

# 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 lymphoid 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:

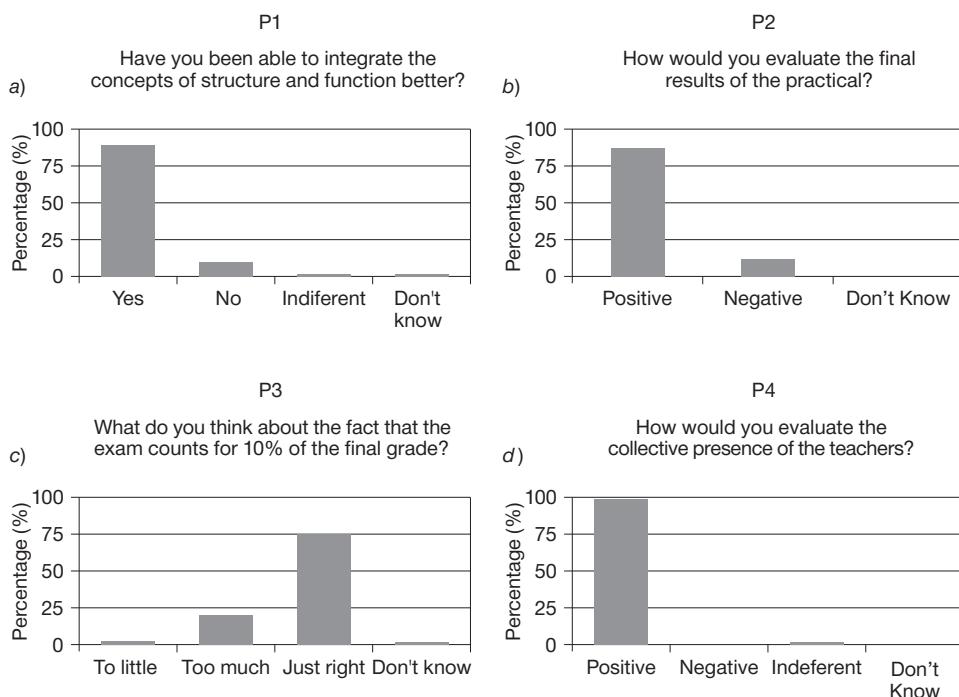
1. Question 1 (P1): Do you think you have better integrated the concepts of the structure and function of the immune system than if you had studied the structure and function separately, that is, the morphology in the first term as part of the Histology course and the function in the second as part of 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

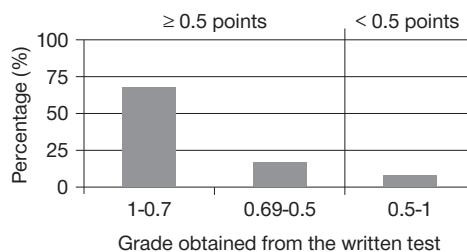
##### 4.1.1. Evaluation of the pack of teaching materials handed out

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.

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## 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.

**Members of the project**

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