

# Histology and Histopathology

*From Cell Biology to Tissue Engineering*

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## **Self-Study and flipped classroom**





## Utility of didactic materials used in the teaching of Histology using the flipped classroom

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The subject Human Histology in the first year of Dentistry at the University of the Basque Country (UPV/EHU) is imparted using the flipped classroom method (Baker, 2000; Lage et al., 2000). Students must study the topics before the corresponding classes, for which they have a subject book in each official language (Sáez Crespo and Badiola Etxaburu, 2017 and 2018) and a video of each topic (available on the eGela platform and <https://ehutb.ehu.eus/series/5f929654f82b2b716a8b46a4>).

During the courses 2019-2020 and 2020-2021, we conducted a student survey on each topic with these questions:

- Please indicate the ease or difficulty of the topic on the following scale, where 1 is very difficult and 10 is very easy.
- Did you find the subject book clear for studying the topic? Please rate on the following scale, where 1 is incomprehensible and 10 is very clear.
- Did you find the video available on eGela useful for studying the topic? Please rate on the following scale, where 1 is very unhelpful and 10 is very helpful.

We analyzed the results using Microsoft Excel ®.

The difficulty or ease of each topic (from 1 to 10) varied between 5.49 and 8.13, with an average of 6.43. The clarity of the book was rated between 7.36 and 8.93, with an average of 8.05. The usefulness of the video was rated between 8.09 and 8.92, with an average of 8.47. The students rated the clarity of the book and the usefulness of the videos highly.

The correlation coefficient between the ease of the subject and the clarity of the book was 0.75. That is, the easier the topic, the clearer the book, or vice versa.

The correlation coefficient between the ease of the topic and the usefulness of the video was 0.51. Considering that the students rated the usefulness of the videos very highly, we can infer that the videos were always useful and their usefulness was little influenced by the ease or difficulty of the topic.

Finally, there was a high positive correlation between the clarity of the book and the usefulness of the video, or vice versa (correlation coefficient 0.83).

In summary, to facilitate the prior study of the topics in the flipped classroom method it is very important to provide the students with clear and useful materials. In this case, both the book and the videos were highly appreciated by the students.

Baker J.W. (2000). The "Classroom Flip": Using Web course management tools to become the guide by the side. In Selected Papers from the 11th International Conference on College Teaching and Learning. Chambers J. A. (ed). Florida Community College. Jacksonville. pp. 9-17.

Lage M.J., Platt G.J., and Treglia M. (2000). Inverting the Classroom: A Gateway to Creating an Inclusive Learning Environment. *J. Econ. Educ.* 31: 30-43.

Sáez Crespo F.J., and Badiola Etxaburu I. (2017). *Manual de Histología Humana para estudiantes de Odontología*. UPV/EHU Editorial Service, Bilbao.

Sáez Crespo F.J., and Badiola Etxaburu I. (2018). *Giza Histologiari buruzko eskuliburua Odontologiako ikasleentzat*. UPV/EHU Editorial Service, Bilbao.

## Proposal of adaptative flipped classroom in Histology

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The flipped classroom is a blended learning methodology that reverses the traditional educational model by delivering instructional content online outside of class and spending class time on practical application assignments. In the adaptative flipped classroom, students must fulfill some reflexive questionnaires online before coming to class so that they let the teacher know what items students understand by themselves, whether there are some misconceptions and what are their difficulties so classes will be focused on the students' needs. We present a proposal to introduce this pedagogical model in the subject Cellular biology and Histology taught during the first course of the Dentistry Degree at the Complutense University of Madrid. As first-year students are not familiar with this educational model we propose to implement it in 5 out of 25 items of the syllabus. For each one, the teacher must prepare some instructive resources, mainly interactive videos and readings of documents as well as online questionnaires to check students' study. Videos and readings should be emailed one week before class with motivating and clear instructions of what they are expected to do and the deadlines. Edpuzzle and H5P embedded in Moodle are two simple and easy-to-use platforms to create interactive videos. Google Forms will be used for preparing the questionnaires. Excell program will be used to process students' answers combined to the Flip in colours approach (Prieto-Martín et al., 2019) for sorting and highlighting different kinds of answers. In-class time is re-defined and re-purposed for focus on the most difficult items, for inquiry and application and to delve into molecular and physiological aspects so students could integrate and construct their own knowledge. It is important that students realize classes will be adapted to what they have admitted not to understand or have asked for a more detailed teaching so they could appreciate teacher's feedback in class. Different gamification strategies may be applied to promote students' engagement and sustained motivation in learning. We propose to use badges, true-false and multiple-choice quizzes in Moodle and classroom response systems (Kahoot, Socrative, Mentimeter). Peer-to-peer discussions and team tasks should also be key to create active learning contexts. The flipped classroom has been proved to get not only much better formative learning and academic results but better learning experiences for both students and instructors (Prieto-Martín et al., 2017; van Alten et al., 2019).

Prieto-Martín, A., Díaz-Martín, D., Lara-Aguilera, I., Monserrat-Sanz, J., Oliva-Martín, R. y Barbarroja-Escudero J. (2017). Aspectos críticos para aplicar con éxito el modelo flipped classroom a la enseñanza de la inmunología: resultados de 5 años de experiencias en la Universidad de Alcalá. *Teach. Learn. Innov. J.*; 18-24

Prieto-Martín, A., Barbarroja-Escudero, J., Lara-Aguilera, I., Díaz-Martín, D., Pérez-Gómez, A., Monserrat-Sanz, J., Corell-Almuzara, A. y Álvarez de Mon-Soto M. (2019). Aula invertida en enseñanzas sanitarias: recomendaciones para su puesta en práctica. *F.E.M.*; 22 (6): 253-262

van Alten, D.C.D., Phielix, C., Janssen, J. y Keste, L. (2019). Effects of flipping the classroom on learning outcomes and satisfaction: A meta-analysis. *Educ. Res. Rev.*; 28: 100281

## **Inverted learning classroom model for acquisition of conceptual competences in tissue engineering**

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Artificial tissues generated by tissue engineering meeting the requirements established by regulatory agencies are considered as advanced therapy medicinal products (ATMP) that can be translated to the clinical practice (Cuende, 2018). As important therapeutic tools, specific training related to these new products should be considered in the curricula of future health professionals. However, the presence of ATMP concepts is scarce in most Pharmacy Degree curricula. For this reason, in our Department we have implemented a “inverted classroom” teaching model applied to students of the Pharmacy Degree. This model is based on the insertion of a self-learning module in the Human Histology course of the Pharmacy Degree at the University of Granada with the aim of providing the students with conceptual competences in tissue engineering. The inverted classroom model is part of the inverse learning model developed by Sams and Bergmann (2013), which emphasizes self-learning by stimulating this process in a time interval allowing students to self-regulate the acquisition of knowledge.

To evaluate the effectiveness of the model, we used a specific questionnaire on ATMP to evaluate a group of 40 students of the Pharmacy Degree enrolled in the Human Histology course (20 women and 20 men) before and after the teaching program. This questionnaire was previously validated in family medicine residents (Sola, 2019). Each conceptual item of the questionnaire was categorized by the students using a Likert scale ranging from 1 (not at all) to 5 (very much). The chi-square test was used to compare the initial and final responses of the students. P values below 0.05 were considered as statistically significant. The study was approved by the ethics committee of the University of Granada.

Results demonstrated that the inverted classroom model favors the acquisition of conceptual competences in the eleven basic concepts analyzed, going from a mean value of  $3.28 \pm 0.17$  to  $4.07 \pm 0.20$  after the evaluation period. Interestingly, all the concepts that were not considered in the classic curriculum of the Pharmacy Degree (stem cells, artificial tissues, tissue engineering, biomaterials, growth factors and GMP cleanrooms) obtained statistically significant differences before and after the implementation of this model, something that did not happen with the most common concepts in the Pharmacy Degree such as cell or tissue.

In conclusion, the proposed inverted classroom model is easy to implement and demonstrated to be able to increment pharmacy students’ knowledge on tissue engineering. The greater interest and motivation of these students, due to the professional and therapeutic expectations it implies, will stimulate the demand for conceptual training in tissue engineering and its future incorporation to the Degree of Pharmacy.

Cuende N, Rasko JEJ, Koh MBC, Dominici M, Ikonomou L. (2018) Cell, tissue and gene products with marketing authorization 25. in 2018 worldwide. *Cytotherapy*; 20: 1401-13.

Sams A, Bergmann J. (2013) Flip your students’ learning. *Educational leadership*; 70: 16-20.

Sola M, Sanchez-Quevedo C, Martín-Piedra MA, Carriel V, Garzón I, Chato-Astrain J, et al. (2019) Evaluation of the awareness of novel advanced therapies among family medicine residents in Spain. *PLoS One*; 14: e0214950.

## **Simulation and digitalization of the professional practice of the histologist and the pathologist for self-learning for medicine students**

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Histology and Pathology is a fundamental specialty of the medical degree. It is a fundamental discipline in the diagnosis of diseases and in the therapeutic decision. The three types of studies that it comprises (biopsies, cytologies and autopsies), present a macroscopic, microscopic and molecular evaluation. Undoubtedly, the microscopic or histopathological study is the one that the histologist and pathologist spend the most time in their routine practice. Students' learning has often been uneven depending on the means of the university hospital center. To alleviate this inequality, we have selected the most representative microscopic fields for many years and made microscopic photos. However, all this is not representative of the true histopathological study. The pathologist moves through the preparation in two directions (horizontal and vertical), but also uses the different magnifications very differently. Panoramas and large magnifications are used differently to guide and specify the diagnosis. When the student can choose to know the usual way of work of the pathologist, she generally does so for a limited period of time and with the limitations of optimal quality of the image derived from the aforementioned. During the last 15 years, digital scanning systems for histopathological preparations have been developed. The improvement of digitization systems has been very marked in recent times, in such a way that this system is already routine in a small percentage of Spanish hospitals. In June 2021, it is being implemented in the different University Hospitals of the University of Alcalá, and it will be the routine way of working and providing assistance. During this course, all the histopathological preparations that comprise the practical course of Histology and Basic Pathological Anatomy have been scanned and incorporated into the learning methodology of the subject. This improvement has made it possible to make all the digitized images available to all students and teachers in the course. The students have the microscopic images for the entire duration of the course, and these images are of a very high quality, identical to those used in anatomopathological practice. With just a computer and a mouse you can simulate practicing as a pathologist. This tool has allowed to take exams on digital format and carry out practical cases with a simultaneity of theoretical classes.

# **Innovation and teaching technology I**



## **Use of Genially as a complement in the practical Histology lessons, Human Histology Cards**

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The Histology Teaching Group of the Autonoma University of Madrid (UAM) teaches two full subjects in the Medicine degree. Special Histology is taught in the second academic year and is based on the knowledge acquired in General Histology during the previous year of the degree. Now, students must integrate the different basic tissues in higher levels of organization. It was observed during past academic years that, systematically, students have difficulties in remembering how to identify cells, basic tissues and stains from General Histology. We believed that it could be especially evident in 2020/21 course, when they are required to determine the tissues found in the different organs to diagnose them, without having undergone any prior training. These 2020/21 Special Histology students did not take any General Histology practical lessons because they were completely suspended due to 2019/20 second semester locked down.

We face the necessity to strengthen the required knowledge about tissue description to the 2020/21 Special Histology students. To do that, we created a histological informative database based on the use of active methodology and implementation of learning strategies using current technologies, that rely on the online tool Genially. The database was supported with a funded project from the 2020/21-UAM-Teaching Innovation Program. The project title is Human Histology Cards, and the coordinator was Dr. Laura Andrés-Delgado, lecturer of Histology. The Genially database was created simulating histology cards with the advantage of being interactive. Cards are composed mainly by images taken from the actual histological preparations used in General Histology practical lessons and are completed with relevant concepts for the diagnosis and understanding of the basic tissues. Magnification of images, appearance of text and information or the possibility of moving between cards are allowed due to interactive elements. A simplified example of our Genially histological card-bank can be found here:

<https://view.genial.ly/612d363804a7270d47bb2874>

Although the students grades were not significantly improved, they remained as in the pre-COVID situation, what we value positively. Also, a survey was conducted to the students on their satisfaction with the Genially cards. They anonymously indicated that the cards are: complete and an extraordinary help; they have saved my life - they complement what was not taught last academic year; you can see that there has been a lot of work behind it - thanks. Besides, 82,50 % of the students considered that active methodologies, as Genially, can help in the study of Histology. 82,05 % found the cards a very useful and informative complement in the study of Histology. The consideration of the students concerning the practical lessons of Special Histology has been increased and their approach to the subject was more pleasant and close.

The Genially cards are going to be used in the next academic courses, to determine if they are useful to achieve the objectives in a more classical teaching situation. As a conclusion, active and current methodologies, as our Genially histological cards, can increase students perception of active learning and favors its approach to the study of Histology.

## **The implementation of Twitter and Instagram as complementary tools during face-to-face practical lessons of Histology**

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During the current COVID-19 pandemic, undergraduate education has undergone profound changes. Two scenarios were regarded as possible: exclusively virtual teaching (non-face-to-face) or bimodal teaching (face-to-face/non-face-to-face). This has brought Histology teaching at health careers in the University of Córdoba (Medicine, Nursing and Physiotherapy) the need to adapt to this new situation. Previously, there used to be a constant interaction between the professor or intern students and the students during Histology practical lessons held at the Microscopy Room. Students would show their findings at the microscope and pose their questions to the teacher. This was incompatible with maintaining social distance. Thus, finding a way to overcome that obstacle was necessary.

Currently, the use of different social networks like Twitter or Instagram is growing not only in the business field but also in higher education, including health careers. These apps are very popular among young people, being a pragmatic way of approaching students while making them feel comfortable and motivated. For that reason, we aim to implement these two social networks during the development of Histology practical lessons to promote student's learning both inside and outside the classroom.

To do so, we designed two methods. On one side, we asked students to take pictures of what they saw in their microscopes after listening to the teachers' explanation of the structures they had to find themselves. These pictures would be edited by students, indicating what they see, and they would post them on the social networks with the pertinent #hashtag. Students could also use it to ask different questions about any histological sample. On the other side, we created an Instagram library of up-to-date histological pictures uploaded by professors and intern students to complete students' self-study. Pictures are followed by a brief explanation and by some questions answered by the students in the comments below. Moreover, different quizzes are published on these platforms to enhance their learning and receive feedback.

We made a Google questionnaire of 20 items filled by 261 students. The majority of them used Twitter (81,61%) more than Instagram (1,15%) during the practical lessons. 32,57% of the students created a new Twitter account specifically for this subject and 29,53% used this app just for this aim. They thought that using social networks was useful to keep social distance during the practice (66,28%), as well as to speed up the lessons (61,30%). Most of the students acknowledged an improvement of their implication (70,90%) and attention (59,59%) on the practical lessons due to the use of these virtual tools, improving the overall dynamics of the lessons (86,64%). With regards to Instagram publications, 63,16% rated them as useful for their daily study with descriptions of perfect text extension (89,47%). In summary, on a scale of 5 points, 46,74% of the students gave these implementations the higher mark, while 37,55% gave it a 4 out of 5.

To conclude, using social networks in Histology improves students' learning skills as they are daily platforms used by young people that make them feel confident while having fun.



## Use of interactive questionnaires in Cell Biology and Histology subjects

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Nowadays, it is a fact that the master class, understood as the presentation of content by the teacher in a unidirectional way, is obsolete. Students demand a more attractive type of teaching that makes classes more dynamic. More and more different teaching models are being imposed where new active work methodologies are introduced seeking to directly involve students in their learning process. They look for, among other objectives, the motivation of the student (Camacho Miñano, 2012). The incorporation of new dynamic elements in the classroom is an important aspect in the development of university teaching. One of these elements is interactive questionnaires, which fall within the methodologies called gamification (Barbancho et al., 2017). This type of methodologies allows the participation of all students in the classroom, in a playful and dynamic way, helping to break with the daily routine of the master class and the passivity of the students. It also looks for the active participation of students in the learning process.

In the present study, we show the work carried out in the subject Cell Biology and Histology in two degrees including in Health Sciences: Degree of Nutrition and Degree of Optics and Optometry. In both cases, interactive questionnaires are used by mean of two mobile applications: Socrative and Kahoot. Questionnaires with multiple choice questions were designed. In the case of the Nutrition Degree, they were used during the development of the practical sessions; conversely, in Optics and Optometry Degree, were used during theoretical sessions. The objectives to be achieved were:

1. Assimilation of basic concepts of each of the blocks of the subjects.
2. Provide agility to the lectures / practices.
3. Encourage student participation (creating a space for shared knowledge).
4. Provide a self-assessment system.
5. Prepare the student for the assessment using multiple choice questions.

At the end of the semester, the students were requested to fill out a satisfaction survey of the activities carried out. In the case of the Degree in Nutrition, 96.5% of the students valued this type of activity positively while in the case of the Degree in Optics and Optometry were 88%. 100% (Nutrition Degree) and 92% (Optics and Optometry Degree) of the surveys agreed that the use of the interactive questionnaire has allowed them to review the contents in an entertaining and dynamic way. Together, we can conclude that this activity helps students to consolidate knowledge and serves as a self-assessment system.

Camacho Miñano. M.M. (2012). El uso de mandos interactivos: una innovación docente para aumentar la motivación y mejorar el aprendizaje del alumnado universitario. EKS., 13 pp. 412-436.

Barbancho MA., Ruiz-Cruces R., Navas-Sánchez P., López-González MV., Lara JP. (2017). Student satisfaction in small group activities in Medicine using interactive response controls based on radio frequencies. *Educación Médica* Volume 18, Issue 3, Pages 160-166

## **Pinterest as a virtual tool for learning Histology in times of pandemic**

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The number of students per teacher in practical classes has increased substantially in recent years and their profile has changed. Accustomed to the use of new technologies, students are increasingly passive in the classroom and demand a new form of teaching. In this context, networked teaching platforms that allow sharing materials and establishing debates, the possibility of video recording, participation in social networks and the development of blogs, have become a great opportunity for teaching innovation and traditional face-to-face classes are becoming obsolete (Álvarez Vázquez, 2018). After teaching Histology classes for three courses in nursing and physiotherapy degrees I know the problems faced by students in the learning of Histology. The use of active learning methods through the social network Pinterest is proposed, to guide students to understand the basic principles of Histology and to build mental models to integrate the complexity of static images with the dynamism of histological function. Currently, students have a large collection of animal histology slides in the Histology practicum. The idea is that university students are able to take pictures with their mobile devices through the optical microscope, and after filtering, these pictures are published in a private Pinterest account exclusively for the 144 students of the subjects of Cell Biology, 1st year of the Degree of Nursing and Histology, 1st year of the Degree of Physiotherapy at the University of Valladolid. Thus, the objective of this activity was to generate a new teaching tool to allow for the COVID-19 pandemic study -bases of images of animal tissues and organs on Pinterest-. In addition, the effectiveness of this educational tool was evaluated. The 144 students presented the internship notebook and increased their internship grades in the 2020/21 course ( $8.0 \pm 0.8$ ) with respect to the three previous courses ( $7.1 \pm 1.1$ ). A total of 97.22% of the students enrolled took the final exam, with a pass rate of 91.42%. These results are higher than those obtained in previous years, with 85.18% taking the exam for a total of 79.13% of students who passed Histology. The survey completed by the students through the Virtual Campus showed that participation in the virtual atlas was 98.6% and the students valued very positively the usefulness (97.2%), ease (94.4%), collaboration in the use (99.3%) and recommended (98.6%) that it be included in future years. In this way it has been possible to involve students in a novel activity and increase their interest in the discipline, and the teaching framework of face-to-face practices has been reinforced. Because the use of virtual images maintains the educational advantages inherent to the use of a real optical microscope, allowing students to better understand the morphological characteristics of traditional optical/electronic microphotographs and to obtain better grades than their peers in previous courses. This could be due to the personalized attention of the teacher on the students.

Álvarez Vázquez M.P. (2018). Continuous vs. traditional evaluation in Histology practices. Pedagogical experiences and educational innovation. Contributions from teaching and research praxis. Ed. OCTAEDRO, S.L., Barcelona, Spain, pp. 1139-1148. ISBN 978-84-17219-78-9

## **Innovation and teaching technology II**



## **Performance of medical students enrolled in a virtual teaching program. A comparative study with presential teaching**

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The current pandemic situation has led to a substantial change in our way of teaching histology (Caruso, 2021). Traditionally, most classes were taught presentially, with the professor and the students physically present in the class. However, during the last year, we have experienced a new teaching model based on virtual classes that are carried out through different platforms allowing non-presential teaching (Darici et al., 2021). Whether or not this change has modified the students' performance should be determined. In the present work, we have compared the scores obtained by students enrolled in a presential and non-presential course of the subject "Cytology, Inheritance and Embryonic Development" to determine the possible effect of non-presential teaching on student performance and success rate. To do so, we analyzed the results obtained by students enrolled in this subject during the academic year 2019-2020, which allowed face-to-face teaching, and the results obtained in 2020-2021, in which a virtual teaching platform was implemented. The analyzed subject consists of five different parts, which were evaluated independently in the final exam of the subject: theoretical concepts in cytology, in inheritance and in development and practical concepts in cytology and inheritance. Results showed that performance of the students was lower for three parts of the exam corresponding to virtual teaching students: theoretical concepts in cytology and development and practical concepts in inheritance, with statistical differences with presential students ( $p < 0.05$ ). No statistically-significant differences were found for the other parts of the subject, or for the final scores obtained by the students. In general, these results suggest that virtual teaching is as efficient as presential teaching in terms of global performance of the students. However, some specific theoretical and practical concepts showed lower scores, suggesting that learning these concepts could require a more direct face-to-face interaction between teachers and students, and novel adaptative measures should be taken if virtual teaching is required.

Caruso MC. (2021). Virtual Microscopy and Other Technologies for Teaching Histology During Covid-19. *Anat. Sci. Educ.* 14,19-21.

Darici D., Reissner C., Brockhaus J. & Missler M. (2021). Implementation of a fully digital histology course in the anatomical teaching curriculum during COVID-19 pandemic. *Ann. Anat.* 236,151718.

## **Changes in the methodology of microscopy practices in the Histology subject of the degree in Dentistry**

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The students of the Degree in Dentistry at the University of Valencia take the Histology subject in the second period of the first academic year. One of the practical activities is the microscopic visualization of histological preparations stained with different techniques. Until the 2018/2019 course, this practical part was distributed in 8 sessions of 2 hours in which 4-6 preparations were explained and visualized in each one. The students had to make drawings in each session of 2 selected preparations studied in which the most important elements indicated in the explanation of the preparations should appear. At the end of the practices, an exam was made. The students had to locate 5 objectives among all the preparations studied. In the present 2020/2021 academic year, several modifications have been made to both the practical sessions and the exam: although the 8 practical sessions have been maintained, they have had to be reduced to 1 hour each due to the capacity restrictions imposed by COVID. Besides, thanks to the award of a teaching innovation project granted in September 2020, the descriptions of the microscopic preparations have been recorded in short videos (4-5 min each) so that students could view them before each practical session or later on to review it. The number of preparations has decreased to 2-3 per session. During the corresponding session, the video was projected so that the student could localize the structures mentioned in the video in their microscopy slides. Instead of drawing the whole preparations, they were given a practice notebook in which 6 representative objectives per session were asked them to draw. The exam had also been modified: among all the preparations, 3 are selected and they must draw them with as much detail as possible and name at least 10 representative objectives of each one. We have analyzed how these changes in methodology have influenced the marks corresponding to the notebook drawings and to the microscopy exam. For this analysis, we have calculated the average mark of each of these items for both academic years 2018/2019 and 2020/2021. Although there are no significant differences, the result is positive since even though the duration of the practical sessions has been reduced by half, the marks of the students have not been affected. Future analysis in non-COVID academic year will be done to check if the new methodology improves students knowledge of Histology.

## **Skeletal Muscle Histology in Physiotherapist Training**

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One of the main organs that the physical therapist works with is the skeletal muscle. In-depth knowledge of its Histology is essential not only to understand the physiological and pathological bases that affect it, but also its plastic capacity in proplastic responses (regeneration, hypertrophy, remodeling) and retroplastic (sarcopenia, disuse atrophy). These responses are essential to understand and know how to act on a scientific basis in the evolution of traumatic muscle injuries and different neuromuscular disorders, among others.

In this sense, in the academic year 2017-18 we began, in the Degree of Physiotherapy, an optional subject ("Biopathology of the Skeletal Muscle") in which, from selected neuromuscular diseases and traumatic muscle injuries, the essential and determining role played by the different histological elements (muscle fibers, satellite cells, extracellular matrix, innervation and vascularization). Specifically, the proplastic and retroplastic phenomena and how they can be involved in the strategies used in physiotherapy are analyzed.

In this communication we present the design of the subject, the teaching strategy used, the evaluation system and the results obtained from the teaching activity carried out in this subject.

## **Evaluation of clinical competences in the practices of medical Histology. A pilot study in epithelial and cartilaginous tissues.**

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The progressive acquisition of clinical competences and skills in medicine should be taken into account during the whole training period of medical students, including the preclinical stages. Histology is one of the main preclinical subjects that could contribute to competence development, especially regarding those related to observation and diagnosis (Peña, 2007). The purpose of the present study is to evaluate the competences of medical students enrolled in the Histology program to identify and diagnose relevant structures that are observed microscopically. Specifically, two practical sessions were evaluated: the epithelial tissue and cartilage. In both cases, students, who had previously received theoretical teaching on these topics, had to answer to a questionnaire related to identification and diagnosis of specific histological structures shown in microscopical images. Preliminary results showed that the tissue identification success rate of these students was higher in the case of the epithelial tissue -correct identification of structures reached 62.6%- as compared to the cartilaginous tissue -with 32.0% of achievement-, with differences being statistically significant ( $P < 0.008$ ). For diagnosis, we found that differences were not statistically significant, with 60% of success in the first case and 48% in the second case. When results were categorized per gender, we found non-significant differences between male and female students ( $P > 0.05$ ), although males tended to identify structures more properly than females, whereas diagnosis was more accurate in the case of females. These results suggest that tissues mainly consisting of cell populations could be easier to identify by medical students, whereas tissues containing abundant extracellular matrix could be more complex to identify and recognize from a histological image. In consequence, teaching programs should be implemented to reinforce the nature and structure of extracellular matrix components of human tissues. In addition, we found that students had the capability to make a diagnosis based on the structures previously identified in the histological images. We suggest that this type of evaluation analysis could be implemented to determine the capability of medical students to link their evaluation competence with the capability to elaborate a diagnosis.

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## **New approaches in the teaching of Histology**



## **Impact of foreign language on the understanding of key tissue engineering-related threshold concepts in postgraduate students**

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The learning process of a discipline is complex, gradual and requires an adequate knowledge of basic threshold concepts (Carmichael, 2010), and their correct identification is crucial (Saavedra-Casado, 2017). Furthermore, the learning process could be affected when students must analyze information in a foreign language (FL). In this context, the aim of this study was to determine if FL could exert an impact on the understanding of key tissue engineering-related threshold concepts (TETC) in postgraduate students.

This study was conducted with postgraduate students of the master of tissue engineering and advanced therapies at the University of Granada. Ten TETC were selected and its understanding was determined through a multiple choice test at the same students in English (n=70) and French (n=68). In addition, students performed a self-assessment FL level test, where they rated their English or French FL level on a scale from 0 (none) to 10 (excellent). The data obtained was used for descriptive and statistical analyses.

The students' performance differed in function of the FL used in the tests. Indeed, the mean score values were higher for the test in English ( $6.04 \pm 1.62$ ) than in French ( $5.81 \pm 1.71$ ), but these differences were not statistically significant for Mann-Whitney non-parametric test ( $p=0.423$ ). Interestingly, 80% of the students passed the TETC test in English and 76% in French. In relation to the self-assessment FL level test, students indicated a significantly higher (ANOVA,  $p=0.000$ ) level of English ( $6.34 \pm 1.8$ ) than French ( $3.54 \pm 2.11$ ). Additionally, Kendall rank correlation test revealed a positive correlation between the students' performance and self-assessment test for English ( $p=0.045$ ) but not for French ( $p=0.832$ ). Finally, when the percentage of correct answers was analyzed, the same degree of difficulty for both FL used was observed. This analysis revealed that the terms "signals/signal" and "scaffold/échafaud" were the most difficult while "construct/construction tissulaire" and "stem cell/cellule souche" were the easiest.

The results obtained in this preliminary study confirm the impact of FL proficiency on the understanding of key threshold concepts related to tissue engineering. In addition, this study suggests that novel didactic strategies should be developed to improve the learning and understanding of threshold concepts in tissue engineering in native and/or FL in order to be able to read and understand scientific information in the field.

Carmichael P. (2010). Threshold concepts and troublesome knowledge: Linkage to ways of thinking and practicing within the disciplines. Edimburg: University of Edimburg; 2003.

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## **Identification of Threshold Concepts linked to tissue organization in dental students. A preliminary study**

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One of the learning theories that considers the student as the central element of learning is Threshold Concepts (TC) theory, which has been a topic of increasing interest for scientific community during the last decade (Cousin, 2009). TC are considered as conceptual gateways that lead to a previously inaccessible way of thinking about something (Meyer y Land, 2003). The identification of specific TC of a discipline may arise as a relevant tool for a focused curricular redesign as the teaching of these concepts may significantly improve the students' learning. A specific survey aimed to the identification of 5 histological threshold concepts based on the students' perception has been developed by the academic staff of the Department of Histology at the University of Granada. This survey used a Likert-like scale ranging from 1 (not at all) to 5 (very much). As a preliminary study of this specific survey, we have assessed the students' perception of concepts around tissue organization in 30 students of Human Histology from Dentistry. All analyzed concepts received a high perception as threshold concepts (scores > 4), except for "disperse cell population". Some differences could be detected among different concepts. "Cell" obtained a perception of  $4.87 \pm 0.43$  over 5 points, being the highest scored and suggesting that students perceive this a core concept for the comprehension of human histology. In fact, the concept of "cell" was significantly higher scored by students when compared to other analyzed items. On the other hand, "disperse cell population" was the concept that received the lowest perception as TC ( $3.7 \pm 1.02$ ), being this result significantly lower when compared to the rest of items. These results suggest the need to characterize specific pedagogical strategies focused to optimize the learning of Human Histology in dentistry and to identify those concepts that present troublesomeness on students. An accurate TC identification could improve the teaching-learning process of specific histological competences and perception.

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## Can Cajal motivate the learning of Histology in today's medical students?

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The knowledge of the human microscopic structure is of vital importance in the training of health professionals, serving medical histology as a bridge between basic and clinical sciences.

But, how to motivate our first-year Medicine students who are impatient to arrive at the clinic to the detriment of basic subjects and who have a particular fear of disciplines related to the nervous system, as they perceive them as complex and difficult? Furthermore, how to awaken their interest in biomedical research in this area?

A great Histologist is formed by knowing another. In this context, the Cajal Conference emerged (5 so far) in 2016 in the Faculty of Medicine of the Complutense University of Madrid, whose objective was to give relevance to the figure of the Nobel Prize winner Santiago Ramón y Cajal in order to bring neurodisciplines closer to first-year Medicine students in the Histology subject, serving as a common thread to develop skills, combat neurophobia and awaken research vocations.

In each academic year they have focused on different themes: Cajal as a model to develop transversal skills, as a vaccine to combat neurophobia and stimulation of scientific vocations; outreach in neuroscience as a tool to promote communication skills and strategies to combat neuromyths.

Researchers, teachers, clinicians and disseminators have participated in the Conference, representing a perfect confluence between basic research, clinical practice and scientific dissemination.

Depending on the theme, various activities have been carried out. In the first conferences, the students attended various neuroscientific research centers such as the Cajal Institute, the beginning of the meeting with the Nobel Prize. In all of them, interactive conferences in which students are participants in the impact of our discipline on clinical practice and science through contact with scientists, neurologists and popularizers.

Subsequently, the students developed teamwork, either writing a popular science article, or making videos, presentations, and infographics. They filled out a survey before and another after the activities to detect variations in their perception after the activities carried out, as well as a satisfaction survey adapted to each conference.

Participation in these activities reached 80%, despite being voluntary.

The results show that the students consider the proposed activities useful for the development of transversal competences. Interestingly, when comparing the results of the surveys before and after the activities, just over 80% of the students perceived the neurosciences as a less complex and more accessible field than they imagined before the activities began.

The dissemination activities and the production of videos allowed them to encourage their communication skills, as well as teamwork, which will be useful in their professional practice.

In relation to fake news, the vast majority of participants consider that it is crucial to disclose correctly to dismantle fake news that affect health.

More than 90% of the respondents affirmed that the talks with researchers have helped them to assess the importance of scientific research in the field of medicine.

In conclusion, the Cajal Conference is presented as a useful strategy to motivate the learning of Histology in Medicine studies.

## Histology teaching for the elderly: La Nau Gran

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La Nau Gran is a program of the University of Valencia for students over 55 years old, which has more than 20 years of experience, and offers eleven different itineraries. The Health Sciences itinerary is taught in three courses; it contains 14 basic subjects and several optional subjects. Each subject is evaluated yearly by means of surveys to the students, keeping only the subjects that obtain a good evaluation. The student must pass the basic subjects (45 credits) plus 30 optional credits to obtain the Nau Gran Diploma (75 credits), without the issuance of an official degree.

Forty students are accepted yearly, and they have 2-3 basic subjects per term, with a total of 15 basic credits/year. Each subject is taught in a session of 1.5-3 hours/week. The Histology unit of the Faculty of Medicine and Dentistry has taught the subject "Biological changes with age" for the last 5 years. It is taught in 2-hour sessions in the second term of the second year and consists of 12 theoretical and one practical teaching sessions.

Our subject focuses on the study of the general bases of human biological aging, analyzing the specific changes in the different organs and systems, at the level of the histological organization of its components. In addition, the concept of tissue engineering and regenerative medicine applied to these changes is introduced for each organ or body system. The practical session is carried out in smaller groups, where students become familiar with the histological technique for later visualization under the microscope. At the end of the course, students are asked to fill out a survey where they rate (from 1 to 5) their opinion on different aspects of the subject.

Over the last five years, more than 95% of the students attended classes and passed the subject. They showed great interest and asked numerous questions, especially aimed at knowing in depth the biological bases of their own changes due to aging, as well as the possibility of regenerating tissues and the latest research on the manufacture of artificial organs.

Moreover, the students valued the teaching received in this subject very positively, with respect to surveys carried out during 3 years with our students of the degrees in Medicine or Chiropody. Regarding the surveys, in the item "Teaching methodology" La Nau students valued 4.61, Medicine 4.13, Chiropody 4.01; "Materials and didactic guide" La Nau showed 4.42, Medicine 4.17, Chiropody 4.08; respect "Teaching Attitude" La Nau obtained 4.86, while Medicine 4.40 and Chiropody 4.30. Finally, regarding "I would recommend this subject to other students", La Nau obtained 4.68, Medicine 4.03, Chiropody 4.02, while "I would recommend this teacher to other students" La Nau showed 4.74, Medicine 4.13 and Chiropody 4.04.

In summary, the students showed a very favorable subjective assessment, great appreciation for having this learning opportunity, and interest in the knowledge of the morphology of the human organism at the microscopic level, as well as new tissue regeneration therapies.

## **Bold Histology: Towards a histology more plastic and without frontiers**

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Knowledge of the structure, composition and function of organisms is essential in the training of graduates in Biomedical Sciences. Cells and tissues are essential components for understanding the normal functioning and disease processes of the body. However, the concept of tissue is a theoretical construct with several inconsistencies (De Juan, 1999). Previously, we observed that histology subjects in medicine and nursing courses were the least important for the training of students (De Juan et al., 1988; Pérez-Cañaveras and De Juan, 1994). Recently (De Juan et al. 2019), we observed significant differences between students and teachers and between women and men regarding the complexity and beauty of the different tissues varieties.

Histological data are microscopic images of cells, tissues, and organs. Traditionally, learning to diagnose histological images was based on repetitive observation, a monotonous and very laborious method. To reduce time and improve learning, we introduced (De Juan 1999) the concept of Tissue Structures (TSs) and developed a graphic and conceptual systematization, in small groups, of the TSs (De Juan et al., 2003; De Juan et al. al., 2015; De Juan et al., 2017, De Juan et al., 2019) observed with classical and current methodologies and the introduction of a reduced number of rules for the 'reading' and interpretation of TSs images.

Nowadays, there are new tools, techniques and methods to understand better the morphology, composition and function of the STs of any of the different existing organisms. Taking this into account allows us to have a much broader and more flexible vision of the educational objectives of our discipline and open a field of discussion about pedagogical aspects based on TSs and the new histological methods.

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