atlas was being produced, it was presented at various Spanish and international meetings and congresses in the field of biomedicine. These meetings highlighted the general interest in the material presented, as it fills an important gap observed by the scientific community and biomedicine professionals and as a consequence, it is becoming a necessary complementary tool for the learning, training and the skills of our students. The production of this atlas has enormously facilitated the preparation and consolidation of the Mouse Anatomy course, which is taught as part of the Transgenic Animals and Gene Therapy module in the Master's degree in Biochemistry, Molecular Biology and Biomedicine at our University. A representative sample of the material provided by the Atlas is shown in the images (Figs. 1-9) obtained from the various mechanisms and systems in the mouse using some of the techniques described in the Methodology section.

5. Conclusions

The graphic material produced has been shown to be of great interest to the scientific community and very useful in graduate level teaching (Anatomy I and II of the Veterinary Medicine degree course) and postgraduate teaching (the Transgenic Animals and Gene Therapy module of the Biochemistry, Molecular Biology and Biomedicine master's degree) at the Universitat Autònoma de Barcelona.

References

CONTI, C. J.; JIMENEZ CONTI, I. B.; BENAVIDES, F.; FRIJHOFF, A. F. J. and CONTI, M. A. (2004). *Atlas of laboratory mouse histology*. Texas histopages Inc.

COOK, M. J. *The anatomy of the laboratory mouse* (1965). New York: Academic Press.

COZZI, B.; BALLARIN, C.; PERUFFO, F. and CARU, F. (2006). *Anatomia degli animali da laboratorio*. Casa Editrici: Ambrosiana.

GUDE, W. D.; Cosgrove, G. E. and Hirsch, G. P. (1982). *Histological atlas of the laboratory mouse*. Plenum Press NY.

IWAKI, T.; YAMASHITA, H. and HAYAKAWA, T. (2001). *A color atlas of sectional Anatomy of the mouse*. Braintree Scientific, Inc.

POPESKO, P.; RAJTOVÀ, V. and HORÀK, J. (1992). *A colour atlas of the anatomy of small laboratory animals*. London: Wolfe publishing Ltd.

Keywords

Independent learning, Anatomy, Phenotyping, Mouse.

Financing

This teaching innovation was supported by a grant in the UAB 2006 Round of grants for teaching innovation projects.

Suplementary materials on the CD-ROM

Images from the photographic atlas of mouse anatomy.

Project leader

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Presentation of the project leader and the working group

Dr. Jesús Ruberte, professor of Anatomy and Embryology in the Faculty of Veterinary Medicine at the Universitat Autònoma de Barcelona and his group have a great deal of experience in the publication of teaching material. Among other works, they have published three volumes of *Dog and Cat Anatomy*, which have been translated into other languages, and are key reference books in the Anatomy field in Spain and internationally. He is currently Head of the Morphological Analysis Unit at the Animal Biotechnology and Gene Therapy Centre at the UAB, and his research focuses on the study of the vascular system in genetically modified mice as models for human diseases.

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Production of online educational resources for the teaching and learning of veterinary anatomy

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Abstract
Anatomy atlases adapted to the web environment are tools for permanent consultation and support for study which enable the problems of traditional teaching on the Veterinary Anatomy course to be overcome. Their production involved the creation of a digital image bank using high quality prosections. The images were archived in PDF format and labelled using the Adobe Acrobat program and linked to a website that enabled learning to take place according to a logical sequence. The Atlases have been published on the Virtual Veterinary Medicine platform of the UAB Faculty of Veterinary Medicine and can also be presented in CD-ROM format. They are easily accessible teaching resources, with permanent and cheap access, and are very highly rated by students. Their use may lead to a decline in presence learning and facilitate adaptation to the European Higher Education Area (EHEA).

General area of interest of this innovation
This innovation is suitable for teachers of subjects being adapted to the EHEA who are interested in information and communication technologies as a teaching support tool. The experience presented here may be particularly useful in subjects where a great deal of images are used, such as the Morphological Sciences.

1. Objectives
In recent years, we at the Anatomy Unit of the UAB Faculty of Veterinary Medicine have considered how to adapt the course to the EHEA, and also tried to solve some of the problems inherent in the teaching and learning of Veterinary Anatomy.

The objectives we propose are to place teaching resources that can be consulted on an ongoing basis at the student's disposal. These are an alternative to traditional attendance-based teaching, reduce the role of the teacher to acting as a mere transmitter of knowledge, and improve and innovate such attendance-based teaching with support initiatives using a distance-based medium.

2. Description of the project

2.1. Current context

The Veterinary Medicine course at the *Universitat Autò noma de Barcelona* has been included in the pilot plan for EHEA adaptation since the 2004-05 academic year. The main purpose of this plan is to adapt the structure of studies to the new regulatory and methodological framework included in the Bologna process. In specific terms, Veterinary Anatomy is a subject with content that is included in the courses of Anatomy I and Anatomy II, which are taught in the first and second six months respectively of the first year of the Veterinary Medicine degree course. The two courses account for a total of 22.5 credits, and involve 225 hours of theoretical and practical presence learning, and 19 ECTS, which involves approximately 475 hours of work by the student. It is therefore a subject that entails a significant workload for the student. The practical classes in the subject are a very important part of the total study and work load, as they account for more than 50% of the total classes and student's work.

2.2. Situation affected by the teaching innovation

Among the main problems involved in the traditional teaching of Veterinary Anatomy is the inevitable lack of teaching hours, at least in attendance-based teaching, due to the change in the educational philosophy of the new Study Plans. The recent introduction of the European credits system, which is based more on the student's personal work than on the hours spent by teachers and students in the classroom, means that there is an emphasis on the time that students spend on their own learning. The student assumes a more central role and is no longer merely a passive receiver of content during class time, and takes on a more participatory role and becomes an active part of his/her own learning. It is therefore obvious that according to the above, increased methodological diversity and greater flexibility in types of learning are necessary in this new situation. One of the measures of adaptation to the European system of credits is that libraries must increase their importance as a teaching support service, and information and communication technologies (ICTs) must play a predominant role and must be integrated into teaching. The creation of specific resources, such as designing websites with didactic content which help in the teaching and learning process, can facilitate autonomous and active distance learning, and increase the student's role in the educational process.

Traditionally, a great deal of the time allocated to practical activities in Veterinary Anatomy is spent on carrying out dissections of the bodies of dogs. These practical sessions are undoubtedly of educational value but also have clear disadvantages, as their full potential is not always exploited by students. The systematic dissection of the body takes up a great deal of time, and the work done by the students is also obviously not of high quality due to the lack of time, their obvious inexperience or because the groups in which they work are larger than would be desirable. Furthermore, the dissection of the body is of a conservative nature, as it attempts to preserve the structures as much as possible, and this means that the student often does not gain a clear idea of the arrangement of the structures and does not clearly understand their function. A further problem is that in order to avoid exposure to toxic products and deterioration of the preparations, students obviously cannot have permanent access in order to look at and study the dissections performed. This means that what is learnt in the Dissection Room is often quickly forgotten due to the impossibility of it being reviewed on a regular basis. The innovation presented here gives students access to a didactic resource that can be consulted at all times with easy access, and which can make at least a partial contribution to relieving the problems of traditional anatomy teaching.

3. Methodology

The first step in the preparation of the Anatomy Atlas was the production of high quality anatomical preparations (prosections). The prosections were photographed in order to create an extensive bank of digital images. The most representative images, which were selected and archived in PDF format, were appropriately labelled using the Adobe Acrobat® program, for which the UAB has a Campus licence. The list of anatomical items of interest was shown In each image, and all the details necessary for correct interpretation by the student of the prosection presented. The features of the program make some degree of interactivity possible, as it is possible to access the images either with or without the labels displayed. This enables the Atlas also to be used as a tool that makes self-directed learning and self-assessment possible.

The images were linked to a website produced using a website editing program, which allowed the documents to be organised in such a way that readers —the students in this cas— had fast and user-friendly access to the general contents of the page and to the table of contents of the images. Hyperlinks were created which facilitated location of the various sections of text that act as a theme for the document, and enabled the various images placed at the student's disposal to be arrived at simply and in different ways. The organisation and presentation of the website was such that by using an explanatory text, students were able to access it quickly and see the image chosen and return to the text quickly. An alternative possibility

is independent access from the page to each of the images, regardless of the text; In this case, the images were ordered using a progressive logical sequence, from the most superficial to the deepest, and from the proximal to the distal regions. The structure of the website also enables the content to be updated quickly. Its structure is versatile enough so that it can be changed, with materials added or replaced, in a very simple way. The way it presents didactic material means that it is also appropriate for presentation on a CD-ROM.

The Atlases were published and made available to students on the Virtual Veterinary Medicine platform of the UAB Faculty of Veterinary Medicine. The series of websites gives access to several hundred images with notes covering various topics in the field of Anatomy and Embryology, which are illustrative of the practical sessions carried out in dissection rooms.

The students were also consulted with regard to the level of acceptance of the didactic materials made available to them, and the grades obtained in recent academic years were also monitored.

4. Results

4.1. Educational resources produced

The following works have been published in recent years in a digital medium on the UAB Virtual Veterinary Medicine platform:

Muscles of the limbs of the dog. Virtual atlas.
http://minnie.uab.es/~veteri/21197/atlas/inicio.htm
Muscles of the dog: Neck, trunk and tail. Virtual atlas.
http://minnie.uab.es/~veteri/21202/inicio.htm
Atlas of the preimplantational embryonic development of domestic mammals.
http://minnie.uab.es/~veteri/21197/embriologia_atles/AtlesText.html
The limbs of the dog: Innervation and vascularization. Virtual atlas.
http://minnie.uab.es/~veteri/21197/AIVM/inicio.html

The general appearance of the websites is shown in Figures 1 to 4.

Figure 1. General appearance of the website. The general contents and image contents appear on the left of the document. The hyperlinks for the contents enable browsing in the main document, and located on the right of the screen, and in the images, included in independent files

Figure 2. General appearance of the website. The text acts as a theme for the document and allows the student to access the various images available simply and by different routes

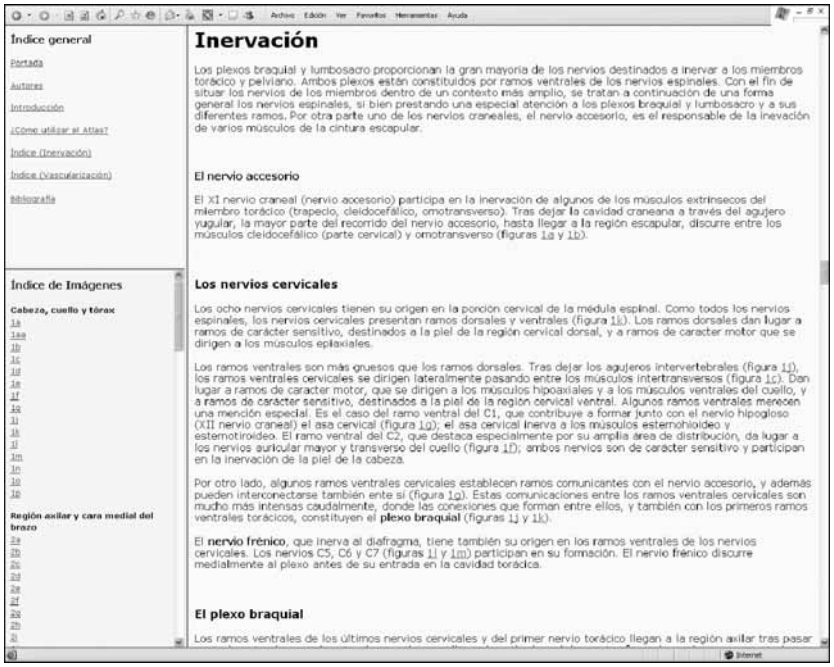


Figure 3. Image in PDF format showing a dissection of the lower limb of the dog, showing various anatomical structures marked with letters and numbers. The images were labelled and titles were added using the Adobe Acrobat® program, for which the UAB has a Campus licence. The labels are folded (cf. Figure 4)

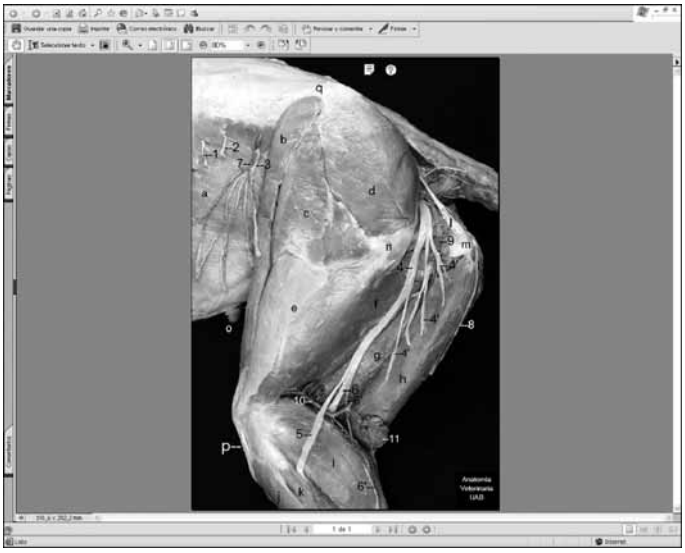
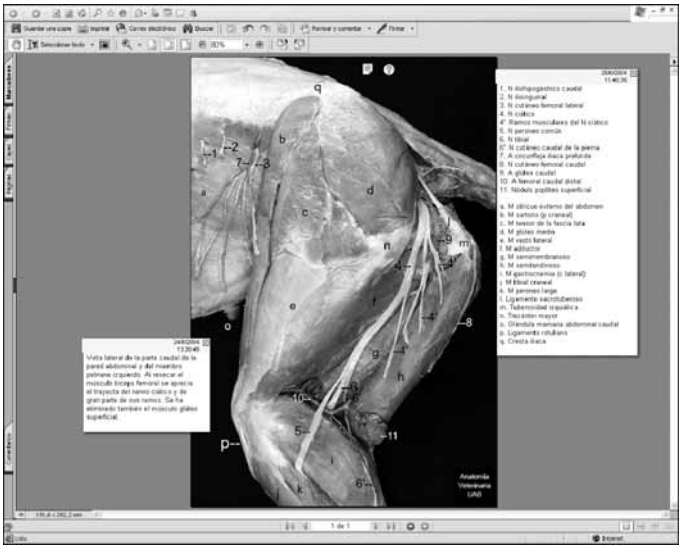


Figure 4. The image shows the same dissection as in figure 3, but in this case the labels have been unfolded in order to be able to identify the various structures and ascertain how the dissection was performed



4.2. Assessment by the students

In order to find out the opinion of the students of the educational materials produced, they were given a questionnaire that included various questions on the Anatomy teaching resources made available to them before the end of the teaching period of the 2004-05 and 2006-07 academic years. Analysis of the surveys showed that the students rated the online publication of the Anatomy Atlases very highly as a means of support for their studies. An almost unanimous majority of those surveyed rated their interest in these resources in their learning process as high or very high (Figure 5). The frequency of use is also high (Figure 6). Of particular note is the frequency of use of the online Atlases, which was significantly higher in the 2006-07 academic year than in the 2004-05 academic year. This is undoubtedly related to the continuous assessment methodologies introduced in the 06-07 academic year, which stimulate more frequent consultation of educational materials.

Figure 5. Students' assessment of the materials in the subject Anatomy I in the 2006-07 academic year. 1: very low rating, 5: very high rating. n=144

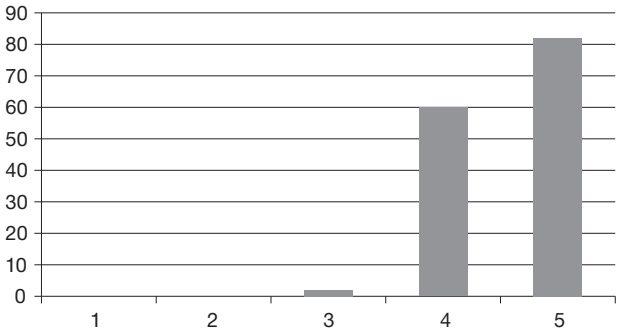
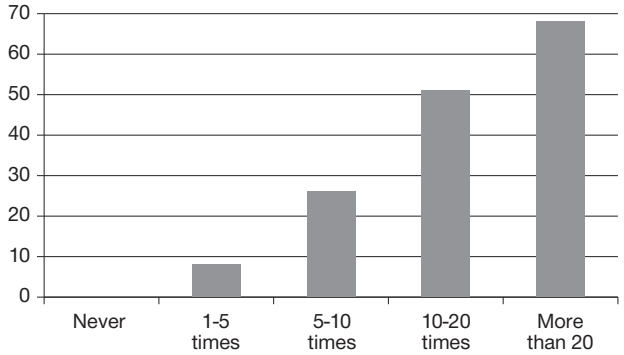


Figure 6. Frequency of use of the materials in the subject Anatomy I in the 2006-07 academic year. n=144



When those surveyed were asked how they rated the quality of the images presented, or whether the presentation format of the material was the most appropriate, 92.5 % of the responses said that the images were good or very good, and a slightly smaller proportion, 80 %, said that the presentation format for the material was appropriate or very appropriate. Most of the students registered - 73 % - used the books recommended in the teaching guide for the subject and the online Anatomy Atlases as a complement to the theory classes or practical sessions.

Ease of access to the online material was frequently determined by the computer equipment that the students had in their own home. In the 2006-07 academic year, 2.8 % of those surveyed still did not have a computer in their home, and 7 % had a computer but still did not have an Internet connection; 15 % said they had a normal connection and finally 75 % had an ADSL connection. The latter figure differs significantly from that recorded in 2004-05, when only 52 % of the total registered students had broad band connections. Finally, when the students were consulted as to whether they would prefer to have the material on another type of medium, only 35 % said that having the material on the Internet was sufficient; 43 % would have preferred to have had a CD-ROM, and 22 % said they would have preferred to have the document on paper, even if this had involved them making a financial payment. Obviously, having a good computer with an ADSL connection is important for getting the most out of online resources; furthermore, the data obtained infers that a large percentage of students prefer not to depend on the fluctuations of the Internet, and for many of them, studying directly on the computer screen is not a comfortable experience.

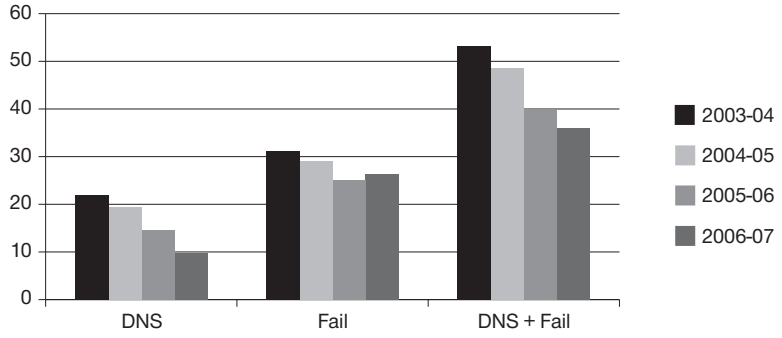
4.3. Academic results obtained

Analysis of the students' academic results shows how they improve slowly compared to those obtained in previous years (Figure 7). However, merely introducing the ICTs does not significantly change teaching if changes in pedagogical practices are not also taken into consideration (Cebrián, 2003). In accordance with this approach, we believe that the improvement in the results is Not due to merely and simply to the educational materials made available to the students, but also to the introduction of continuous assessment in recent academic years, after the beginning of adaptation of the subject to the EHEA. We feel that the Atlases presented here will enable different types of continuous educational assessment managed over the Internet to be introduced. This has been seen to be an effective strategy in encouraging students' learning (Cebrián, 2003).

5. Conclusions

The publication of the Anatomy Atlases on the UAB Virtual Veterinary Medicine platform makes them an easily accessible didactic resource, with a low financial cost and permanent access, which students can consult at any time, both at the faculty and at

Figure 7. Academic results obtained in the Anatomy I subject. The percentages of Did Not Sit (DNS) and Fails (Fail), and therefore the percentage of students who did not pass the subject has fallen in recent academic years with the introduction of continuous assessment methods, which has led to a clear improvement in results.



home, using any computer connected to the Internet. Their use leads to a reduction in the dependence on attendance-based teaching in Veterinary Anatomy, and also decreases dependence on learning in the Dissection Room and the limitations of space and time that this entails. When the teaching resource is well presented and well produced, it is very highly rated by the students, although its use is only optimised when the student has the appropriate computer equipment. The use of this didactic instrument can promote self-directed learning and facilitate the introduction of continuous educational assessment strategies. These materials may be a useful tool in the process of adaptation of the subject to the EHEA.

We are planning to publish more Atlases that cover the existing range of content in the future. Furthermore, now we are moving towards education that is more focused on the student, in which the role of the teacher is changing. Teachers will no longer play the central role and instead become facilitators of the learning process. It therefore seems appropriate to add a list of learning objectives that is well-structured and feasible in the time available to the online material. It would also be advisable to include self-assessment trials in the document in order that students can see whether they are reaching the educational objectives set for themselves.

References

Bosco, A. (2007). «EVAINU Research: New virtual learning environments for educational innovation at university». *Journal of Cases on Information Technology*, 9 (2), 49-60.

Cebrián, M. (co-ord.) (2003). *Enseñ anza virtual para la innovació n universitaria.* Madrid: Narcea.

Parcerisa, A. (co-ord.) (2005). *Materiales para la docencia universitaria.* Barcelona: Octaedro/ICE-UB.

Interesting link

- Innovation website: http://quiro.uab.es/

Keywords

Veterinary anatomy, education, computer-aided learning, ICTs.

Financing

Project financed by the AGAUR programme for the Improvement of Teaching Quality in Catalan universities (MQD) for 2006 (Call 2004MQD 00094).

UAB 2003 round of grants for teaching innovation projects (2004 00049 round 2004 00049).

Supplementary materials on the CD-ROM

Demonstration of the VIRTUAL VET website: tour of the virtual collection of images taken from prosections for the Anatomy I course.

Project leader

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Presentation of the project leader

The head of the project has been a Professor in the area of Anatomy and Compared Pathological Anatomy since 1984. He has been a Full Professor since 1993 and in various academic years, he has been the head of the subjects Anatomy I, Anatomy II and Clinical Anatomy of the UAB Veterinary Medicine Degree Course. He has been a Qualification Co-ordinator and Facilitator of the Pilot Plan for adaptation of Veterinary Medicine studies to the EHEA. He is currently vice-dean of Teaching in the UAB Faculty of Veterinary Medicine.

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Computerisation and digitalisation of real autopsy cases as the basis for independent learning in veterinary pathology

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Abstract

A brief description is given of the procedure by which the autopsy cases sent to a public veterinary pathology diagnostic service are used to programme:

1. A module of autopsy practical sessions carried out with real cases;
2. Teaching of self-directed learning by means of the production of clinical-pathological studies based on «real cases»;
3. Public exposition and discussion seminars of cases of self-directed learning presented by the students themselves;
4. Creation and maintenance of a collection-repository of digitised images of veterinary pathology that is unique in Catalonia;
5. A website of great educational interest in which a selection of the most important autopsy cases of those taking place every academic year is published;
6. ICTs and EHEA teaching procedures that actively encourage criticism and the systematic approach of explanatory hypotheses for the facts observed are actively used throughout the entire process, which is completely computerised and digitised. Taken as a whole, this is a very good introduction to professional practice.

General area of interest of this innovation

Generally in disciplines in the area of Health Sciences.

1. Objectives

1. Greater efficiency in autopsy practical sessions based on real cases. Use of a single autopsy case to:
   a) To schedule practical sessions based on real cases in the Autopsy Room in the Faculty of Veterinary Medicine.

   b) To enable «virtual attendance» of additional autopsy cases — to which the students would otherwise not have access —by means of the presentation of seminars based on real cases (programmed teaching)
   c) To provide free access to a selection of these autopsy cases by means of the Internet: the «virtual autopsy»
2. To eliminate «theory» seminars
3. To use cases of autopsies for programming self-directed learning based on real cases.
4. To develop self-directed learning skills for the production and explanation of complex reports, and for public presentation.
5. To create and maintain a large digitised archive of autopsy case images and clinical-pathological cases for an academic purpose and interest.

2. Description of the project

The methodological approach set out here makes sense in the context of the European Area of Higher Education as a teaching proposal that directly promotes:

1. self-directed learning as a teaching methodology,
2. teaching based on real cases,
3. continuous assessment,
4. the use of ICTs,
5. teamwork,
6. the intensive use of reasoning, argument and the presentation of hypotheses in order to solve problems. The proposal consists of using autopsy cases referred to the Public Veterinary Pathology Diagnostic Service of the Animal Health and Anatomy Department as cases of self-directed learning based on real cases that are prepared and solved in groups, and which are subsequently presented publicly in seminars on the subject. Finally, an illustrative selection of these is published on the Internet.

3. Methodology

This activity is compulsory. It is carried out in groups (2-3 students) and the basic process is as follows:

1. Students perform the autopsies during the scheduled practical Pathological Anatomy sessions («practical sessions based on clinical-pathological cases»),
2. Choice (supervised) of an autopsy case performed beforehand during the practical module (2 weeks),
3. Production — with the data obtained in the autopsy — of a complete clinical-pathological report in writing,
4. Public presentation of the case autopsied to other colleagues in specific sessions for the presentation of cases during seminars on the subject,

5. Publication of a supervised selection of these cases on the Internet: «The virtual autopsy»,

The following are provided to carry out the task:

1. The clinical history accompanying the request for an autopsy.
2. A copy of the official autopsy report issued by the Veterinary Medicine Pathology Diagnosis Service for each case.
3. The most important macroscopic and microscopic images necessary for presentation of the case autopsied in seminars are supplied to complete them.

The teaching staff of the subject is available for discussion of the progress of work or to solve possible problems or incidents that may arise while it is taking place throughout the process.

The clinical-pathological report must consist of the following compulsory sections:

3.1. Details of the animal autopsied

- species
- breed
- Age
- sex

3.2. Clinical history

This includes all the information relevant to the disease that caused the euthanasia or death of the animal. This includes

1. the anamnesis of the case,
2. the results of clinical examination of the patient or the inspection of a farm by health authorities
3. the complementary analyses carried out (haemogram, serology, biochemical, microbiological, parasitology,…)
4. the results of the image diagnosis techniques used. If the case for autopsy comes from the faculty's clinical veterinary hospital or farm, the students consult and study the records available in these centres.

3.3. Macroscopy

A concise but precise description of the lesions and anatomopathological macroscopic findings observed

3.4. Microscopy

Description of the microscopic lesions observed, and the complementary pathological techniques that may have been used.

Both the macroscopic images (which are produced during the autopsies) and the microscopic images are provided directly to the students by the teaching staff in charge of the subject. To that end, files (folders) are created for the autopsy cases which are

duly identified with the autopsy code. These are downloaded over the Internet in the temporary directory shared by all the computers in the faculty's computer room, where students can produce PowerPoint presentations for each case. The images used throughout the process come from the Pathological Anatomy Digital Pathology Archive of the UAB Faculty of Veterinary Medicine.

3.5. Diagnosis

Three types of diagnosis are encouraged, if possible:

1. *Anatomopathological or lesional*, which requires a very precise and correct use of terminology
2. *Etiological,* if any causal agent (viral, bacterial, parasitic, toxic, etc.) can be identified.)
3. when possible, *diagnosis of the disease* that caused the death (or euthanasia) of the animal.

Students should be advised that all three types of diagnosis are not always possible, but this does not mean that there is no need to argue and speculate reasonably on the cause or causes of the disease that the animal autopsied was suffering from.

3.6. Discussion

3.6.1. Pathogeny

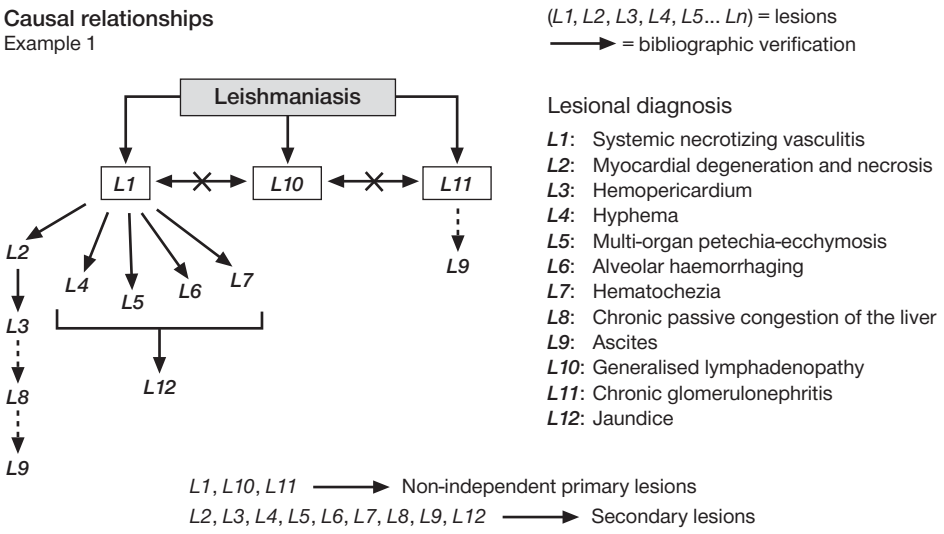
The objective of this section is to integrate all the information available from the specific case analysed and to establish reasonable (and reasoned) cause-effect relationships between the various anatomopathological lesions observed and between those lesions and the clinical signs (symptomology) manifesting during the animal's disease.

The pathogeny is subdivided in turn into three sections that facilitate general understanding of the case:

1. Establishment of causal relationships between the lesions observe
   The objective of this exercise is:
   a) To ascertain whether there are causal relationships between the various lesions diagnosed.
   b) To ascertain whether these lesions, taken together, are physiopathologically linked to a single syndrome or a single disease or whether on the other hand there are lesions that are not apparently linked to each other which may have a different cause.
   c) to ascertain whether there are concurrent diseases. In other words, it is necessary to find out whether the various lesions observed are the consequence of the same primary cause or of various causes that could have been concomitant in the individual.
   d) to ascertain which lesions are primary (arising directly from the cause of the disease) and which are secondary (arising from primary lesions).

Some examples of pathogenic diagrams produced according to the causal relationships established and/or supposed in the range of lesions observed are shown below:

Figure 1. Pathogenic diagram for Leishmaniasis



Assessment of the causal relationships between the various pathological lesions observed is based on simple hypothetical propositions that assess the possible cause-effect relationship between each one. These are simple propositions along the lines of: *L1* → *L2*, in which L1 would be the cause of *L2*. Obviously, the establishment of these causal relationships must always be argued in accordance with the basic existing bibliography (generic reference texts recommended by the various academic disciplines).

2. Establishment of causal relationships between the lesions and clinical signs and symptomology observed.

   The objective of this exercise is:

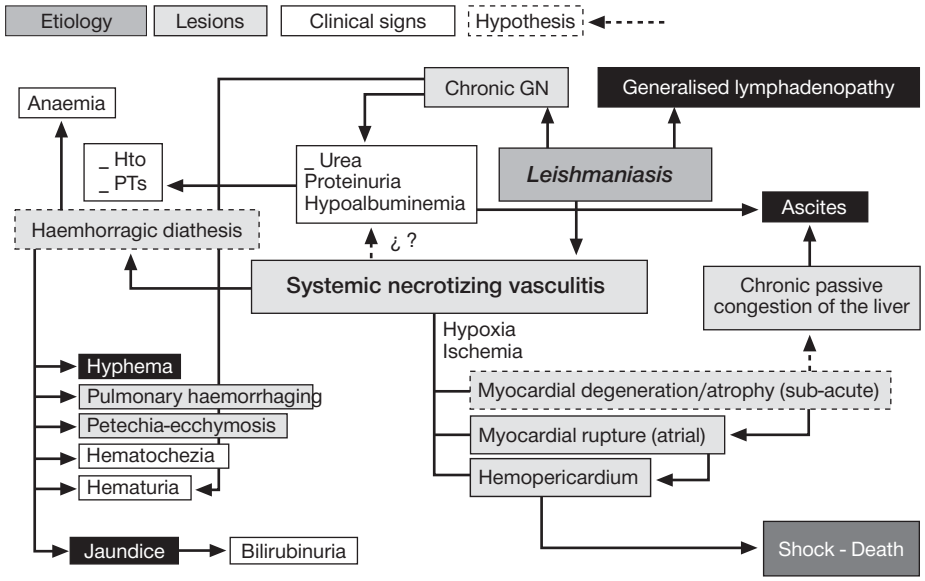
   a) to ascertain whether there are causal relationships between the various lesions diagnosed and the clinical signs and symptomology.

   b) to ascertain whether the clinical signs observed are a manifestation of a single syndrome or the same disease or whether there are clinical signs and symptomology that are not apparently linked to each other and which may have different causes.

   c) to ascertain whether there are concurrent diseases.

Example 1: (linked to «Example 1» – causal relationships)

Figure 2. Causal relationships



3. Ascertain the ultimate cause of death of the individual
   From both a point of view of professional ethics and the scientific point of view, in the final analysis, the ultimate objective is to try and explain the disease as thoroughly as possible or to ascertain the ultimate cause (or contributory causes) leading to the death of the animal; or where appropriate, produce reasoned and reasonable hypotheses (checked using the bibliography) in that regard.

3.6.2. Differential diagnosis

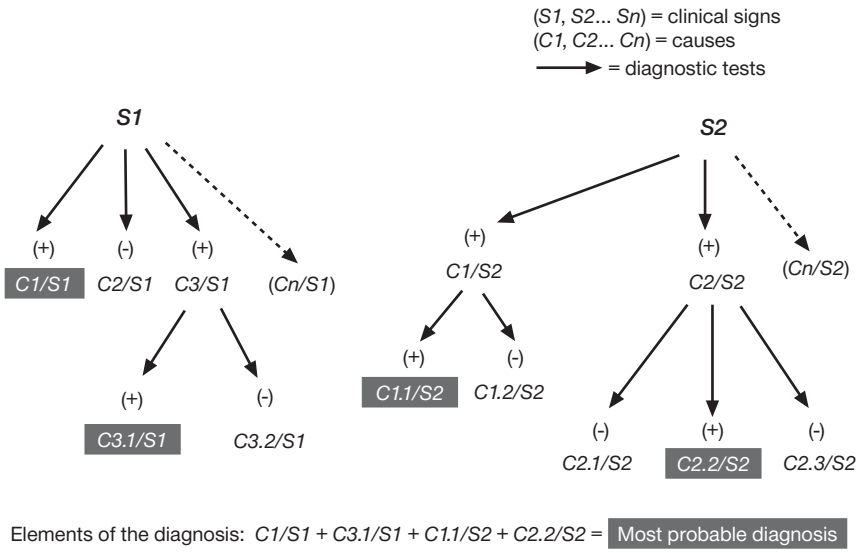
In essence, this section involves a thorough «recreation» of the entire diagnostic process supervised by the professionals/teaching staff responsible for the clinical-pathological case studied: from the point at which the patient began to show clinical signs of disease —*ante-mortem*— until it was autopsied and the final report on the cause of death was produced —*post-mortem*.

This «recreation» takes place using a reasoned and systematic protocol which attempts to ascertain, from among all the possible causes of the clinical signs presented by the patient, only those that are really related to the disease that the animal suffered from. This process is called the ***diagnostic algorithm***. To that end, the protocol is helped by and uses the diagnostic techniques currently available in professional veteri-

nary practice to discern which cause or causes from among all those possible were in reality responsible for the pathological process analysed.

The diagnostic algorithm is as follows:

Figure 3. Diagnostic algorithm



3.6.3. Bibliography

http://minnie.uab.es/~veteri/necropsia/index.html

3.7. Presentation

The presentation of autopsy cases takes place in the classroom (seminars) as follows:

1. 4 seminars of 1.5 h
2. 3-4 cases / seminar
3. 2-4 students / group
4. Procedure:
   a) Free presentation (lasting around 15-20 mins).
   b) Discussion between the group making the presentation and the other students and teaching staff.
   c) Final comments by the teacher on the case and assessment of the strong points and weak points of the report presented and the presentation made.

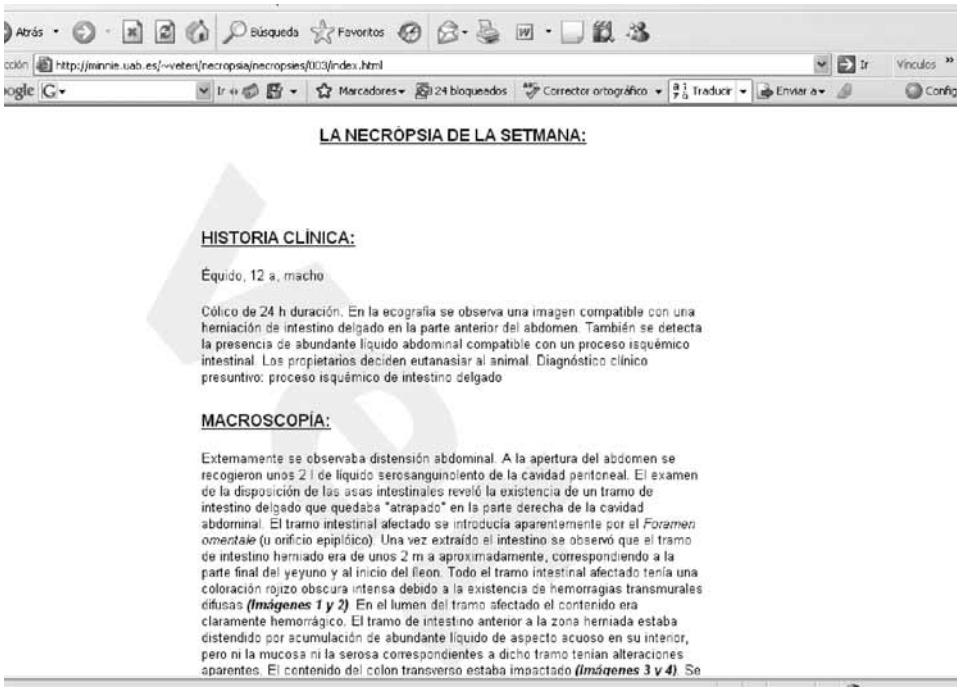
- Assessment: equivalent to 20% of the final grade. The format of presentation of work, the contents and presentation and classroom discussion is taken into consideration.

3.8. The virtual autopsy

A selection of the most relevant or representative cases among those considered during the practical autopsy module is permanently available on the Internet on the «Virtual Autopsy page»: http://minnie.uab.es/~veteri/necropsia/index.html

The objective is to build an archive that is sufficiently representative to be used as an invaluable complement to standard teaching.

Figure 4. Virtual necropsy



4. Results and discussion

The application of the initiatives described above enable the following results to be obtained

- An increase in the number of autopsies «attended» by students (12-15 additional autopsies /student): as well as the «real» autopsies attended by the students during the course's autopsy practical sessions (25 scheduled hours), all students have the opportunity to attend the presentation of 12-15 additional «virtual» autopsies, which have a high level of pathogeny development and discussion of these cases. In addition, the Internet Virtual Autopsy is a page that is always avail-

able, where the archive of autopsies of different species selected by the teaching staff of the discipline can be consulted.

- Use of the same autopsy for programming two different practical sessions: this means that some autopsies selected in the autopsy room because of their educational interest, as well as being discussed «in situ» in the autopsies room, are subsequently worked on by groups of students as set out above.
- Elimination of theoretical seminars: as the autopsy practical session is undoubtedly the most important and recommendable type of practical session in the subject from the educational point of view and one of the most important in the qualification, eliminating the seminars that were only for complying with the number of practical credits assigned and replacing them with practical sessions was a priority. In addition, given that the annual influx of autopsy cases and the number of students that take the subject each year (around 180) does not permit more than two weeks of autopsies/student to be programmed, the «virtual» autopsy was used as a type of practical session. Although it is of lower quality than the «real» autopsy, it nevertheless had other important characteristics that made it useful and interesting according to the teaching criteria set out by the EHEA.
- Reduction of presence learning: the effort that each students has to make to produce the autopsy report is estimated at 40 h.
- The main advantage and the most important educational benefit of this type of teaching is that it involves «integrated» learning of the clinical procedure and the entire diagnostic process of the disease. This in turn infers that the main characteristic of these practical sessions is their interdisciplinarity, as work with different subjects in medicine and veterinary health is required in order to produce the reports and their presentation in the classroom, and specifically those related to the professional sphere.
- Direct learning from the professionals responsible for the cases studied: as well as the tutorials for the subject itself, students can consult the clinical-pathological record of the case on an ongoing basis and discuss it with the professionals who were responsible in the case of the autopsy studied.
- Establishment of cause-effect relationships between the clinical profile and the lesional profile (pathogeny) of the *specific* case in the autopsy studied: this means that the student has to make an effort towards understanding the physiopathology and pathology of the case studied, the main advantage of which is that it refers to the specific animal autopsied and not to the disease which it may have suffered from in a generic sense. In other words, it is learning based on a «real» case, which has the very important advantage of being if not comparable, demonstrative and easy to assimilate to the real cases that students will have to solve during their professional life.
- Obligatory production of a justified and argued diagnostic algorithm: the crucial importance of the diagnostic protocol shown to the student in this type of prac-

tical session is that it is the same as the one used by medical and health veterinarians in their profession life. Teaching the student that not all cases can be solved (diagnosed) in a satisfactory or reliable manner is also considered of vital importance, as it is necessary to accept this due to its inevitability.

- Appropriate use of terminology and appropriate use of concepts: a great deal of emphasis is placed in the various sections of the report on the appropriate use of terminology, particularly as regards diagnoses.
- Encouragement of criticism and the consideration of explanatory hypotheses for the facts observed: as a whole, the general idea applied for the production of the report which is passed on as a key idea for future professional practice is that it is necessary to justify and argue all the terms of the clinical-pathological discussion of the possible problems that may arise during profession work. Furthermore, in terms of the final diagnosis of the disease that may have caused the death of the patient, the student is urged to learn how to distinguish between what is a certainty and what is a reasoned speculation that is considered probable. For this reason, in the event that it is impossible to give a reliable diagnosis (insufficient or contradictory information, lack of specific information, etc.) on the cause or causes of the animal's death, the student is made accustomed to consideration of explanatory hypotheses on what the most probable causes could be.
- Introduction to professional practice: in general, for all the reasons above, we feel that this type of practical session is a reasonable approximation to professional work.

5. Conclusions

1. This type of teaching is a very useful and relevant example of «learning based on real cases».
2. Conceptually and operationally, it is comparable to a «pre-professional» practice
3. It vastly increases the efficiency and use of autopsy cases, which is a type of activity that is lacking and quite onerous in terms of carrying it out: It maximises the use of real autopsy cases carried out by the Public Veterinary Pathology Diagnostic Service in the Faculty of Veterinary Medicine autopsy room.
4. It is a type of learning that promotes and encourages criticism and logical thought and systematic in a radical way.
5. The entire process enables a very important digital pathology archive to be maintained, which is unique in Catalonia.
6. There is a very significant level of acceptance and regard for the entire process by the students.

References

Bosco, A. (2007). «EVAINU research: new virtual learning environments for educational innovation at university». *Journal of cases on information techonology*. 9 (2), 49-60.

Interesting links

- Innovation website: http://quiro.uab.es

Keywords

Self-directed learning based on real cases, interdisciplinarity criticism, digital pathology archive, teaching efficiency, EHEA, ICTs.

Financing

This project was financed by the 2005 AGAUR program for the Improvement of Teaching Quality in Catalan Universities (ITQ) (identification number 2005MQD 00055.).

Supplementary materials on the CD-ROM

Demonstration of the VIRTUAL VET website: tour of the real necropsies for the the Special Pathological Anatomy course.

Project leader

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Presentation of the project leader

The author is a professor of Pathology (Pathological Anatomy) at the UAB Faculty of Veterinary Medicine. He is also head of the Veterinary Pathology Diagnosis Service which provides the cases for autopsy necessary for practical sessions in teaching. He works on the implementation of the ICTs and the EHEA in pathology teaching in Veterinary Medicine, and mainly on the use of the ICTs to achieve maximum accessibility for students to materials with a high educational value, as well as on types of self-directed learning and learning based on real cases as key strategies for the teaching of Veterinary Medicine in the future.

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Production of videos of biochemistry techniques and databases of questions raised

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Abstract

The general objective of this project is the production of materials for use as tools for promoting independent learning in a semi-distance learning environment. Two videos were produced of two basic experimental techniques in Biochemistry: chromatography and radioligand binding. Both videos include the filming of experiments that involved sophisticated manipulations which had to be carried out in the teaching laboratories of the Biochemistry Unit in the Faculty of Medicine. A database of multiple choice questions was produced. This currently consists of 200 classified and reviewed Biochemistry and Molecular Biology questions. Supervised use of the video and the questions, together with assessment of understanding of presence sessions by means of a Rapid Test and linking biochemical knowledge to normal intuitive knowledge, has led to an improvement in the academic performance of the students, as it has increased the number of students passing the subject as well as the proportion of students with good grades.

General area interest of this innovation

In the subject: «Biochemistry and Molecular Biology» of the first year of Medicine and in the subjects: «Biochemistry of the Nervous System» and «Pharmacological Biochemistry» in the current Biochemistry Degree course (3rd and 4th year). Other studies which include Biosciences teaching.

1. Objectives

The overall objective of the project consisted of producing teaching material aimed at improving the student's education and academic performance, for use in a semi-distance learning environment. The specific objectives sought with the materials produced are:

1. to promote understanding of the concepts explained in the theoretical classes.
2. to give the student an idea of experimental techniques that are impossible to cover in teaching laboratories, due to their complexity and/or danger.

2. Description of the project

In order to achieve these objectives, two videos were produced showing experiments that involved sophisticated manipulations, and a database of two hundred Biochemistry and Molecular Biology questions was prepared. Other related initiatives were: *a*) assessment of understanding of presence learning by means of a «Rapid Test» and *b*) linking biochemical knowledge to normal intuitive knowledge in the students' surroundings, using «metaphorical» examples called «Figurative Biochemistry».

Video 1 with the following title:
Teaching video for understanding chromatography: use of the HPLC Technique to determine changes in the synthesis of a neuro: histamine.

This Video has received the following ISBN number: 978-84-690-7137-3

At present, first year Medicine students carry out practical laboratory sessions in which they apply thin layer chromatography to separate molecules and perform qualitative analysis of its presence in samples of tissue. Despite the theoretical principles being basically the same, it is impossible in practice to carry out high resolution chromatography (HPLC), which is commonly used to quantify various molecules, not only in basic research but also in the clinical laboratory. Third and fourth year students in the Biochemistry degree course are aware of the theoretical foundations of HPLC but also cannot carry out high resolution chromatography in practical laboratory sessions due to its high level of complexity and the expense involved.

Video 2 with the following title:
Teaching video for understanding the concept of chemical balance by means of a laboratory practical session : a study of the coliergic muscarinic receptors using the radioligand binding technique

This Video has received the following ISBN number: 978-84-690-7136-6

At present, the theoretical basis of enzymology and the study of first messenger receptors, which share the concept of chemical balance, are explained to both first year students of Medicine and third and fourth year students on the Biochem-

istry Degree course. Despite being crucial in understanding most biochemical phenomena, this concept is difficult to pass on the students properly in both basic and advanced courses.

For the last five years, Biochemistry degree course students have been carrying out laboratory sessions focusing on the study of first messenger receptors by means of the radioligand binding technique, but the level of complexity, danger and expense of this technique, means that it cannot be fully carried out in experimental laboratories.

3. Methodology

Experiments of the same type as those used in the research lines of some teachers in the team, and which use the techniques to be shown, took place during the filming of the video. In this case, the experiments focused on a specific breakdown of the various stages in each technique. Brain tissue from two Sprague-Dawley rats bred in the UAB animal supply facility were used as biological material. The animals were handled in accordance with the European Community Directive on the regulation and use of laboratory animals (86/609/CEE of 24 November 1986) and the Autonomous Regional Government of Catalonia decree (Official Bulletin of the Autonomous Regional Government of Catalonia 2450 7/8/1977). The experimental procedures were approved by the Animal and Human Experimentation Ethics Committee of the UAB and used in previous studies (Torrent et al., 2005; Robles and Sabriá, 2006).

Video 1, focusing on chromatography, presents:

1. Obtaining samples suitable for the study of neurotransmission from brain tissue
2. The basic foundations of two types of chromatographies: ion exchange and HPLC
3. The application of these techniques to a practical example the study of changes in the synthesis of the histamine neurotransmitter due to the effects of depolarizing stimulants.

Video 2, which focuses on understanding the concept of balance, presents the introductory part which is not possible to undertake in the practical laboratory, in the following sections:

1. Obtaining cerebral cortex membrane samples
2. The basic foundations of the radioligand binding technique
3. The application of these techniques to a practical example determination of the dissociation constant of a high affinity muscarinic ligand by means of a saturation curve
4. The mathematical working which is the basis for calculation of the dissociation balance constant (Kd) of the ligand to its receptor

The video is designed to be shown just before the students begin the experiment. After the experiment is completed, the data obtained by the students in the laboratory are analysed in the computer room in order to obtain the Kd value.

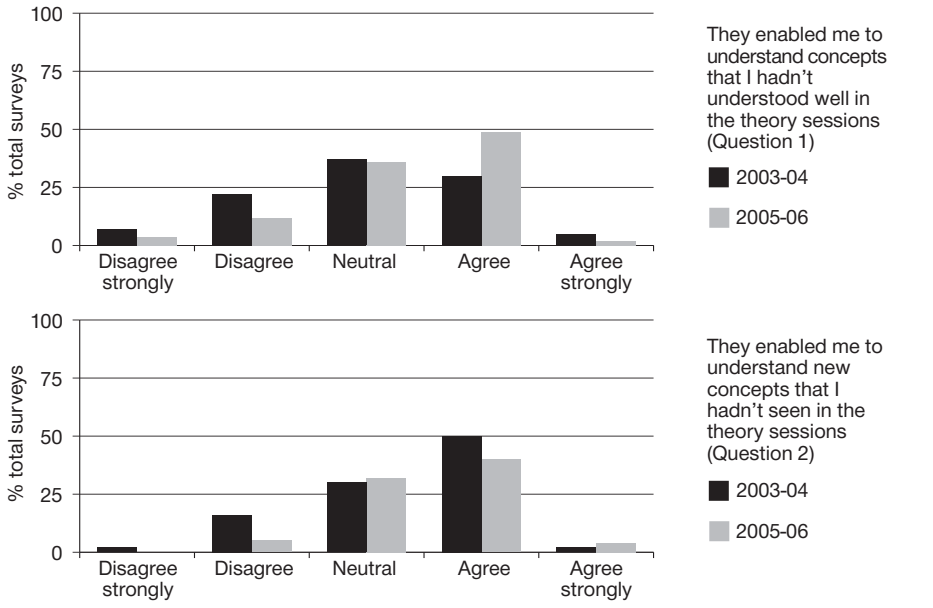
In order to make up the database, multiple choice questions were used, as well as short answer questions used in course examinations and/or classroom seminars over the previous 4 years.

4. Results

4.1. Use of the videos

The results of the use of the previous educational videos for the 1st, 2nd and 3rd cycles is currently in the assessment phase. Despite the assessment process being in its initial phase, there are observations available from previous courses, in which videos on techniques for obtaining biological samples and experimental techniques with cell cultures have been used with 1st year students on the Medicine degree course and 3rd year Biochemistry degree course students. In both cases, comparison of the grades obtained by the students in the sections covering the subjects dealt with in the videos showed an improvement in grades (an increase of 0.25 points in the final grade), and the improvement was also noted in students' performance and motivation based on a survey evaluating the practical sessions, and their protocols which were published by the UAB in 2005 (Sabriá et al. 2005) (Figure 1).

Figure 1. Results of the surveys on the perception of practical sessions of 1st year Biochemistry and Molecular Biology students in Medicine (2003-2004 academic year: 166 surveys; 2005-2006: 236 surveys)



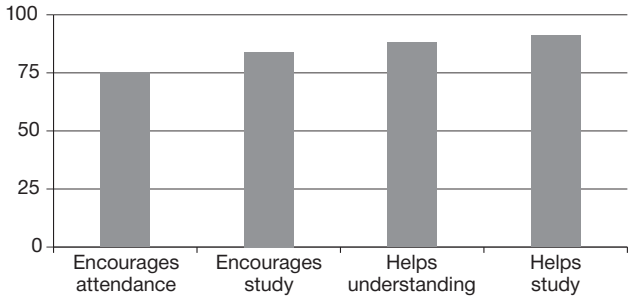
We feel that the activities mentioned above could have contributed to this increase in the number of students choosing our course.

As regards the video on the binding technique for understanding the concept of chemical balance, Dr. E. Claro, one of the teachers participating in this project, published the manuscript entitled: «Analyzing ligand depletion in a saturation equilibrium binding experiment» in the international journal on Biochemistry teaching Biochemistry and Molecular Biology Education, (Claro, 2006). We also saw how the implementation of the technique described in the video on the «Pharmacological Biochemistry» course and the opening of a *Forum* on the Virtual Campus coincided with an increase of over 50 % in the number of people registering for the course. Despite there being no objective data showing a cause-effect relationship, it is possible to suggest that these activities may have contributed to this increase in students choosing the course.

4.2. Use of the Rapid Test (QQ)

In order to assess understanding of face to face sessions, (watching videos, theoretical classes and classroom seminars) experiments also took place on the educational usefulness of the «rapid test» type tool (currently included in the HPLC Video) during the 2005-2006 and 2006-2007 academic years, with students on the «Biochemistry of the Nervous System» and «Pharmacological Biochemistry» courses, in Classroom Practical Sessions and Seminars. In this activity, the teacher distributed several scientific articles on the given theoretical subject for class discussion, after a brief introduction by the teacher emphasising the points that he/she considered most important. A discussion then took place in which the teacher recorded the contributions made by students and the «Rapid Test» finally took place. An improvement in the students' academic performance and motivation was observed. In specific terms, this was: the final mark obtained by students in this test

Figure 2. Results of surveys on the usefulness of the Rapid Test (QQ) of Biochemistry of the Nervous System and Pharmocological Biochemistry students (2005-2006 and 2006-2007 academic years). Total surveys: 41

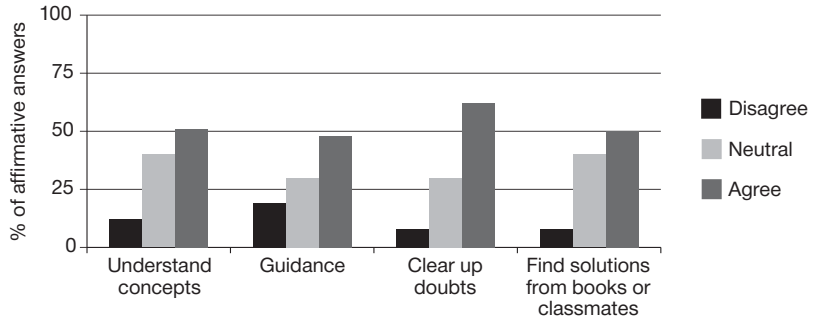


was excellent in all cases, and the results of a survey in two academic years of students in two second cycle subjects showed that over 70% of students thought that the «Rapid Test» had been useful to them (Figure 2).

4.3. Use of the Biochemistry questions database

Part of the Biochemistry questions database were used in the 2006-2007 academic year in order to complement teaching by means of supervised independent learning sessions (SILS). These are the basis for the Teaching Innovation experience which is being undertaken at the Medical Biochemistry Unit of the Biochemistry and Molecular Biology Department at the UAB. The results of an anonymous survey completed by 216 students out of a total of 344 who sat the second partial examination in June 2007 showed that over 50% positively rated the supervised independent learning activity, which includes the use of questions with corrected answers. (See Figure 3)

Figure 3. Results of the surveys on the usefulness of surveys SILS (supervised independent learning sessions) of Biochemistry and Molecular Biology students in the first year of Medicine. (2006-2007 academic year). Total surveys: 216



4.4. Other experiences: «Figurative Biochemistry Tales»

During the 2002-2003 academic year, students from a theory group on the «Biochemistry and Molecular Biology» course of the 1st year of Medicine (160 students in total) were invited to submit a «text commentary» on the article «A long, long time ago...» (Bootland, 1998) and to create what we called «Figurative Biochemistry Tales». Work was received from 40 students, of which more than 70% passed the course and over half did so with very good marks in the final grade. Their subjective assessment was very positive.

5. Conclusions

The use of the following activities and teaching items: *a*) projection of videos, *b*) «Rapid Test» of understanding, *c*) voluntary submission of a «figurative-metaphorical» task, *d*) establishment of a *Discussion* Forum on the experimental results in the Virtual Campus was valued very positively by the students and was seen to be correlated with improved academic performance by the students.

References

BOOTLAND, Duncan (1998). «A long, long time ago in a land far away, a story about alpha-Ketoglutarate». *Biochemical Education*, 26, 14-15.

CLARO, Enrique (2006). «Analyzing depletion in a saturation equilibrium binding experiment». *Biochemistry and Molecular Biology Education*, 34, 428-431.

ROBLES, Noemí; SABRIÁ, M. Josefa (2006). «Ethanol consumption produces changes in behavior and on hippocampal alpha7 and alpha4beta2 nicotinic receptors». *Journal of Molecular Neuroscience*, 30, 119-20.

SABRIÁ, M. Josefa; BALTRONS, M. Antonia; GIL, Carles; ORTIZ, Jordi (co-ord). (2005). *Pràctiques de laboratori i problemes de bioquímica i biologia molecular*. Bellaterra: Universitat Autònoma de Barcelona Publications Service.

TORRENT, Anna; MORENO-DELGADO, David; GÓMEZ-RAMÍREZ, Jordi; RODRÍGUEZ-AGUDO, Daniel; RODRÍGUEZ-CASO, Carlos; SÁNCHEZ-JIMÉNEZ, Francisca; BLANCO, Isaac; ORTIZ, Jordi (2005). «H3 autoreceptors modulate histamine synthesis through calcium/calmodulin- and cAMP-dependent protein kinase pathways». *Molecular Pharmacology*, 67,195-203.

Interesting links

The videos produced can be viewed via the video streaming server of the Faculty of Medicine Multimedia Resources Centre, where they are accessible from the Internet by means of the following URLs:

- http://medic101.uab.es/qtmedia/media/hplc.mov [2008]
- http://medic101.uab.es/qtmedia/media/hplc_2.mov [2008]
- http://medic101.uab.es/qtmedia/media/qnb.mov [2008]

Keywords

Biochemical techniques, chromatography, chemical balance.

Financing

This project was financed by the 2005 AGAUR program for the Improvement of Teaching Quality in Catalan Universities (ITQ) (identification number 2005MQD 0009).

Supplementary materials on the CD-ROM

Video of biochemical techniques and data bases of commented questions.

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Presentation of the project leader

The head of the project, Dr. M.J. Sabrià, has participated in various teaching innovation initiatives for over ten years: these include the production of educational videos, advice on higher secondary education research work as part of the Argó Programme, producing supervised independent learning sessions, attendance at IDES training workshops and presenting communications to teaching innovation day sessions.

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Health in the Twenty-First Century: a Shared Responsibility
An experience for creating an interprofessional working culture

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Abstract

Health in the Twenty-First Century: a Shared Responsibility is a university course that aims to provide students studying various courses with the skills to understand and construct the concepts of health and welfare from an overall perspective and to provide interdisciplinary answers to the most frequent health problems. The aim was to attain capacity for interdisciplinary work by means of acquiring skills such as responsibility, dialogue and agreement skills, knowledge integration, adaptation to changes, tolerance and uncertainty management. Problem-based learning (PBL) methodology was used for working on these skills. With these objectives, a team of teachers from various courses and attached centres of the UAB suggested the creation of this course in the 2004-2005 academic year. This publication presents the results of three years of experience, from 2004 to 2007.

General area of interest of this innovation

The key teaching innovation features of this course were an interdisciplinary focus on health and students' self-directed learning, using problem-based learning methodology (PBL). This interdisciplinary approach was a challenge for both the students and the teaching staff, who had to adapt to working with the logic of complexity and uncertainty.

1. Objectives

The purpose of this project is to create an interdisciplinary working space where the various aspects related to health are taken into account: these include its biological, psychological, social, cultural, economic, political and environmental facets, among others. Based on this purpose, three general objectives were established: (1) To understand and construct the concepts of health and disease from an overall perspective; (2) To generate interdisciplinary answers to the most frequent health problems, without forgetting individual responsibility; and (3) To develop self-directed learning skills In order to attain these objectives, twenty-three learning objectives associated with three specific skills and five transversal skills were established (see the correlation between the skills and learning objectives in table 1). The teaching team, which was accustomed to working in a clearly defined knowledge environment, also had to acquire new skills for working in an interdisciplinary team and to learn the PBL methodology.

Table 1. General objectives of the course, skills and learning objectives

General objectives of the course

1. To understand and construct the concepts of health and disease from an overall perspective.
2. To generate interdisciplinary answers to the most frequent health problems, without forgetting individual responsibility.
3. To develop self-directed learning skills.

Specific skills	Learning objectives Atesa una situació o un escenari d'aprenentatge, l'estudiant ha de ser capaç de:
1. Analyse the concept of health and welfare from an overall perspective.	1. Identify the determining factors that affect the situation considered. 2. Analyse the relationship and involvement of the various determining factors in the problem presented. 3. Formulate pertinent questions and consider possible explanatory hypotheses. 4. Assess the health and welfare needs of individuals from an overall perspective.

2. Work as part of a team and analyse the benefits arising from an interdisciplinary approach.	1. Establish priorities, goals and objectives for action. 2. Identify the various perspectives for analysis and dealing with the same problem. 3. Analyse the role of the various professionals involved in terms of the proposed solution and clearly identify the contribution of their knowledge area.
3. Suggest comprehensive solutions to the health and welfare situations considered and be able to apply them on a general basis	1. Define the advantages and possible disadvantages of interdisciplinary work. 2. Assess the importance of individual responsibility in comparison to teamwork. 3. Plan a working pattern consistent with the learning objectives as a group.
Transversal skills	**Learning objectives** In all the group work situations and in the individual assessment, the student will be able to:
1. Responsibility	1. Keep to timetables. 2. Carry out previously established tasks.
2. Inter-personal communication skills	1. Establish empathetic and assertive communication with classmates. 2. Effectively use listening and non-verbal communication.
3. Effective oral and written communication	1. Express and describe their ideas and knowledge of the learning objectives established in the tutorial sessions in an appropriate and understandable manner. 2. Write their ideas correctly and clearly. 3. Interrelate specific knowledge comparing various perspectives. 4. Argue their position on decisions taken, in a well researched manner.
4. Research capacity and information management	1. Seek relevant information for learning. 2. Use the tools and information technology (ICTs) in a manner appropriate to the established objectives.
5. Tolerance and handling of uncertainty	1. Be tolerant when facing ambiguous situations 2. Develop creative and intellectual thought to manage uncertainty. 3. Develop a critical facet.

2. Description of the project

2.1. Analysis of the context and improvements that the innovation could contribute

The diversity and complexity of interactions between the factors explaining health, the social transformations of recent decades, the culture of specialisation and the fragmentation of knowledge make a paradigm shift necessary that leads to the recovery of a holistic construction of health (Caminal, 2005). The multicausality which explains the majority of health problems and the revealing information that can be obtained from the multidisciplinary perspective must have an important influence on the training of

future professionals in order to provide them with the skills for working in interdisciplinary teams (Orchard, 2005). In this context, it is clear that generic knowledge of understanding and giving answers to health problems from an overall and integrated perspective competition is a basic skill for all professionals, and those in the health field in particular.

Designing and organising a teaching product on health which involves various areas of knowledge beyond the frontiers between faculties and courses is complex and difficult. Despite this difficulty, there have been some studies (Goelen et. al., 2006) that have shown the effects of a positive change in attitudes on the value of interdisciplinary work in the health field after experiments in university education using PBL methodology. As a result, it is therefore to be anticipated that students become familiar with the complexity of health and disease, and analyse and suggest possible answers to the problems generated by the psychological, social and political conditions in which people live.

2.2. Stages in the process of creating a course

The creation of this course took place in the following phases: (1) Establishment of the teaching team and design of the project (2003-2004); (2) Development and organisation of the project and training and experimentation with the PBL by the teaching team.

2.3. Characteristics of the innovation

The following tools and strategies were used to in the students' interdisciplinary learning and self-directed learning: (1) Case studies that ensure an interdisciplinary approach and which are appropriate to the diversity of origins and levels of knowledge of *health* among the students; (2) The ongoing training of the teaching team in the PBL methodology and their training as tutors and (3) Promotion of the cultural change in the attitudes of teaching staff towards implementing teaching in a multidisciplinary team and developing and maintaining learning skills within the framework of the «*learn by teaching*» paradigm. This change requires working in a climate of trust and constructive critical analysis in order to be able to include the complexity of health as a knowledge area that is not defined, and awareness that the knowledge area is incomplete (Consul, 2007).

3. Methodology

The methodology includes two tools: (1) PBL as an innovative teaching tool which facilitates the self-directed learning experience and interdisciplinary teamwork in order to structure the health knowledge unit, and (2) shared assessment as an exercise in responsibility which enables the student to take autonomous decisions.

3.1. Problem-based learning (PBL) methodology

PBL is based on a new paradigm of self-directed learning: The student plays the central role in his/her learning and the teacher is a facilitator or tutor in this process. The starting point of PBL is a situation, case or scenario which enables the student to identify needs in order to analyse the situation based on the learning objectives. The aim of PBL is for the student to understand and undertake an in-depth search for the answers to the problems that arise, which can be transplanted to other similar situations. This methodology includes the development of critical thought and uncertainty management as there is no single solution. It is also the excuse for learning and not the final objective of the process (Branda, 2001).

In order to ensure that the case studies contributed to an interdisciplinary focus on health, the following criteria were established: (1) The health problems considered were a real reflection of everyday life, so that the students easily identified cases from their future professional life; (2) When the text was written, all specialised language and the use of restrictive semantics were removed, no technical jargon was used and its point of view did not focus exclusively on knowledge of the health sciences; (3) They had to answer questions such as: Does it raise a problem which has possible solutions from various knowledge areas? Is it possible to provide an appropriate and effective professional response? Are there strategic formulas for integrating knowledge from the various professions involved? (See Appendix 1).

Student-based learning confers a great deal of importance on self-assessment as an exercise in free and responsible self-criticism, providing that this is subject to the opinion of both the other students and the members of the teaching staff

3.2. Shared assessment

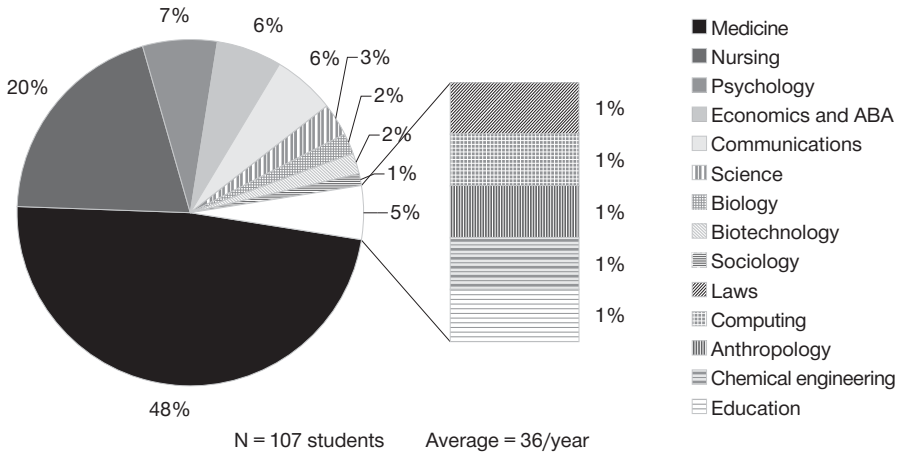
The assessment on the course includes self-assessment, by both the student and the tutor, peer assessment, a written final assessment test and evaluation of the satisfaction level. Shared assessment between the tutor and the students is an effective tool for working on individual responsibility and co-operative work (Aradilla and Tort, 2006). The assessment questionnaires were adapted for the UAB from the Medicine degree document of the Universidad Nacional del Sur, Bahía Blanca, Argentina, after permission was given.

4. Results

4.1. Level of penetration of the course on the campus

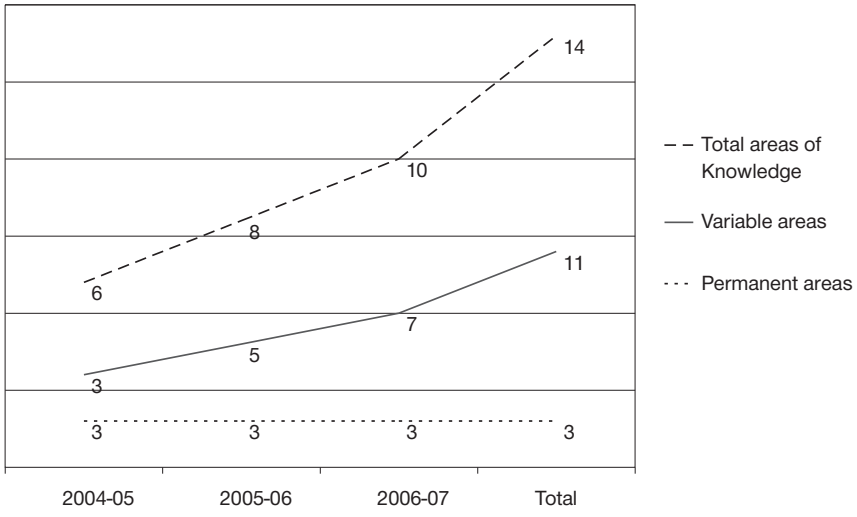
A total of 107 students on 14 different courses registered for the course in the three academic years between 2004-2007, which is an average of 36 students per academic year (see graph 1).

Graph 1. Percentage distribution of students by knowledge area. Period 2004-2007



During the study period, 3 permanent courses (Medicine, Nursing and Psychology) and 11 variable courses were identified. In the 11 variable courses, an increase from 3 qualifications in the first year to 7 in the third year was observed (see graph 2).

Graph 2. Distribution of knowledge areas. Period 2004-2007



4.2. Qualitative and quantitative assessment of the course by the students

The qualitative assessment particularly covered the transversal skills and took place by means of free and responsible self-criticism in the final minutes of the tutorial sessions, and used the information from the assessment questionnaires completed twice during each academic year. Students and tutors were subject to assessment in all phases (see results in table 2).

Table 2. Assesment of transversal skills. This table shows the summarised information (average answer) from the analysis of the components of the 5 transversal skills covered.

SKILLS	AT THE BEGINNING OF THE COURSE	AT THE END OF THE COURSE (% of students questionnaire assessment skills)
1. Responsibility	It is difficult for students to identify their responsibility in their everyday commitments to their classmates (punctuality, completion of tasks required) and they focus their attention on the teacher above all.	Students learn to inform their classmates of their absences and to negotiate the distribution of tasks (75%). They also learn to jointly decide who will assume leadership of a task (60%). They stop continuously looking at the teacher as they did at the beginning of the course (95%).
2. Inter-personal communication skills	Students do not interrupt each other, but do not include contributions from other classmates (active listening).	Students do not interrupt each other, and learn to undertake active listening without answering in a defensive way (75%).
3. Effective oral and written communication	Students express their difficulties with public speaking and expressing their ideas.	Students improve their skills in public speaking and in writing a text justifying their opinions with validated information. Improvement in argumental consistency (80%).
4. Research capacity and information management	Students do not know what and who are valid sources of information and associate searching for information exclusively with consulting the dissemination pages on the Internet.	Students have learnt to consult databases, to consult experts and to visit centres and institutions related with the case study. Improvement in the management and integration of information (60%).
5. Tolerance and handling of uncertainty	The students do not feel involved in situations that are not clearly defined and shift responsibility to institutions.	The students have learnt that there are no single and definite answers to the problems raised (90%).

The level of satisfaction with the course is assessed by means of the questionnaire completed by the students at the end of the course. Given that a significant percentage of the students (20 %) had had previous experience of the PBL methodology, the analysis was stratified according to the categories of the «*prior PBL experience*» (YES/NO) variable created). The results showed no statistically significant differences between the two groups. This meant that when teaching innovation is experienced (PBL in this case), unjustified resistance to it falls. Two positive assessments and two aspects for improvement are described in the open questions section in the questionnaire. The positive assessments were (the most significant expression is given): (1) Positive assessment of the teamwork experience (70 %) («I would never have thought that I could learn from courses so different from mine») and (2) positive assessment of the self-directed learning experience (85 %) («self-directed learning is much more difficult than conventional learning — in self-directed learning we have to set the work ourselves and we think that we learn more»). The aspects for improvement were: (1) Explaining the PBL methodology in more detail (45 %) and (2) More diversity in the make-up of groups (one of the two groups consisted exclusively of nursing and medicine students for two consecutive years) (30 %).

Quantitative assessment: measures the level to which all the specific and some transversal skills have been obtained. These skills are assessed individually by means of the individual's work on a case in order for the student to demonstrate his/her learning in two phases: (1) Make a work plan and plan the search for information; and (2) Respond to the personalised questions raised according to the course objectives and the proposal in their work plan. The average annual marks ranged between 7.5 and 7.8 and the individual marks between 5.1 and 10.

4.3. Qualitative assessment of the teaching innovation experience by the teachers

The establishment of a consolidated and stable interdisciplinary teaching team is one of the benefits generated by this teaching innovation course. Most of the teachers agree that the level required is very high, due to the need to deconstruct the administrative teaching models to which they are accustomed and also to acquire new skills, like the tutor. Contributing to work in interdisciplinary teams in the health field is a long and complex task which involves a cultural change that could start in university studies, as is being shown by this educational experience.

5. Conclusions

1. This health teaching innovation course obtained a very positive level of acceptance and penetration in the university community (36 students/year on average and 14 courses involved).

2. PBL is a methodology that facilitates the acquisition of transversal skills that are closely related to the capacity for interdisciplinary teamwork (active listening, respectful debate and the defence of one's own opinions, the recognition of one's own and others' value and constructive criticism).
3. Working in an interdisciplinary team was a participatory learning opportunity for both the students and teachers.
4. This teaching experience could be extended as a transversal subject on the curriculum of more qualifications, especially those in the health field; it could also be a useful tool in continuous training. In both cases, it would contribute to the cultural change necessary for sharing all health responsibilities.

References

ARADILLA, A. and TORT, G. (2006). *Mò dul transversal en infermeria gerià trica i comunità ria. L'Aprenentatge basat en problemes com a oportunitat per a un aprenentatge compartit*. Col·lecció Materials, 180. Bellaterra: Editorial UAB (pp. 37-40).

BRANDA L. A. (2001). *Aprendizaje basado en problemas centrado en el estudiante, orientado a la comunidad. Aportes para un cambio curricular en Argentina*. University of Buenos Aires and Pan-American Health Organization: Buenos Aires (pp. 79-101).

CAMINAL J. (2005). «Les necessitats de salut en el marc de la societat actual». A: Boixareu, R. M. (coord.). *La gestió de la salut, frontera è tica?* Ramon Llull University. Editorial Prohom, Edicions i Serveis Culturals, SL: Barcelona (pp. 43-66).

CÒNSUL, M. (2007). «La formación del profesorado: un cambio de cultura docente». A: CÒNSUL, M. (co-ord.). *Historia de un cambio: un curriculum integrado con el aprendizaje basado en problemas*. Vall d'Hebron University Nursing School. Servicios Editoriales. Enciclopedia Catalana, SAU: Barcelona (pp. 71-78).

GOELEN, G.; DE CLERCQ, G.; HUYGHENS, L. i KERCKHOFS, E. (2006). *Measuring the effect of interprofessional problem-based learning on the attitudes of undergraduate health care students. Medical Education, 40 (6),* 555-561.

ORCHARD, C. A.; CURRAN, V. and KABENE, S. (2005). *Creating a Culture for Interdisciplinary Collaborative Professional Practice*. Medical Education Online [http://www.med-ed-online.org. (Consulta: 08-03-2008)]: 1-13.

Keywords

Health, interdisciplinarity, problem-based learning, self-directed learning.

Financing

This course received financing in the UAB-2004 and AGAUR-2005 rounds. Figures taken from the UAB (Round of teaching innovation grants for 2004) and the AGAUR

(round of grants for financing projects for the improvement of teaching quality in the universities of Catalonia. 2005MQD-00282).

Supplementary materials on the CD-ROM

This publication includes an appendix containing some case studies in pdf format.

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Presentation of the working group

The majority of the members of the Health Teaching Innovation team belong to the «Equity in Health and Network Dynamics» Research Group. Their work is based on paradigm changes in the health model and they subscribe to the theoretical models for Social Determining Factors of Inequalities in Health and the integrationist models of cures from the bilateral arrangement perspective. They undertake interdisciplinary work in the research and teaching fields based on mutual trust, respect and the ethic of action.

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Virtual basic psychology laboratory: experience as the key to learning

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Abstract

The Virtual Basic Psychology Laboratory (VBPL) is a tool that accompanies the student on a journey through experiments that have become classics in the Cognitive Psychology field. The platform reproduces experiments from the study of emotion, language, memory, motivation, thought and perception.

In each experiment, the VBPL presents an introductory text with some articles for reference, where these experiments were suggested for the first time.

The VBPL is based on the Moodle e-learning platform, which enables each student to have their own space for saving the data, results and analysis that they have produced. All interaction with the system is recorded and can be consulted by both the student and the teacher at any time. This also enables the VBPL to be used as an assessment tool by the teacher.

The platform can be accessed at the following website: http://psicol93.uab.es/lvpb.

General area of interest of this innovation

This resource is especially aimed at Basic Psychology teachers, and practical teachers in particular. It is also an interesting resource for anyone wishing to learn some of the foundations of Cognitive Psychology by means of a series of classic experiments in this area which have been carried out over the last century.

1. Objectives

Universities have gradually been introducing tools for distance learning for some years. Of particular note within the knowledge area of Psychology has been the emergence of virtual laboratories that enable experiments to be carried out using computers, with no need to use the expensive infrastructure of experimental laboratories.

The proposal presented here is the first Virtual Basic Psychology Laboratory (VBPL), which contains some of the most typical experiments of the various basic processes psychological in the Catalan and Spanish languages. The main reason for the project was the need to reconsider the current methodology used for teaching some Basic Psychology courses. Much of the knowledge taught on these courses comes from experimental results, when means that the infrastructures necessary to allow all the students to carry out experiments must be available. In the majority of cases, this is very costly and inefficient. The VBPL is a feasible alternative to these limitations.

The VBPL is a tool that makes it possible for students to learn the key concepts of Basic Psychology based on their involvement in the knowledge construction process. To that end, the VBPL has all the materials necessary for students to acquire the necessary knowledge. The platform enables up to 10 different experiments to be carried out, the results obtained individually or as a group to be analysed, graphic depiction of these results, the original works where these experiments were presented for the first time to be read and scientific reports on the experiments carried out to be written.

The specific objectives of the VBPL are:

1. To develop the capacity to obtain knowledge based on one's own experience by means of performing experiments and the information available on the platform.
2. To contribute to the acquisition of instrumental skills (the ability to organise and manage information and to resolve problems arising during the experimental procedure).
3. To enable Psychology students to carry out experiments and data analysis anywhere and at any time.
4. To promote learning among equals by stimulating scientific exchange among users of the platform
5. To make a tool available to Psychology teachers enabling them to organise their practical classes in the environment of experiments and real data.

2. Description of the project

2.1. Context of the project

The Virtual Basic Psychology Laboratory (VBPL) is a joint project between the Universitat Autònoma de Barcelona and the University of the Balearic Islands, which

enables experiments to be designed, executed and their results analysed. The most immediate precedent for this project can be found on the web platform on visual illusions and thought (http://psicol93.uab.es/ilusions) which some teachers involved in this project had developed. This platform on illusions presents the effects of illusions in an educational and comprehensive manner, in order to encourage the deduction of explanations by students based on interaction with the Internet platform. The aim was also for the VBPL to contribute to developing the ability to obtain knowledge from one's own experience and to acquire instrumental skills.

2.2. Characteristics of the VBPL and the materials developed

In order to attain these objectives, it was necessary to define a «minimum journey» that the students would take on the platform. This «journey» had to promote the acquisition of instrumental skills when deducing the procedure for obtaining the results of experiments. In order to encourage progressive learning based on interaction with the platform, various phases were defined for each experiment presented in the Laboratory. The basic learning unit of the VBPL is «an experiment», and each experiment contains 3 distinct phases: presentation, execution of the experiment and analysis of results.

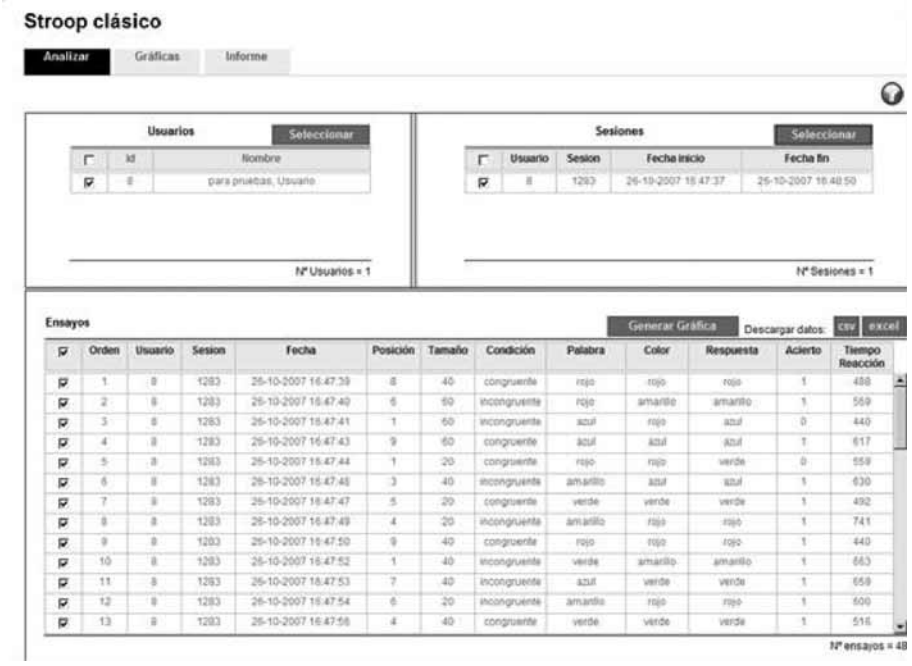
a) ***Presentation:*** this consists of the written introduction to the experiment in order act as a leveller of the knowledge related to the questions that were the reason for the experiment in question. This objective is achieved by text presenting the experiment (written by teachers specialising in the subject) which is also used to present the original article in which the experiment was carried out for the first time. The platform contains all the original articles in PDF format, as they are part of the material necessary to study the key concepts of the experiment in depth.

b) ***Experiment:*** consists of the student carrying out the experiments as a subject. The student can perform any of the experiments available as many times as he/she considers necessary. All the experiments are implemented in Flash Macromedia language, which enables accurate measurement of the data generated by interaction with the student (such as reaction time). The platform records each interaction with the student by the experiment, generating an experimental record. Various tests make up a session, in which the specific execution results (the independent and dependent variables of each test) and the general data (time, student's name, experiment performed, etc.) are kept. This enables the student not only to collect data from various sessions that he/she has executed, but also provides the opportunity to obtain data from various participants.

c) ***Results:*** This phase shows three tabs with different functions that are explained below: «Analyse», «Graphs» and «Report» (Figure 1).

Analyse: the VBPL presents a dynamic matrix of data for each experiment that makes work with data possible (ordering and removing cases and producing graphs)

Figure 1. Screen showing phase 3 of the Stroop experiment. In this case, what a student who has performed just one experiment session on 26 October 2007 would see is shown



so that the student begins to deduce possible relationships between the variables in the experiment. This process is essential for learning the concepts and for this reason, the student is guided in this search for relationships by the help tables and introductory text provided in the presentation phase of the experiment. During this phase, the student has a specific help text which will guide him/her through the analysis of data.

Graphs: in this phase, the VBPL enables various graphic depictions of the results to be generated based on the data selected beforehand in the matrix. These depictions can be left and recovered at any time in the «Graphics tab».

Report: The VBPL has a function that enables an online scientific report to be written for each experiment, according to the patterns and sections of a classic scientific report. To do so, the VBPL presents the student (after he/she has analysed and graphically depicted the results) with a text editor and a template providing guidance with writing the report. After the student has finished writing the report, he/she can press a button that shows that the teacher can read it. At the same time, the teacher

will receive notification that he/she has reports to assess, and has the opportunity to give feedback and make comments and to assess it with a grade. The VBPL therefore also contains a useful and efficient assessment tool.

2.3. Contents

At present, the VBPL consists of ten experiments that are illustrative of the main psychological processes (memory, language, motivation and emotion, attention, perception and thought). The specific experiments in the VBPL are shown in Table 1.

Table 1. Experiments currently available in the VBPL

Experiment	Process	Article reference
Meaning and Memory	Memory	Moscovitch and Craik (1977)
Contrast Sensitivity Function	Perception	Campbell and Robson (1968)
Mental Rotation	Perception	Shepard and Metzler (1971)
Emotional Stroop	Emotion	McKenna i Sharma (1995)
Iowa Test	Emotion	Bechara, Damasio, Damasio and Anderson (1994)
Classic Stroop	Attention	Stroop (1935)
Flanker Compatibility	Attention	Eriksen and Eriksen (1974)
Lexical Decision Task	Language	Forster and Chambers (1973)
Anchorage	Thought	Tversky and Kahneman (1974)
Framing	Thought	Tversky and Kahneman (1981)

2.4. Use

There are 9 courses involved in the VBPL: 4 at the UAB (Attention, Perception and Memory, Motivation and Emotion, Psychology of Thought and Language, and Principles of Psychology) and 5 at the UIB (Memory, Perception, Attention, Motivation and Emotion, and Introduction to Psychology). For this reason, the VBPL is flexible and allows each teacher to adapt it to the course objectives. The *Moodle* platform on which the VBPL has been created enables new courses to be produced, which means that teachers can add or remove content, thereby adapting a new VBPL course format using the experiments and activities that they select.

The VBPL is aimed mainly at students of these subjects. However, it is material that is open and accessible to other students and Internet users in general (although guest users have less functionalities available to them than a user registered on a course).

The VBPL web platform is implemented on *Moodle*. *Moodle* is a course management system designed for distance learning. This system enables the creation of virtual courses and student-teacher interaction in various ways (wikis, forums, questionnaires, file exchanges, links to web pages, etc.) The Student always works with a *Moodle* interface, which is very intuitive. It can be viewed at http://psicol93.uab.es/lvpb.(2008) In order to enter as a registered user, it is necessary to complete a short questionnaire giving a user name and password which enable the student to be identified throughout his/her interaction with the VBPL.

3. Methodology

The main initiatives carried out during the development of the VBPL can be summarised as four phases.

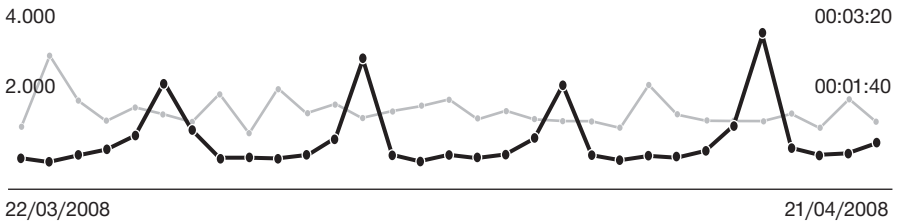
First, the general structure of the VBPL was defined. This included definition of the general phases on the journey of an experiment, interaction with the student and the opportunities for the platform to measure the experiments. The second phase covered the choice of experiments and the specific implementations required by each experiment. The third phase covered the technical assembly of the interactions in each phase. This assembly required specific knowledge of *Moodle*, *Flash* and *PHP* language. Finally, the last phase of development involved creating the texts accompanying each phase of the experiments (presentation, instructions for the experiment and help in analysis of the results) and writing the VBPL Users' Manual.

4. Results

The VBPL has been available since December 2007. Only teachers who participated in the project have been permitted to open courses during this initial trial phase. The VBPL will be open to teachers all over Spain from September 2008 onwards. This total opening phase of the VBPL means that it will be possible for any psychology teacher at a Spanish university to ask for their course to be opened in the VBPL. It is therefore important to stress that the results presented below come from this initial trial phase and must therefore be considered as preliminary.

There are currently 12 fully operational courses in the VBPL with a total of registered 753 users. To have some idea of the approximate size of the traffic, some of the figures for the last month (between 22 March and 21 April) can be used as an example. In that month, the VBPL recorded a total of 1393 visits, which led to a total of 17,629 pages being visited. This shows that in the medium term, each student that entered the VBPL visited approximately 13 pages and remained connected for an average of 11 minutes. In other words, less than one minute was spent on each page (see figure 2).

Figure 2. Daily changes in the amount of pages visited by all users (in black) and the average time spent on the page.



As regards the time taken for each visit in this period, the distribution of visits by duration is shown in figure 3. This figure shows that approximately 15 % of visits last less than 30 seconds (i.e. they are not real visits) while most visits last between 10 and 30 minutes (enough time for a student's visit).

Figure 3. Distribution of the duration of visits to the VBPL during the period between 22/3/2007 and 21/04/2008.

Duration of visit	Visits	Percentage of all visits
0-10 seconds	104	7.47 %
11-30 seconds	124	8.90 %
31-60 seconds	104	7.47 %
61-180 seconds	175	12.56 %
181-600 seconds	296	21.25 %
601-1.800 seconds	458	32.88 %
1.801 + seconds	132	9.48 %

96.85 % of these visits come from direct traffic. This means that users do not come to the VBPL from another page, but instead mostly write the address directly in their browsers (undoubtedly on the instructions of their teachers who give the http address during face to face classes). A more specific overview of the use of the VBPL can be obtained from an analysis of some qualitative indicators for a specific course. For example, the Perception course at the University of Balearic Islands offers a VBPL activity as an option. Of the total of 80 students on the classroom course, 50 accessed the VBPL at least once. Of these 50, 39 succeeded in executing at least one complete experimental session (20 % withdrew). The real produc-

tion of these 39 students can be seen in 68 graphs and 20 scientific reports (both products are placed in the VBPL, associated with each user, and are available to the teacher at all times). From the qualitative point of view, the teacher gave a very positive assessment of the use of the VBPL on his course, in terms of both ease of use and the relationship with the learning objectives that had been established for this activity. In any event, it should be borne in mind that we still have no specific comparative study that enables us to confirm the differences in learning after the introduction of the VBPL on a specific course. Studies of this type are planned for the second year of use of the platform.

5. Conclusions

By way of a conclusion, it can be said that the preliminary results currently available predict a high level of use of the VBPL by Basic Psychology teachers. We feel that the VBPL will have a great deal of impact on the implementation of teaching, mainly in practical sessions.

Furthermore, its use in practical sessions in core subjects enables improved the co-ordination of content between various subjects. We also feel that it will reinforce students' motivation.

In short, we expect the VBPL to contribute to the learning and understanding of various psychological processes, as well as becoming a useful tool for students to learn from their own experience.

References

BECHARA, A.; DAMASIO, A. R.; DAMASIO, H. and ANDERSON, S. W. (1994). *Insensitivity to future consequences following damage to human prefrontal cortex*. Cognition, 50, 7-15.

CAMPBELL, F. W. and ROBSON, J. G. (1968). *Application of Fourier analysis to the visibility of gratings*. J. Physiol. (Lond.), 197:551-566.

ERIKSEN, B. A. and ERIKSEN, C. W. (1974). *Effects of noise letters on the identification of a target letter in a nonsearch task*. Perception & Psychophysics, 16, 143-149.

FORSTER, K. I. and CHAMBERS, S. M. (1973). *Lexical access and naming time*. Journal of Verbal Learning and Verbal Behavior, 12, 627-635.

MCKENNA, F. P. and SHARMA, D. (1995). *Intrusive cognitions: An investigation of the emotional Stroop task*. Journal of Experimental Psychology: Learning, Memory, and Cognition, 21, 1595-1607.

MOSCOVITCH, M. and CRAIK, F. I. M. (1977). *Depth of processing, retrieval cues, and uniqueness of encoding as factors in recall*. Journal of Verbal Learning and Verbal Behavior, 16, 151-171.

SHEPARD, R. and METZLER, J. (1971). *Mental rotation of three dimensional objects*. Science, 171, 701-3.

STROOP, J. R. (1935). *Studies of interference in serial verbal reactions*. Journal of Experimental Psychology, 28, 643-662.

TVERSKY, A. and KAHNEMAN, D. (1974). *Judgement under uncertainty: Heuristics and biases*. Science, 185, 1124-1130.

TVERSKY, A. and KAHNEMAN, D. (1981). *The framing of decisions and the psychology of choice*. Science, 211, 453 - 458.

Interesting links

- Innovation website http://psicol93.uab.es/lvpb/login/index.php

Keywords

Virtual laboratory, experiments, cognitive psychology, virtual Campus.

Financing

AGAUR round (University and Research Grant Management Agency): Grants for financing projects for the improvement of quality in Catalan universities for 2006 (MQD) opened by Resolution UNI/53/2006, of 11 January. Date of ruling: 14 July 2006. File No: 2006MQD00068.

Basic Psychology Department of the UIB, and Basic Psychology Department of the UAB.

Supplementary materials on the CD-ROM

Web demonstration of the LVPB and virtual tour of different experiments that have become classics in cognitive psychology.

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Presentation of the working group

The team that undertook this project consisted of 13 basic psychology teachers at the UAB and the UIB, one research fellow and 3 computer technicians.

The management of the project was the responsibility of a smaller group of people consisting of 4 teachers (3 from the UAB and one from the UIB, the project's research fellow and the head computer technician. This group of workers remains active, working on platform maintenance tasks. The complete list of members of the group and their tasks within the project can be seen on the platform's home page.

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Development and assessment of the student's skills by means of the use of virtual learning files (VLFs)

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Abstract

This work presents the implementation of a teaching innovation undertaken at the UAB by a group of five teachers from five different courses. The experience consists of the implementation of Virtual Learning Files (VLFs) in order to improve the teaching, learning and assessment of general and specific skills in the context of the European Space for Higher Education, while including innovative non-classroom support methodologies based on Information and Communication Technologies. It includes the objectives, the theoretical framework leading to the innovation, the methodology used and an assessment of the results from the point of view of the teachers and students involved in the project, which considers the advantages and disadvantages of the experience.

General area of interest of this innovation

This innovative experience is of interest to university students and teaching staff in various knowledge areas: due to convergence with the European Higher Education Area, inclusion of the ICTs, student-focused learning, guided teaching and continuous assessment.

1. Objectives

The purpose of this project is to improve teaching, learning and assessment processes of the students' general and specific skills in the context of the European Space for Higher Education Area by using virtual learning files.

The following specific objectives were proposed:

1. To improve the students' performance and academic training in order to promote the development and assessment of transversal and specific skills that can be transferred to professional practice.
2. To introduce innovative teaching methodologies focused on the student's teaching and learning processes in the context of the European Higher Education Area.
3. To improve presence learning with the inclusion of distance support initiatives using new information and communication technologies.
4. To provide the university community with a guide to the implementation of the learning files in various subjects and knowledge areas.

2. Description of the work

The idea for this project arose in a work session organised as part of the Teaching Training Plan of the Group for Teaching Innovation in Higher Education (IDES) at the Universitat Autònoma de Barcelona (UAB) in 2006, at which a number of teachers from many highly varied disciplines and contexts (Computer Science, Veterinary Science, Social Sciences Teaching and English Philology) decided to undertake a project to improve the development and assessment of student's skills in the context of the European Higher Education Area (EHEA), using virtual learning files (VLFs) in various knowledge areas and using Information and Communication Technologies (ICTs) to improve the quality of teaching.

Both teachers and students are experiencing a process of profound change in the education system, which focuses on students and their learning (learning to learn). In this new scenario, the concepts of teaching and learning, their relationship with the skills to be developed and continuous assessment raise questions that encourage teamwork and interdisciplinary reflection by those involved, who are concerned to improve the quality of teaching.

It is this interest in the students' learning that has led them to share the experience in order to encourage teaching innovation and to facilitate the development of transversal and specific skills among students, in both presence and distance learning contexts.

Virtuality also encourages the gathering of evidence by teaching staff, constant feedback for improved management of teaching and continuous assessment of students throughout the teaching-learning process.

3. Methodology

3.1. Brief framework of reference

The learning file is one of many methods that can be used in higher education to assess students' learning, as it can be easily adapted to the needs of the context and situations in question. We feel that it is a method that is highly focused on the students' learning. It is a useful tool that enables the vast amount of evidence that illustrates the efforts and progress made by a student during the training process to be gathered.

Recently, the most specialised literature on learning files as an assessment method (Barberà, 2005; Colén, Giné and Imbermón, 2006; Gimeno, 2004; Klenowski, 2004; Zubizarreta, 2004; et al.) considers some of the objectives that facilitate its implementation in the teaching-learning process in higher education.

The Objectives of the Learning File in Higher Education are:

1. To observe the progress and process followed during learning, by both the teacher and the student.
2. To involve the student in his/her own assessment, as the student knows the objectives and assessment criteria and maintains a constant dialogue with the teacher about his/her own learning.
3. To demonstrate the level of competence and degree of in-depth learning and to validate teaching methods and techniques to facilitate and promote them.

To provide the teacher with more diversified information on learning and assessment and from different perspectives. By using learning files, subjects can become a path in which there is a permanent dialogue between group and individual work, and between reading and reflection. The course structure is that of a network in which the various activities on offer are the points of anchorage for the content structuring the programme. During the semester, the students construct the links between the various contents and consider them in depth, in order to have an overall view of the course by the end, and an overview of each of the contents and the relationships established between them. That is why assessment becomes an further factor in the teaching-learning process. It is considered as a process that gives information on the learning acquired by the student and helps to certify that the objectives have been achieved. Assessment by learning files becomes a tool that helps to analyse both the process and progress and the end result of learning.

3.2. Actions, means and resources used for the Teaching Innovation

Three instruments were designed and used for the introduction of the higher education virtual learning files (VLFs). Each of these had a different objective and therefore was used at a different point in the Teaching Innovation. The first instrument designed was the «initial questionnaire». This questionnaire consisted of 12 questions, organised in two blocs. Only students who had used a learning file previously

had to answer the first bloc. Those who had not used a file before had to answer the second bloc. The objectives of this questionnaire were basically:

1. To discover how many students had used a Higher Education Learning File (HELF), and how many had not.
2. To find out whether this file had been supported by the ICTs (virtual file — VLFs).
3. To find out how much weight the various HELF-VLFs had had in the final assessment.
4. To assess the experience of having used HELF-VLFs (positive/negative, advantages/disadvantages).

The aim of this questionnaire was to enable students to draw a general map of their knowledge and use of the learning file and of how they subsequently valued the experience.

The second instrument was the construction of a learning file index for each subject and the design of the Virtual Campus space. Decisions were taken depending on the theoretical framework briefly described above, i.e. the working dynamic and contributions from other members if the GI-HELF group and joint considerations with the UAB's Autonomous Interactive Teacher's Office (AITO) on improvement of the UAB's Virtual Campus.

The third and last instrument used in this teaching innovation was an adaptation of the Student Experience of Education Questionnaire (SEEQ). The blocs in which this questionnaire is organised were retained, and some new ones were added, which were linked to virtuality and the use of assessment systems other than final examinations, such as the learning file.

These three instruments, produced jointly by all the teachers involved in the innovation and assessed by experts in the field, and the collection of the process and students' progress, their productions and assessments, should enable:

1. A review and assessment of the design and construction of VLFs.
2. Proposals to be made for improvement of each of the subjects where the innovation has been carried out.
3. Encouragement of the student as the key player in the learning process based on reflection, self-assessment and metacognition.

The range of initiatives in this project has been an emerging, gradual and flexible process, which is the result of interaction between constructed theory and observed and analysed practice. The ongoing dialogue between the two guided the design of the working plan, the review of the teaching plans in each of the subjects involved, the production of the criteria for the construction of the file indexes, the implementation of the innovation in classrooms, and the constant and permanent reconstruction of the process.

4. Results

The Teaching Innovation was implemented in the following subjects:

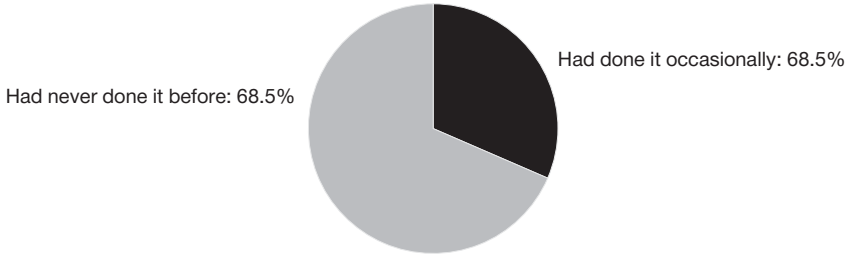
- Teaching Practice II. Teaching Diploma (Primary Education).
- Evolutionary and Educational Psychology. Teaching Diploma (Special Education).
- English language. Teaching Degree Course.
- Equine Clinical Training Veterinary Science Degree Course.
- Software Engineering II. Computer Engineering.
- The platform wich supported the project was the UAB Virtual Campus.

4.1. The students

4.1.1. Starting point

The initial questionnaire was answered by a total of 124 students, 39 of whom (31.5 %) had used HELF before and 85 (68.5 %) had never done so. The majority (85 %) of those that had used the files thought that HELF helped with learning and rated them positively. The main criticism was that they require a great deal of work and are difficult for use in group work. Only 35 % of the students who had never used HELF had never heard of them before and in general, they described them as a collection of work during the course.

Graph 1. Experience of students in HELF use



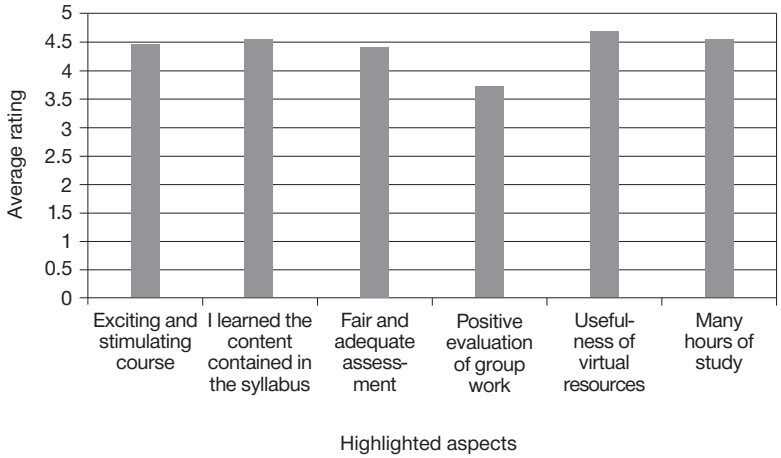
The starting point was therefore a group of students with little experience with HELF and a very limited concept of learning files.

4.1.2. General contributions to students

The final questionnaire was completed by 158 students. As regards learning (Graph 2), most students felt that the course had been intellectually engaging and stimulating (average satisfaction 3.9/5) and they had learnt and understood the contents of the subjects (average satisfaction 4.1/5). They considered the assessment methods to be fair and appropriate (average satisfaction 3.8/5). As regards virtuality, group work

and use of the virtual campus, the majority of students expressed high levels of satisfaction with all the issues raised (3.71-4.36/5). Finally, the majority of students felt that they had spent more time working on that specific subject than on others (average satisfaction 4.1/5).

Graph 2. Student assessment of the experience



In overall terms, the general level of satisfaction among students with the teaching innovation used is high, despite the fact that they require a significant amount of work.

4.1.3. The students' voices

As well as quantitative assessment using the questionnaires, the students' qualitative assessment of what learning by files entails and its advantages and disadvantages was also obtained after the experience. In general, the students displayed a very high level of knowledge of the concept of HELF, with comments on the reflection involved in learning with files and how this exercise facilitates their autonomy and helps them to internalise knowledge and develop their own criteria. They also felt that the innovation enabled them to organise their tasks better and encouraged them to participate in the course, improved their motivation and dialogue with teaching staff. The only disadvantage mentioned by the students was that the HELF required more work than other learning systems.

4.1.4. The teaching staff

The level of satisfaction among the teaching staff involved in this teaching innovation was very high. In general, the VLFs promoted autonomous learning and metacog-

nition among students, enabled assessment of the various types of skills with a single instrument, encouraged participation and involvement by the students and reciprocal feedback, ensured continuous assessment and facilitated the students' awareness of what they learn and how they learn. The perception of the teacher as a member of the help and support group rather than an authority figure also increases students' commitment and helps them to become the centre of the learning process. Virtuality made the exchange of information more fluid and functional, and facilitated the organisation of and access to materials. Being able to access the files at any time and from anywhere is a clear advantage for both the students and the teaching staff.

The main disadvantages were the greater amount of time than that required for traditional teaching approaches and some technical problems arising from the use of the VC as a platform for the VLFs.

The results of the two questionnaires, direct observation, the students' files and the joint reflections of the group enabled the teaching staff to adapt the production of the files to conditions in each group of students and to consider improvements in the subjects for the future.

The integration of the teaching staff involved in this project in the GI-HELF group as a platform for exchanging experiences and seeking information was very enriching and facilitated the attainment of the fourth objective, which was the publication of a guide to the HELF (Blanch et. al., in press).

5. Conclusions

This publication is complemented with the consolidation of an interdisciplinary working group in order to share innovative teaching experiences linked to learning files and to promote co-ordination among teaching staff (GI-HELF), the «Student File» workshop that we provide as part of the IDEAS-UAB training activities, and participation in the Themed Network «*Electronic Portfolios*» (*e-portfolios*) financed by the Ministry of Education and Science, the R+D+I National Plan [European Regional Development Funds (ERDF) and the General State Budget (PGE)] (SEJ2006-27543-E/EDUC and SEJ2007-30284-E/EDUC) in which 14 Spanish universities participate.

1. The assessment by the students and the teaching staff involved in this experience confirms that the objectives set were met, and we therefore feel that the HELF —and the VLFs in particular— are useful tools for improving students' performance and training.
2. Among teachers, the VLFs involved a reformulation of teaching methodology which entailed a great deal of reflection on educational philosophy, and led to a substantial improvement in teaching practice.
3. The increase in the time spent by both teaching staff and students due to the VLFs means that it is important to focus attention on designing the indexes and main-

taining fluid communication with teachers of other subjects in order to avoid the advantages of the experience being diluted by an excessive workload

4. The UAB Virtual Campus can be used to work with VLFs, despite having some technical limitations that must be resolved in order to for it to be an optimum platform.
5. The publication produced by the GI-HELF group of the IDES provides access to a guide that facilitates the implementation of this tool by the entire university community.

References

BARBERÀ, E. (2005). «La evaluación de competencias complejas: la práctica del portafolio». *Educere: Revista Venezolana de Educación,* 31, 497-503. Also online at: http://www.saber.ula.ve/db/ssaber/Edocs/pubelectronicas/educere/vol9num31/articulo4.pdf

BLANCH, S.; BOSCO, A.; GIMENO, X.; GONZÁLEZ, N.; FUENTES, M.; JARIOT, M.; JIMÉNEZ, J.; OLIVER, S.; RIFÀ, M.; SANTIVERI, N.; SEGURA, D. and TRAFÍ, L. *Carpetes d'Aprenentatge a l'Educació Superior: una oportunitat per a repensar la docència.* UAB: Eines. In press.

CASTRO QUITORA, L. (2002). «El portafolio de enseñanza como herramienta y texto para la reflexión pedagógica». *Revista Perspectiva Educativa*, 3, 5-20. Also available online at: http://www.ut.edu.co/tolima/hermesoft/portal/home_1/rec/arc_6519.pdf [Last consulted: 15/12/2007]

COLÉN, M.; GINÉ, N. and IMBERMÓN, F. (2006). *La carpeta de aprendizaje del alumnado universitario: la autonomía del estudiante en el proceso de aprendizaje*. Barcelona: Octaedro-ICE.

DUART, J. M. and SANGRÀ, A. (comp.) (2000). *Aprender en la virtualidad*. Barcelona: Gedisa.

GIMENO, X. (2004). *La carpeta d'aprenentatge com a instrument de formació i avaluació . I Jornades de Campus d'Innovació Docent*. UAB: IDES. 17 September 2004.

GONZÁLEZ, N.; FUENTES, M.; OLIVER, S.; JIMÉNEZ, J. and SEGURA, D. (2007). «Uso de las TIC y las carpetas de aprendizaje en el Practicum». In: CID, A., MURADÁS, M., ZABALZA, M. A., SANMAMED, M., RAPOSO, M. and IGLESIAS, M. L. (co-ord.) *Buenas prácticas en el practicum*. Poio: USC, 487-498.

KLENOWSKI, V. (2004). *Desarrollo de portafolios para el aprendizaje y la evaluación*. Madrid: Narcea.

YÁBAR, J. M.; HERNÁNDEZ, J.; CASTELLÀ, J. and LÓPEZ, P. (2005). «El campus virtual de la UAB una eina docent en constant evolució». II Teaching Innovation Campus Day Sessions. UAB: IDES.

ZUBIZARRETA, J. (2004). *The Learnng Portfolio. Reflective practice for improving student learning*. Bolton MA: Anker

Interesting links

- Helen Barrett. *Electronic portfolios*. University of Alaska, Anchorage. http://electronicportfolios.com/ [Last updated: November 2007]
- Joice L. Morris. *EPortfolios*. University of Vermont. http://www.uvm.edu/~jmorris/ portresources.html [Last updated: August 2007].
- Aracelly Ugalde and Rocio López. *El portafolio: En zapatos de estudiante*. Escuela de bibliotecología, documentación e información. [online] http://www.una.ac.cr/bibliotecologia/boletinbiblioteca/1995/Elportafolio.doc [Last consulted: 15/12/2007]
- Education and New technologies Centre (CENT). *ePortfolio*. Castellón: Jaume I University. [online] http://cent.uji.es/octeto/taxonomy/term/46 [Last consulted: 15/12/2007]

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Learning file (portfolio), information and communication technologies (ICTs), teaching innovation, higher education.

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Design and application of an activity to integrate knowledge and self-assessment of methodological skills

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Abstract
As part of the adaptation of the «Psychological research methods, design and techniques» subject to the European Higher Education Area, an activity to promote integration in the process of acquiring methodological skills and their self-assessment was proposed. A «Significant Learning Activity based on Centres of Interest» was designed based on a subject well-known to the student. One of the centres of interest used was «the lack of discipline among students in the classroom» which in this context, is a teaching resource instead of a problem. The results show the suitability of the activity for the introduction of the subject and facilitating self-assessment. They also show a positive relationship between the level of completion of the activity and marks in the examination. They also provide evidence of the activity's «sustainability,» in the sense of its feasibility in large groups and the fact that it involves only a slight increase in the workload of the teaching monitor and teacher.

General area of interest of this innovativion
Changes to methodology and approach to curriculum. New teaching methodologies inspired by centres of interest. The proposed activity is of special interest for subjects with a methodological basis with a high number of students, regardless of the qualification.

1. Objectives
As part of the requirements for adaptation to the European Higher Education Area, the purpose of this project was to promote the acquisition and assessment of trans-

versal skills (those involving significant integration of knowledge and production of critical judgements, arguing and justifying the explanation) and specific skills in the subject «Research methods, designs and techniques in Psychology» (MeDiTi), by means of designing a teaching-learning activity aimed at achieving the following objectives:

1. Facilitating the integration of the methodological skills acquired by the student before coming to University by means of designing an initial contact with the subject that is appealing and sensitive to this prior knowledge.
2. Assessment of the students' starting point in terms of the practical application of methodological concepts, and integration of this information in teaching practice on the course and tutoring tasks in particular.
3. Self-assessment of the student's progress in learning of the subject.

2. Description of the project

2.1. Starting point and diagnosis

The subjects linked to the MeDiTI core subject have an essentially methodological nature which means that they are taken at the beginning of the respective degree courses —usually during the first year and often during the first semester. This situation, which will very probably continue in future Psychology degrees adapted to the European Higher Education Space, raises interesting challenges.

The majority of those in the group we deal with has no knowledge of substantial areas of psychological contents and also has no prior knowledge of research methods, design and techniques. We also know that most students who are new to the Faculty of Psychology have expectations that differ from the skills covered in this subject. Furthermore, «methodology» is often seen as a course that is less appealing than the other subjects that are taken at the same time.

These are challenges rather than problems because we feel that it is necessary to confront this situation. We are convinced that the acquisition of basic methodological skills by first year degree course students is vital for the appropriate transfer of these skills to the other subjects in the Psychology study plan. We also feel that the less attractive the content of a course is, the more important it is to have activities that encourage the students' interest from the very first day, and to increase their sensitivity towards progress in learning. These convictions were the basis for a teaching product that we call a «Significant Learning Activity based on Centres of Interest)» (SLACI).

2.2. Design of the activity

The design of the activity consisted of the following elements:

2.2.1. Selection of a subject well-known to the student

Based on the choice of a subject well-known to and of interest to the student, the aim is to create a teaching situation that increases the students' motivation for learning contents that have traditionally been explained by examples that are difficult for students to relate to. The aim is for subjects related with MeDiTI to begin with centres of interest that facilitate the student's acquisition and self-assessment of methodological skills based on their prior knowledge and a subject well-known to them, so that they become familiar with the process of giving consistency and meaning to the new concepts that appear on the syllabus.

The key feature in the proposal of innovation is the choice of this centre of interest, which could vary according to the context, situation, environment, etc. The aim is therefore for the student to undertake significant learning based on the constructivist perspective (Coll and Solé, 1989 and Gómez and Coll, 1994), which considers that learning in the long term is acquired by construction, and that humans connect some concepts with others, like a puzzle in which pieces fit together (Ballester, 1999). This means that learning must take place in significant contexts in order to promote the relationship of new knowledge with the conceptions and experience prior to that to be learned (Villa and Poblete, 2007).

After comparing various subjects and analysing their advantages and limitations, «disturbing behaviour by students in the classroom» was selected. As explained in a previous study (Portell, Boixadós and Sotoca, 2005; Portell and Boixadós, 2006), among the advantages of this subject is the fact that the student has information, experience and opinions on this behaviour. To a certain extent, the selection of this subject brings key elements of the reflection that Wagensberg (1999) entitled «The scientific method as an idea for coexistence» into the teaching sphere. Scientific methodology, as a means to learn from experience effectively, can therefore establish interesting synergies with the process of acquisition of basic personal skills in the new framework proposed by the European Higher Education Space.

2.2.2. Production of a script or form

The questions considered in this form must lead the student to bring to bear the following conceptual blocs of the subject: «variables, definitions and operating definitions», «data collection methods and techniques», «theories and hypotheses», «relation, causality and control», «population and sampling», «validity and reliability». A final bloc examines the difficulty of the activity itself. Table 1 includes the specific questions related to «disturbing behaviour by students in the classroom».

2.2.3. Production of the «prototype answer»

The «prototype answer» was designed based on analysis of the answers to the questions in Table 1. We use this label to designate the material produced using the correct answers and illustrative errors from the answers by the group/class. This material is used

Table 1. Initial form and methodological blocs. Application to the centre of interest: «disturbing behaviour by students in the classroom».

Question	Methodological bloc
1. Build a list of disturbing behaviour by students in the classroom.	Variables and operating definitions.
2. What would you do to find out how many of the behaviour patterns you mentioned in the previous question are seen in this group/class during the course?	Data collection methods, designs and techniques.
3. Choose one of the behaviour patterns mentioned in question 1. Suggest an explanation for this behaviour.	Theory and hypothesis. Relation and causality. Control
4. What would you do to find out if the explanation you proposed in the previous question is correct?	Population and sample. Validity, reliability.
5. State the doubts you had when answering the questions above. If you had no doubts, say which of the subjects you have studied so far have been most useful in answering these questions.	

to introduce concepts during the semester and to provide complementary information to the self-assessment of the initial answers of each student.

3. Methodology

After the centre of interest for which all the students have information and experience has been determined, the application of the activity is organised in three phases as shown in Figure 1.

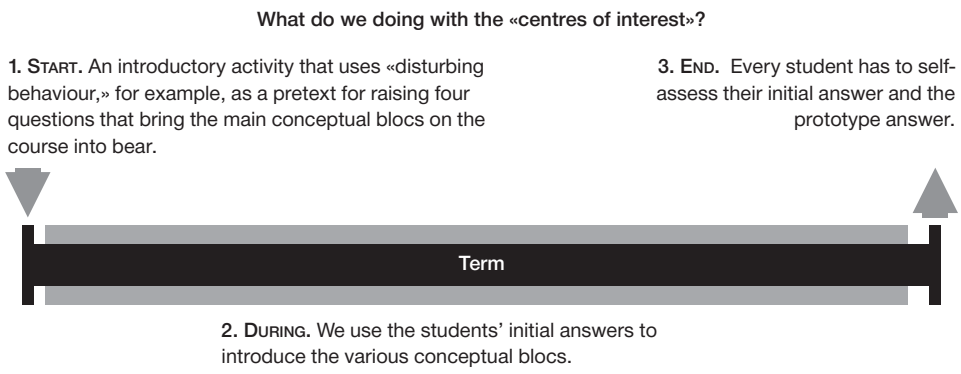
1. *Stage 1: Start of the course*. Application of the activity to «class 0» for presentation of the course and digitalised gathering of the written information; qualitative analysis of the information from the initial phase and production of the «prototype answer».
2. *Stage 2: During the course*. Use of the «prototype answer» as a resource for introducing concepts during the semester.
3. *Stage 3: End of the course*. The initial work is sent to every student with a request for quantitative and qualitative self-assessment of their answers according to the knowledge acquired on the course; sending of a «prototype answer» with the request for them to review it and grade their progress; assessment of the return.

4. Results

This activity has been applied and assessed in various courses and learning environments, both in both virtual and presence learning. The results presented in the most detail are those of the initial assessment of the experience with Psychology students at the UAB and in a classroom learning environment. They were also widely used and assessed in the UAB

Psychopedagogy course (Vives, Portell, Boixadós, 2007). The SLACI has also been adapted to other centres of interest for a virtual teaching-learning environment in the project carried out by the Psychology studies at the Open University of Catalonia (Boixadós, Portell, Redolar and Vives, 2007). In the latter case, the centre of interest was «the forum of the virtual classroom and the elements that affect the learning process in this space», based on the fact that all the students at the Open University of Catalonia know the classroom forum as a space to which the consultant tutor and the group of students have access.

Figure 1. Schedule of the activity

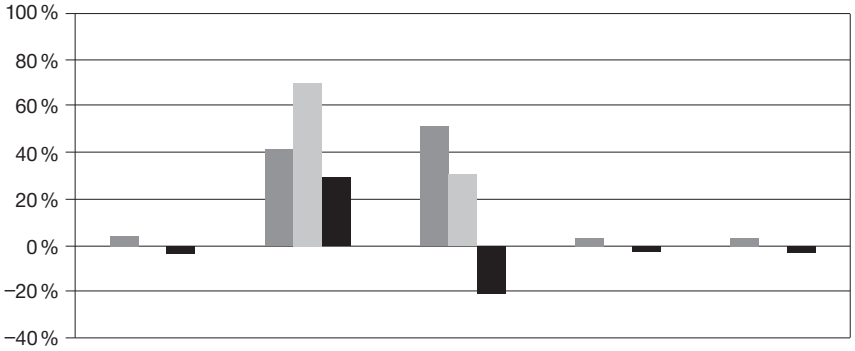


In the initial application of the activity based around the «disturbing behaviour by the student in the classroom» centre of interest, the assessment process is carried out using a multi-method approach that combines quantitative data from the result and qualitative data from the process.

Of the total number of students registered on the Research Methods course for the UAB Psychology Degree 2005-06 (452 students), 72 % participated in the activity (325 students), and 28 % of these completed it (beginning, end and prototype answer).

1. An initial level of assessment: this is based on analysis of the evidence of learning from the activity. The responses to the initial and final open questions were produced qualitatively by means of a content analysis using Atlas.ti 4.2 (Muñoz Justicia, 2005). This process led to various systems of categories being produced. Interesting results are obtained about the evolution of the group-class by comparing the application of these categories to the initial data and the final self-correction. By way of an example, Figure 2 summarises the categorisation and comparison of the responses to Question 4 in Table 1. It shows how the percentage of students basing their explanation on strategies other than the logic of scientific research falls.

Figure 2. Analysis of the contents of final self-correction in the activity and comparison with the initial answer to question 4



	Explanational path: No response	Exp. path: Emprical study: not mention method/ technique	Exp. path: Emprical study: not mention method/tech	Documentation	Non empirical procedures
Beginning	3.28 %	40.98 %	50.82 %	2.46 %	2.46 %
End	0.00 %	69.92 %	30.08 %	0.00 %	0.00 %
Dif F−1	−3.28 %	28.94 %	−20.47 %	−2.46 %	−2.46 %

2. A second level of assessment provides a comparison of the quantitative self-assessment by the students of their execution. It can be seen that the average self-assessment in the initial activity is 4.8 points ($SD = 1.3$; $Md = 5$) while the average self-assessment of the final activity is 7 ($SD = 1.1$; $Md = 7$) and this difference is statistically significant ($t = 17.8$, $gl = 124$; $p<0.001$). The boxplot shows the distribution of these two self-assessments (Figure 3). In categorical terms, when the students finish the course they feel that they have progressed from a fail grade to an excellent.
3. A third level of assessment is based on studying the relationship between completion of the activity and the result in the final examination of the course. Among the students completing the activity, there was a statistically significant reduction in the proportion who did not sit the final examination ($X^2 = 40.67$; $gl = 1$; $p < 0.001$). When we analyse the relationship between the grade in the final examination and extent to which the activity had been completed in the sub-sample of 380 students that sat the examination, a statistically significant relationship is obtained (F=16.2, $gl_1 = 2$, $gl_2 = 377$, $p < 0.001$). The trend observed was as expected: the average grade of the group who did the entire activity is higher, followed by the average of the group who did part of it (Figure 4).

Figure 3. Self-assessment by the student

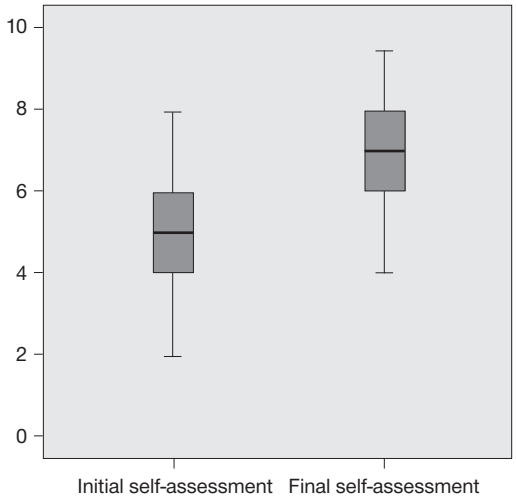
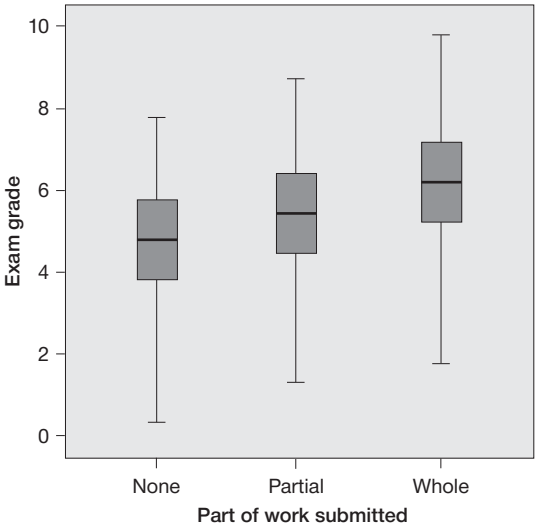


Figure 4. Relationship between the level of completion of the activity and the grade in the final with examination

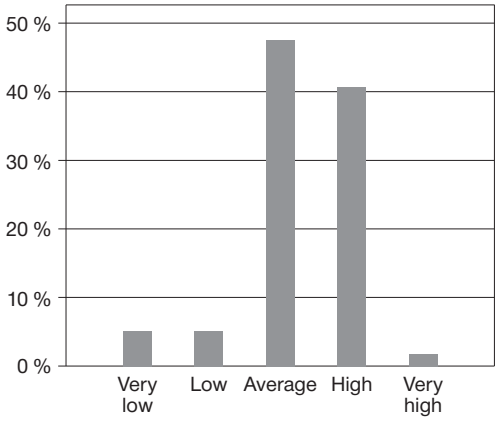


4. A fourth assessment level for the activity was based on the response to an opinion questionnaire. Among other aspects, the assessment survey for the activity provides information on the time spent on the activity. 70 % of the sample completed the self-assessment exercise within 30 minutes and only 10 % needed more than one hour. As regards the overall assessment of the student of this learning strategy, the majority felt it was of medium/high usefulness (Figure 5).

5. Conclusions

1. The activity enabled the objectives set to be attained. The assessment performed shows that this activity is appropriate for promoting self-assessment of the methodological skills acquisition process among first year Psychology students. Although the data is not shown here, the references to their dissemination in other areas can be consulted.
2. The relationship observed between completion of the activity and the grade in the final examination is an indicator which leads to positive assessment of the contribution made by the SLACI to the specific MeDiTi skills.
3. The activity promotes transversal skills of significant knowledge integration and the making of critical judgements while arguing and justifying the explanation.

Figure 5. Overall assessment of the activity



4. This learning strategy can easily be applied to numerous groups without an excessive increase in the workload of the teaching staff or the students.
5. The two centres of interest mentioned above —«disturbing behaviour» and «the forum of the virtual classroom and the elements that affect the learning process in this space»— are by no means the only possibilities for application of the general structure of the activity. Here are some other centres of interest that could be adapted: courtesy on campus; the Psychology students' expectations of what Psychology is; the use of contraception by young people; use of Messenger; or young peoples' preference for designer-label clothing.
6. Finally, we would like to conclude by mentioning a phrase that we particularly like: «learning is not obvious». We believe that in methodology-based subjects,

which are usually unappealing to students when they have to study them, it is necessary to provide resources that contribute to making the learning process clear and relevant. We also feel that these resources must be carefully evaluated and must require a «sustainable» workload from both the teaching staff and the teaching monitor. We believe that the proposal made in this project meets these two requirements and can be used in other subjects that introduce the methodology of research.

References

BALLESTER, A (1999). «Hacer realidad el aprendizaje significativo». *Revista Cuadernos de Pedagogí a*, *277,* 29-33

BOIXADÓS, M.; PORTELL, M.; REDOLAR, D. and VIVES, J. (2007). «El fòrum de l'aula virtual de la UOC, com a pretext per adquirir i avaluar competències metodològiques». Communication presented at the II EHES Online Day Sessions: Sharing new teaching techniques. UOC.

COLL, C. and SOLÉ, I. (1989). «Aprendizaje significativo y ayuda pedagógica» (article translated in Spanish). *Cuadernos de Pedagogia , 168*, 50-54.

GOMÉZ, C. and COLL, C. (1994). «¿De qué hablamos cuando hablamos de constructivismo?». *Cuadernos de pedagogia 221,* 8-10.

MUÑOZ JUSTICIA, J. (2005). *Análisis de datos textuales con Atlas.ti 5*. Obtained in February 2008 from the Universitat Autònoma de Barcelona al lloc: http://psicologiasocial.uab.es/juan/index.php?option=com_docman&task=doc_download&gid=1&Itemid=

PORTELL, M. and BOIXADÓS, M. (2006). «Disseny d'una activitat per a integrar coneixement i autoavaluar competències metodològiques». Communication presented at the III Teaching Innovation Campus Sessions. UAB.

PORTELL, M.; BOIXADÓS, M. and SOTOCA, C. (2005). *Learning research methods in psychology: practical activity based on the lack of classroom discipline*. Poster presented at the IX European Congress on Psychology.

VILLA, A. and POBLETE, M. (2007). *Aprendizaje basado en competencias. Una propuesta para la evaluació n de las competencias gené ricas*. Vice-Dean of Innovation and Quality, Institute of Education Sciences, University of Deusto. Bilbao.

WAGENSBERG, J. (1999). *Ideas para la imaginació n impura* (2nd ed.). Barcelona: Tusquets.

VIVES, J.; PORTELL, M.; BOIXADÓS, M. and RIPOLLÈS, E. (2007). «Recursos d'autoaprenentatge de mètodes d'investigació en entorns virtuals». Communication presented at the IV Teaching Innovation Campus Day Sessions. UAB.

Keywords

Research methods; Self-assessment of skills; Significant learning.

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Presentation of the working group
The group has extensive experience in MeDiTI teaching and has produced the joint publication «Research methods: teaching resources». The group has had experience in teaching innovation projects since 1997, when Mariona Portell began the Faculty of Psychology Reception Plan. Mercè Boixadós has participated in pilot studies by ANECA (the National Agency for Quality Assessment and Accreditation) and AQU (the University Quality Assurance Agency) on European convergence and is responsible for the adaptation of the Psychology course to the European Higher Education Space. Jaume Vives has extensive experience in the use of computer techniques applied to teaching and research in Psychology.

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Design of the portfolio to increase academic motivation and converge with the European Higher Education Area

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Abstract

This experience is part of Psychology of Personality, the core subject in the 1st cycle of the Psychology Degree Course. The project, based on European Higher Education Area (EHEA) guidelines, consists of the design and application of the student's portfolio in the teaching-learning process. In order to guarantee the students' participation in the assessment of the internal quality of this teaching innovation process, an inventory of six items was administered in order to ascertain the influence of the portfolio on the learning process in a sample of 179 students. The results show that 89 % of the students positively rated the introduction of the portfolio in their learning process, and concludes that the process of adaptation to the European Higher Education Space took place correctly and satisfactorily.

General area of interest of this innovation

The interest in the innovation includes three areas: the characteristics of the course (a core 1st cycle course), the introduction of the portfolio as a teaching tool designed to attain the educational objectives of the European Higher Education Space, and finally, the assessment of the internal quality of the innovation process by means of student participation, as recommended by Reichert & Tauch (2005), in their report *Trends IV: European Universities Implementing Bologna.*

1. Objectives

The purpose of the project is to design a teaching tool that increases students' motivation for the subject and meets the European higher education standards.

The objectives are as follows:

1. To design the student's Portfolio in order to improve the teaching-learning process on the course.
2. To adapt the course to the requirements of the European Space for Higher Education Area.
3. To increase the students' motivation concerning the subject.
4. To facilitate students' assimilation of the content taught in class.
5. To work on and develop written communication, as a transversal skill in higher education.

2. Description of the project

2.1. Introduction

In this context of European reforms to implement the Skills Training Model, the replacement of traditional teaching with teacher-focused classes with student-focused teaching strategies, in which students can participate actively, autonomously and cooperatively, and in which students can set their own pace of learning, is widely recommended. The use of these methods in large first cycle classes is complex, and adapting the European standards in this situation is a major challenge (Slaughter, 1998). However, in the scientific literature and various teaching innovation seminars based around the European Higher Education Area, a teaching tool has been identified which meets the new needs of university education: the student portfolio. The student portfolio is a tool that comes from the art and design world, and can be defined as a collection of evidence of the work done by the student, and which should include, arrange and organise in a file and show and summarise the work done and his/her level of commitment during the course (McMullan, 2006; Wright, Knight & Pomperlau, 1999). As well as providing evidence of their academic progress, the portfolio helps students to develop the skills required in their professional field (Elango, Jutti & Lee, 2005; Roberts, Newble & O'Rourke, 2002; Tarwijk, Driessen, van der Bleuten & Stokking, 2007). It may be structured, semi-structured or free, and its aim is to facilitate the student's assimilation of knowledge, the development of skills and the promotion of attitude, as described in the Tuning project for a common European pedagogical strategy (González & Wagenaar, 2003). Independently of the specific knowledge, skills and attitudes in the particular area of Psychology (Peiró & Lundt, 2002; Roe, 2002), use of the student portfolio in higher education has become considerably more widespread during the last decade in order to adapt learning processes to the requirements of the European Higher Education Space and to guarantee continuous assessment of students.

One of the basic objectives of the portfolio is promote in-depth rather than superficial learning (Biggs, 1993; Furnham, Christopher, Garwood and Martin, 2007; Slaughter, 1998). These terms refer to the level of processing applied by students to the learning task. Students presenting in-depth learning are intrinsically motivated by knowledge, try to understand the material they study, relate new knowledge to old knowledge, include knowledge from other subjects, seek meaning in texts and are motivated by a strong desire for personal satisfaction. By contrast, students who process knowledge on a superficial basis focus on memorising in order only to pass the examination, have an extrinsic motivation for knowledge, do not seek meaning or relationships with other subjects and have a superficial strategy for reproducing knowledge in order to meet the minimum requirements for understanding the contents. Despite some the suggestion by some authors that individual differences, personality and preferences of learning style are important in designing teaching strategies and assessment methods (Fallan, 2006; Furnham et al., 2007), the difficulty in personalising the learning process in classes with a large number of students means that structured and systematic methodologies that are the same for all students must be created.

In the context of the European Higher Education Area, the co-operative approach is obviously also considered a factor to be taken into account in the design of new teaching strategies. Cartney & Rouse (2006) report that the impact of social integration in the first years of university is a key factor that may influence the subsequent progress of students. Some authors say that when the students experience a cohesive social working group, the learning process improves and motivates them to continue. For example, estimates suggest that between 33 % and 45 % of students in English universities give up their education. An important challenge for European universities is therefore to define how to motivate and increase the potential of their students and how to retain those wishing to give up their education. For this reason, co-operative work is not just one of the transversal skills in higher education, but is also a factor in motivation and maintenance in the continuity of studies. Group work encourages participation in collective discussions and opens up new points of view for the students, as well as helping them to learn to work as part of a team in order to meet future professional challenges. However, working in a group can be seen both positively and negatively. In an ideal context, students should enjoy the experience of co-operation, which should include creative disagreement, shared enthusiasm, fair distribution of tasks, the establishment of positive leadership processes and the gregarious feeling of satisfactorily forming part of a group. However, students may feel overwhelmed, unable to share their ideas, and to say what they think or to contribute in the way they would like, as they are in situations where the distribution of tasks is not balanced, or they have to face situations of interpersonal confrontation when taking consensus-based decisions.

A gradual intervention is therefore necessary starting with the first courses at university using new educational strategies in order to be able to attain the basic objec-

tives of the ESHE in classrooms: integration of the Skills Training Model (STM), promotion of teamwork and improvement of the quality of learning processes.

2.2. Design and application of the portfolio

In order to improve the learning process, students' motivation and performance within the framework of the EHEA and based on the criteria above, a reform process was implemented of the teaching methods in a course on the Psychology Degree course at the Universitat Autònoma de Barcelona: Personality Psychology. This is a core first cycle subject, taught during the first term of the second year of a qualification that is still not part of the Bologna Pilot Plan and therefore still has no MFC design. The average number of students registered in first cycle subjects in this qualification is 448, distributed in 112 students per theoretical module and 46 per practical module (AQU, 2000). It consists of 9 credits, for which students attend six weekly sessions, of one hour's class time each, organised into three theoretical sessions, two practical sessions and one tutorial. Assessment of the course traditionally consisted of a multiple choice examination which assessed both theoretical and practical knowledge. The Psychology assessment report produced in 1999 said that the number of first time passes is low, the number of those failing to sit the examination is large, and that absenteeism in the afternoon presence learning groups is high. The possible reasons are that the background of Psychology students is very varied (access is possible from any branch of higher secondary education) and their adaptation to the first courses is therefore slow and difficult. Moreover, many students combine their studies with work.

Designing a student portfolio was proposed in order to improve students' motivation and to adapt the course requirements to the European Higher Education Area. The design of the portfolio was based on two fundamental ideas:

1. Implementing a learning process that is focused on the student, more active, cooperative and profound, in order to facilitate understanding of the contents of the course, help to study for the final examination and increase motivation and teamwork among the students.
2. Introduction of the Skills Training Model. The skills to be worked on were the following:
   a) *Skill 1 - Generic to the qualification*
   Written communication is vital for both the qualification and in higher education. This is defined as the ability to understand, organise and summarise written information and to write academic texts correctly (correct spelling, grammar and formal presentation), and the ability to communicate ideas and answer in writing in a clear and precise manner.
   b) *Skill 2 - Specific to the course*
   Being aware of, relating and applying basic diagnostic and personality assessment instruments.

Production of the portfolio was proposed and applied by means of practical sessions on the course in groups of 3 or 4 students. 10 activities were organised. These had to be handed in to the teacher on a pre-established date, so that the teacher could return the corrected activities to the students at intervals during the course. Production of the portfolio was voluntary but was assessed with 10% of the final mark. The portfolios that failed to meet the conditions explicitly stated at the beginning of the course and during it were not assessed. The instructions for producing the portfolio were provided orally by the class teachers at the beginning and during the course. They were also given in writing in the course programme and through the medium of the Virtual Campus.

2.3. Design of the assessment of quality

As recommended by the European standards (Reichert & Tauch, 2005), a brief inventory was designed for the students with two objectives:

1. To promote the students' participation in the process of assessment of the internal quality of new learning processes.
2. To ascertain the perceived influence of the portfolio in the learning process.

Due to the lack of validated instruments in the scientific literature with these objectives, an inventory to measure the quality of the new learning process using the portfolio was designed specifically for this project.

3. Methodology

3.1. Participants

368 students (82 % of the 450 students registered for the course) in the 2006-2007 academic year decided to produce the portfolio. Of these, 179 students (75 % women, 25 % men) aged between 18 and 23 years old answered the final inventory to ascertain the influence of the portfolio on the teaching-learning process. The inventory was administered by various teachers during the final session of each of the four theory modules, so that the students had passed through the entire portfolio production process. The students completed the inventory voluntarily and anonymously, and returned them to the teacher during the same session.

3.2. Material

The Inventory to ascertain the Influence of the Portfolio on the Students' Learning Process (I-IPSLP) was designed and administered (Muro & Gomà-i-Freixanet, 2007).

This Inventory consisted of six Likert format items, with answers showing the level of agreement on a scale of 1 to 5 (1 = none, 2 = a little, 3 = some, 4 = a fair amount, 5 = very much). It examined six aspects of the portfolio that were taken from the scientific literature consulted and which were the basis for its design: understanding

of knowledge, motivation for the course, help with studying for the final examination, group work, the structure and approach of the process, and finally the workload involved (see Appendix 1). The scores ranged between 6 and 30. The answers were encoded to establish a dichotomic cut-off point between «*Perceived influence*» and «*No perceived influence*» on the learning process. Scores from 6 to 17 were deemed as no perceived influence and those from 18 to 30 were deemed to be *perceived influence*.

Analysis of the data was carried out using the SPSS 14.0 statistics program.

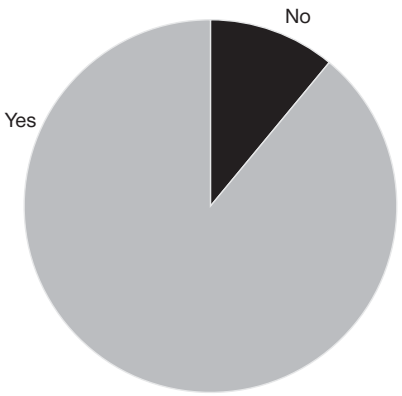
4. Results

The internal reliability of the inventory was high (Cronbach's alpha = 0.76). Analysis of the portfolio's influence on the learning process showed that 89 % of students had a positive perception of the portfolio (Figure 1). The difference in averages between the group of students who valued the portfolio positively and those who valued it negatively shows that portfolio influenced the learning process in a statistically significant manner (F = 145,088, p < .005).

Table 1. Averages and standard deviations on the marks obtained in the I-IPSLP

		M (DE)	*n* = 179
Perceived influence	**YES**	22.6 (2.7)	160 (89.4%)
	NO	15.0 (1.8)	19 (10.6%)

Figure 1. Influence of the Portfolio on learning according to the students



The results of analysis of the frequencies of responses are shown in Table 2. It can be seen that the total percentage of «none or very little» answers is low, except in item 6, which was formulated in the reverse format. The other answers showed that the aspects of the portfolio assessed influenced a little, some and a great deal, with total percentages of between 84 % and 96 %.

Table 2. Frequency of answers in the various aspects of the portfolio

	n = 179				
	None	**Very little**	**A bit**	**Some**	**Very much**
1 It helped me to understand the contents of the course.	1 (0.6 %)	6 (3.4 %)	47 (26.3 %)	95 (53.1 %)	30 (16.8 %)
2 It motivated me to continue the course.	5 (2.8 %)	23 (12.8 %)	57 (31.8 %)	66 (36.9 %)	28 (15.6 %)
3 It helped me to study for the examination.	1 (0.6 %)	12 (6.7 %)	59 (33 %)	75 (41.9 %)	32 (17.9 %)
4 Working in a group made the task easier for me.	6 (3.4 %)	23 (12.8 %)	46 (25.7 %)	65 (36.3 %)	39 (21.8 %)
5 The structure, approach and distribution made it easier for me to produce it.	2 (1.1 %)	6 (3.4 %)	66 (36.9 %)	77 (43 %)	28 (15.6 %)
6 Producing it involved a lot of work for me.	18 (10.1 %)	65 (36.3 %)	75 (41.9 %)	19 (10.6 %)	2 (1.1 %)

5. Conclusions

From the results obtained, we can conclude that the teaching innovation process was introduced satisfactorily by means of use of the portfolio. The data provide evidence of the positive perception of the portfolio in the case of students of this core first cycle subject presented here. It was also observed that most students perceive this tool as a positive influence on the various aspects that guided its construction. These data are relevant for expanding and confirming the hypothesis that the portfolio improves the learning process (Elango et al., 2005; Wright, 1999) and that the design of teaching tools that promote co-operative work have a positive influence on students' motivation (Cartney & Rouse, 2006), thus increasing their likelihood of continuing their studies and reducing the risk of them leaving their studies during the first years. Appropriate design of the portfolio is essential for its satisfactory inclusion in the learning process (Tarwijk et al., 2007): Its design must take into account the objectives to be achieved in the learning process and its context, including the characteristics of the students, teachers and the course. Furthermore, without a realistic and adequate design, the portfolio could become an obstacle to the correct

implementation of the process and take up a large amount of time for both students when producing it and teachers when correcting it (Elango et al., 2005; McMullan, 2006). In the case presented here, this factor was taken into account in the design of the portfolio in order not to impose too great an effort on the students. It was observed that this factor was controlled appropriately, as the students did not perceive the portfolio as an excessive addition to their workload; only 12 % thought that doing it involved a great deal of work.

These data are interesting because they provide the students' view of the teaching innovations proposed by the EHEA. There is little data of this nature available and there are few studies with these characteristics (Elango et al., 2005; Reichert & Tauch, 2005; Vila & Monreal, 2004). Obtaining a positive assessment of the process for introducing European standards by means of the portfolio confirms the success of the introduction of the new university teaching model in the specific case of the first cycle core subject presented here — Personality Psychology. It can also be concluded that the Skills Training Model (González & Wagenaar, 2007) has also been introduced satisfactorily and it has been possible to appropriately assess both generic competence in written communication and specific competence related to the particular skills worked on in the practical classes on the course.

The I-IPSLP (Muro & Gomà-i-Freixanet, 2007) is therefore proposed as a reliable and useful instrument for examining the quality of the teaching-learning process using the portfolio. Taking into account the lack of published instruments in the scientific literature with the same objective, we suggest that it may be suitable for use in ensuring the internal quality of teaching adapted to the European Higher Education Space (Reichert & Tauch, 2005). Both the apparent validity of the inventory and the high level of internal reliability obtained confirm that its construction was relevant according to European higher education standards. This experience fulfils the condition of making students participate in internal assessment processes and assessing learning as an overall process in which the student plays a central role to the detriment of traditional internal assessment by teachers, in which the teacher's reputation and prestige, and his/her particular performance in the classroom or personal image are seen as more important than the educational process in itself (Gurung & Vespia, 2007). In the context of the European Higher Education Area, and ideally in any educational context, the role of the teacher should be to guarantee quality in education, and should be that of a guide and facilitator of independent, active and co-operative learning, and to promote in-depth consideration of the contents proposed in classes (Furnham et al., 2007; Slaughter, 1998). This educational task of teachers must gradually replace the oral transmission of knowledge as an exclusive means of teaching, as the focus of the process according to the new higher education standards is on the student and on the time he/she invests in working on the course, and not on the specific performance of teachers in classes.

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References

Agència per a la Qualitat del Sistema Universitari de Catalunya. (2000). *Informe annual de la facultat de Psicologia de la Universitat Autò noma de Barcelona.* http://www.aqucatalunya.org/scripts/web/pagina.asp?cid=cat&id=1280&cat=pag&tit=Universitat+Aut%F2noma+de+Barcelona&res=110&op=158

BIGGS, J. (1993). «What do inventories of students' learning process really measure?». *Journal of Educational Psychology, 3*, 3-19.

CARTNEY, P. and ROUSE, A. (2006). «The emotional impact of learning in small groups: highlighting the impact on student progression and retention». *Teaching in Higher Education, 11* (1), 79-91. http://www.bologna-bergen2005.no/Docs/France/050520_Bergen_Communique-Fr.pdf

ELANGO, S.; JUTTI, R. C. and LEE, L. K. (2005). «Portfolio as a learning tool: student's perspective». *Annals Academy of Medicine, 34*, 511-514.

FALLAN, L. (2006). «Quality Reform: Personality type, preferred learning style and majors in a business school». *Quality in Higher Education*, *12*(2), 193-206.

FURNHAM, A.; CHRISTOPHER, A.; GARWOOD, J. and MARTIN, N. G. (2007). «Ability, demography, learning style and personality trait correlates of student preference for assessment method». *Educational Psychology*, *28* (1), 15-27.

GONZÁLEZ, J. and WAGENNAR, R. (2003). *Tuning Educational Structures in Europe*. Bilbao: Coordinated by University of Deusto and University of Groningen. http://www.relint.deusto.es/TUNINGProject/spanish/doc_fase1/Tuning%20Educational.pdf

MCMULLAN, M. (2006). «Student's perceptions on the use of portfolios in pre-registration nursing education. A questionnaire survey». *International Journal of Nursing Studies, 43*, 333-343.

MURO, A. and GOMÀ-I-FREIXANET, M. (2007). *Inventari per conè ixer la Influè ncia del Portfoli en el Procé s d'Aprenentatge*. Barcelona: Clinical and Health Psychology Department, Universitat Autònoma de Barcelona. (unpub.).

PEIRÓ, J. M. and LUNT, I. (2002). «The Context for a European Framework for Psychologists' Training». *European Psychologist, 7* (3), 169-179.

REICHERT, S. and TAUCH, C. (2005). *Trends IV: European Universities implementing Bologna.* European University Association publications. http://www.eua.be/fileadmin/user_upload/files/EUA1_documents/TrendsIV_FINAL.1117012084971.pdf

SLAUGHTER, V. (1998). «Teaching Psychology in large classes: An international survey of solutions. In University of Queensland Ed.». *Teaching in large classes*. Queensland: Teaching and Educational Development Institute.

TARTWIJK, J.; DRIESSEN, E; VAN DER BLEUTEN, C and STOKKING, K. (2007). «Factors influencing de successful introduction of portfolios». *Quality in Higher Education, 13*(1), 69-79.

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Presentation of the project leader and the working group
Montserrat Gomà i Freixanet is a full professor in Personality Psychology in the Faculty of Psychology and is head of the UAB *Personality and Individual Differences Research Group*, of which the other members of the project are also members. The research objectives are: to apply and analyse personality psychology in various social and health areas, to adapt and generate instruments for measuring personality, checking the basic structure of personality and providing a response to unresolved questions within the discipline.

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Design and application of a digital platform for the improvement of students' learning

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Abstract

The purpose of the project was to create a multimedia platform, which by means of the strategy teaching of the case would enable monitoring of students' learning to be optimised, teaching materials to be improved and which would self-promote independent responsibility and independent learning. To that end, a four-stage working methodology was followed:

1. Definition of the skills profile of the organisational psychologist.
2. Establishment of the skills levels by course.
3. Use of the case as a teaching strategy.
4. Production of a multimedia learning tool that contains an organisation and business simulator (Learning e.OS) and a CMS (Content Management System).

General area of interest of this innovation

This tool provides an innovative pedagogical resource for all students studying the subjects included in the organisations and human resources itinerary. The results of the implementation of the innovation experience with students taking the Human Resources Planning and Management course show that they quickly become involved in the various cases worked on, and acquire a higher level of development in some of the skills described in phase 1 of the project.

Furthermore, the tool itself can be used in the environment of other subjects and learning areas as they are a series of virtual businesses, which can be the context in which many processes (those we design) and situations arise. For example, among the options are an economic study of a business, a design for it in spatial terms, a legal study of its personnel or an external marketing process.

1. Objectives

The purpose of this project was to consider in depth the renewal of supervised teaching (ST) on Organisations and Human resources courses and to increase their potential as a learning environment that encourages the acquisition of the professional skills defined for the subjects. With this focus, the general objective of the project was to create a multimedia platform.

The specific objectives of the project were:

1. To increase the levels of understanding of organisational complexity by students studying the Organisations and Human resources itinerary.
2. To increase students' interest in and motivation for the subject.
3. To develop organisational supervision skills.
4. To increase interaction between students in order to increase their teamwork skills.
5. To promote independent learning and autonomy, using a multimedia medium.
6. To familiarise participants with new technologies

2. Description of the work

Our awareness of the real need to boost teaching activities with educational resources that encourage reflexive learning as a team of teachers of the subjects included in the Organisations and Human resources itinerary led us to consider undertaking a process for updating the teaching/learning methodologies. To that end, the decision was taken to reconsider the teaching objectives based on a broader and more enriching perspective. The focus of professional skills was reviewed, and the skills framework that would guide our work was defined based on this. The decision was also taken to redesign a learning resource that was not being used to its entire potential: supervised teaching (ST).

The cases method was adopted as the methodology for this resource. The project discussed in this chapter is the result of the learning and renewal that have been applied to the teaching activities over the last two years. New activities have been designed, new material has been produced to facilitate learning, and explanatory videos showing the processes carried out have been edited, etc.

3. Methodology

The joint work by the entire team of teachers that will be involved in the management of this learning tool was adopted as the methodology of the project. This guarantees a general agreement in the proposals for change in ST and enriches the entire process with the experience and knowledge of the teachers involved.

The methodological design of the project was anticipated to involve 7 gradual phases, which would range from the definition of the transversal skills to be covered by

the various courses in the Organisations and HR itinerary, to an overall assessment of the results, based on which the teaching resources designed initially were altered.

Figure 1. Phases of the working process

The scope and description of each of these phases is described in the following section.

3.1. Definition of skills

The skills profile of an organisation intervention professional was defined during the 2003-2004 academic year, based on data obtained from various academics and professionals in the organisations world. The objective was to ascertain which skills had to be promoted in our learning spaces in order to make the development of students possible. The fifteen skills below were extracted from this process:

Table 1. Skills profile of the organisational psychologist

Analysis and synthesis	Creativity	Teamwork
Negotiation/persuasion	Command of ISTs	Judgement
Autonomy	Client focus	Systematic vision

(*continued*)

Obtaining information	Empathy	Leadership
Communication	Planning	
Organisation	Flexibility-adaptation	

3.2. Skill levels per course

The subjects assessed were: Organisational Psychology, Planning and Management of Human resources and Intervention (Organisation). A series of transversal skills was determined for these, which were present in all three subjects, but at different levels. Other skills specific to each course were also established. The skills established for each course are shown below (Table 2).

By way of an example of the method used to establish the various levels of transversal skills, the contents of the «autonomy» skill is shown for each of the three subjects:

Autonomy (1) / Organisational Psychology: self-management in the specific classroom activities, with prior specification of objectives and criteria.

Autonomy (2) / Planning and management of Human resources: short term planning and performance of activities, by means of clarification of objectives and criteria, with teaching tutorials.

Autonomy (3) / Intervention (Organisation): specification of demands and definition of needs with teaching tutorials on the products. Assessment of results according to the criteria established by the students themselves.

This descriptive process was followed for the other fourteen skills identified in the Human resources and Organisations itinerary.

Table 2. Skill levels per course

Type of skill	Subjects		
	Organisational Psychology	**Planning and Management of HR**	**Intervention (Organisation)**
Transversal	Analysis and synthesis (1) Communication (1) Autonomy (1) Planning (1) Command of ISTs	Analysis and synthesis (2) Communication (2) Autonomy (2) Planning (2) Teamwork (1) Command of ISTs	Communication (3) Autonomy (3) Teamwork (2) Command of ISTs
Specific	Obtaining information Groupwork Systematic vision	Flexibility-adaptation Empathy Organisation	Creativity Leadership Client-focused Negotiation-persuasion

3.3. Production of cases as teaching material

The decision was taken to work with the methodology of cases due to its educational potential, especially as a result of its ability to promote reflexive learning and facilitate understanding of complex issues (Andrews, 1960). The main characteristic of this teaching method is not based on the fact that it uses cases, but instead on the way it approaches them. This was the reason why we produced so much information that simulates reality, such as questions and exercises that enable questions to be asked about it.

Organisations described in great depth were created, and a web page created for them, as well as an intranet for each one (a gas company, an advertising company, a hotel, a town council, a medical centre and a shopping centre), and a complete guide was designed for each of the planned activities. These activities are organised in teaching dossiers. Each dossier covers the following pedagogical items:

1. Activities to be carried out.
2. Objectives of the activities.
3. Skills/levels focused on in the activity.
4. Result indicators.
5. Resources necessary to carry out the activities included in the dossier.
6. Definition of the methodology to be used (individual and/or group).
7. Description of the actions to be carried out.
8. Description of the tangible products generated after completion of the dossier.

While the cases took place, we endeavoured that they were all linked in some way, as interdependent systems, in order to promote understanding of organisations as open institutions, affected by their relationship with the environment in which they are located. Although each case enables a range of contents to be dealt with, we assigned each one a specific target theme, depending on the course in question (Table 3).

Table 3. Cases and subjects by course

Organisation (cases)	Subjects	
	Organisational Psychology	Planning and Management of HR
Vents del Mar Hotel	Diagnostic Models	Training
Bosc Profund Town Council	Organisational Communication	—
Esfera Advertising Agency	Organisational Culture	The function of HR
Gax, S.A. Natural Gas Distributorl	Leadership	Communication
Les Flors Medical Centre	Quality of working life	—
Rampa de les Flors Shopping Centre	Concept of Organisation	Selection

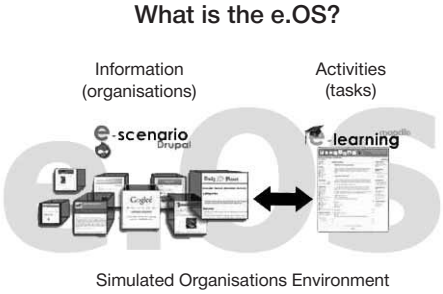
3.4. Design of the multimedia tool for learning

Guided by the objectives mentioned in point 1.3 and numerous analysis meetings, the multidisciplinary team which carried out this project reached the conclusion that the tool that needed to be created had to include the following requirements:

1. To provide a realistic approach to new technologies, in order to promote learning of the ICTs, but also to act as a motivating support for students.
2. To be easy to change and administer by the teaching staff teaching the course. The cases are «live activities», which change over time, according to the changing needs of the teachers and students.
3. Because it is a public development, it was necessary for the work done to return to the public sphere, and as such it was felt necessary to use open source software.
4. Access to the tool at any time and from anywhere.

Considering these needs, the proposal was consolidated as two different areas, but which were closely related: a simulator of business intranets (the cases) and a tool to facilitate teaching management (the campus). The resulting tool is e.OS: Environment of Simulated Organisations (Figure 2).

Figure 2. Generic Architecture of the e.OS



With the observation in point *d*) it was obvious that we were looking at a development that required web technology, but many details concerning the implementation of these two spaces remained to be resolved.

The first space, the e-scenario, had to contain the intranets of the organisations which would be the subject of discussion in the cases to be worked on (with discussion forums, web forms, videos, and audio), so it was decided to use the base provided by an open source management system called *Drupal* (Mansfield, 2007). This content management system facilitated the creation and customisation of websites by means of assisted panels and a web editor similar to conventional text editors (as suggested in point b), but the website resource needs meant that it was necessary to extend the content management system with modules that enabled audio, video, panels and

forums to be included. The aim was to achieve the realism mentioned in point a). In order to facilitate learning, it was decided to build two special additional websites. A search engine (called Goglée) and a newspaper (the Daily Planet) helped with the location of the teaching resources that we had included in the corporate intranets of the organisations in the cases.

Fortunately for the technicians, the implementation of the teaching area was a simpler task. An excellent previous development called Moodle (Rice, 2006) provided us with all the necessary tools for facilitating virtual teaching and assessment of our students. Moodle made a more individualised relationship between students and teaching staff possible and gave both groups unprecedented flexibility and independence in the management of their courses. With changes to the interface of our Moodle which were supported in the hyperlink, moving from one space to the other was a simple and transparent process. Thanks to Moodle, the courses are spaces managed by the teachers of the course, who can use simple panels to change its structure and contents.

Finally, we needed the help of an error management tool to help in the trial process and assist our teaching staff in the initial phases of implementation of the project. Mantis is another open source project that is a bugtracking system which enables users to report bugs and monitor them. No error is missed, and users are informed of the status of the problem which they have reported.

3.5. Training of the teaching team

Before the implementation of the platform as a resource, the teaching staff concerned took two training courses focusing on familiarisation with the use of the tool and its implications in daily management. The training received by the teachers was highly practical, although it included references of a general character to the characteristics of the tool used.

The themed blocs were ordered based on a cycle of actions that had to be taken in order to complete each of the activities (tasks) proposed. This cycle of actions dealt first with the point of view of the student (what the student could see and would be able to do), and then with the perspective of the teaching staff. In specific terms, the training sessions were based on a brief introduction to Drupal and Moodle, the computer resources that were combined to form the tool. Afterwards, all the steps were followed that the students themselves would have to take in order to:

1. create a user account on the platform
2. carry out the activities proposed
3. receive feedback from the teacher.

The way in which teachers had to resolve students' doubts and correct the activities carried out in order to give feedback was added to this. Finally, areas related to administration of the platform and the channels for dealing with problems were reviewed.

3.6. Application of the pilot experience

The first application of this new tool took place on the Organisational Psychology course (2006-07). It was initially considered a pilot experience which would provide information for adapting the tool and which would be the space necessary to practice our skills as teachers in this new methodology. The tool was also applied (only in the web spaces of the businesses) in the two groups (240 students) of Psychology of Work II on the Labour Relations course.

Before starting with the application of the tool on the course, the project was presented to the students in the first presence learning class, and all those interested were invited to participate in a training session. Thirteen students participated in this session. The training focused on a presentation of the tool, the creation of user accounts and the method for producing and receiving feedback for each task. Special emphasis was placed on the participatory and dynamic nature of this learning methodology.

3.7. Assessment

The team in charge designed the assessment phase of the experience with the following objectives in mind:

1. To assess the effectiveness of the e.OS as a learning instrument.
2. To provide a critical analysis of the nature and the structure of the activities according to their educational value.
3. To identify difficulties in the use of the tool, both in technical terms as regards contents and the student-teacher relationship.
4. To identify practices and conditions that promote an effective use of the tool.
5. To produce proposals for improvement for these to be applied in the next academic year.
6. To produce a guide of good practices in order to promote effective use of the tool.

As can be seen, the aim was to assess the functionality of the tool and they way it was being used, but the most important point concerns the type of work required of students, i.e. with the learning activities presented. Based on this question, interest concerned the assessment of to what extent these activities enable the contents of the subjects to be understood, the educational objectives specified to be grasped and above all, skills at the levels specified to be developed.

The assessment took place in such a way that it included the point of view of the team that had carried out the innovation project, the teachers who had participated in the pilot phase and especially the students who had used the tool, both in the supervised teaching of the Organisational Psychology course, as part of the Psychology qualification, and on the Employment Psychology II course, as part of the Employment Relations qualification. The criteria established for assessment were grouped in four large blocs, depending on the area of interest. These criteria are shown in Table 4.

The students' assessment took place in two ways: a questionnaire and a group interview. The questionnaire was answered using the e.OS tool, using the feedback activity.

The assessment by teachers and the team that developed the project took place in two phases: individual work and a working meeting. The first phase, of individual work, consisted of a review of the cases (the activities presented and the available information), work handed in by students and the feedback received by the teachers themselves. As mentioned at the start, the objective of this phase was to assess the type of activity that students wanted and its value as a learning medium.

Table 4. Skill levels per course

Use of the tool	Student-teacher interaction	Quality of the materiall	Educational usefulness
· Complexity of use · Time spent · Places of connection · Type of work · Difficulties noted · General assessment	· Availability of the teacher · Assessment of response time · Means of communication used · Difficulties noted · General assessment	· Clarity of instructions · Interest in the activities suggested · Appeal of the web pages · Sufficient amount and quality of information on web pages to complete the activities.	· Clear links between the theory and the cases. · Co-ordination of classwork with online activities. · Implementation of contents. · Usefulness as a learning tool. · General assessments

In the second phase, the comments made individually were shared, and data concerning use of the tool were gathered.

4. Results

The tangible results of the project include the platform that has been operating since the pilot test in the 2006 academic year, which covers a total of three subjects, with three more being designed. The assessment carried out and the results of the experience show that the digital platform is an innovative and motivating pedagogical resource for all students taking the subjects included in the Organisations and HR itinerary.

The tool was rated positively as a good learning space by the students and teaching staff who participated in the assessment. These assessments are summarised in Table 5.

Table 5. Summary of the assessment pilot test

Students' assessment	Teachers' assessment
Practical.	Time flexibility for the teacher when using the tool.
Useful for practical work.	Time flexibility when giving feedback to the student on the practical session (corrections).
Interesting.	No accumulation of written material on paper.
Dynamic.	The tool enables creativity in the design and creation of materials (video, audio, films, etc.).
Entertaining: «you learn and you have fun».	Attractive and motivating cases for students.
It encourages learning	Encourages involvement and commitment by students.
An innovative way of learning.	Strengthens the teacher-student bond.
Interesting and varied cases, different businesses that make you think about employment situations «it's a dynamic and effective way to work, you have the information you want at any time and anywhere on top of that...».	

This assessment also enables us to ascertain the weak points of the tool in order to be able to propose improvements: Link the cases to a single web (business), position the audio and video resources more clearly, clarify the instructions, produce a web map and balance the time allocated to resolving the cases. In the courses following the pilot test, work has been done on improving all these aspects.

5. Conclusions

The group of teachers involved in the subjects in the Organisational Psychology field hope that in the medium term, they can provide evidence of an increase in the academic performance of the students involved in this pilot phase, which will be reflected in their academic grades. An increasing number of students wanting to participate in the practical sessions that use this platform as a medium has begun to be noted during the 2007-08 academic year. An increase in interest in the discipline in the organisational intervention field is also anticipated, as well as greater autonomy in learning and increased development at all levels of the skills involved in each course. The grades obtained by the students suggest that this is indeed occurring.

There is also improved knowledge by teaching staff of the new technologies as applied to the field of human resources.

In view of these results the team asked for another grant, to cover work up to the 2008 academic year on the needs for improvement noted and the creation of new courses for all the Organisational Psychology subjects that take place in other courses (Socio-Employment Auditing) and work sciences.

We are aware that there is still a long way to go, but we are convinced that we must continue working in this area of methodology in which the student rather than the teacher plays the active role if we want to provide training for skills.

References

ANDREWS, K. R. (1960). *The case method of teaching human relations and administration: an interim statment*. Cambridge, Mss.: Harvard University Press.

MANSFIELD, N. (2007). *Practical Drupal: Evaluating and Using a Web Content Management System*. Cambridge: UIT Cambridge.

RICE, W. (2006). *Moodle E-Learning Course Development*. Birmingham: Packt Publishing.

Interesting links

Our Moodle space is at:

- http://psicologiasocial.uab.es/campus [2008]

Our simulated organisations can be found at:

- http://psicologiasocial.uab.es/eos2/[name of the organisation: a*gency*, *town council, project, commercial, medical*, *hotel*, etc.]

Keywords

Innovation, new technologies, learning and motivation.

Financing

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Supplementary materials on the CD-ROM

Demonstration of the application of a digital platform for working with case methodology in Psychology of Organizations.

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Presentation of the working group

The working group presenting this project is part of the group of teachers and technicians in the Department of Social Psychology. We have been working on various projects related with teaching innovation and the improvement of learning processes since 2002. Among the projects undertaken have been the creation of an educational video on Assessment Centres, as well as a video for teachers explaining the objective and the phases of the «La Fira» experience for Labour Relations projects; and the management of projects such as «Design of supervised teaching activities for the improvement of learn-

ing in the organisational field» and «Resources for continuous training, professional guidance and employment placement for students in the Faculty of Psychology», as well as the creation of cases and material for working on professional skills.

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