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**14TH INTERNATIONAL CONFERENCE  
ON EDUCATION AND NEW LEARNING  
TECHNOLOGIES**

**PALMA (SPAIN)  
4TH-6TH OF JULY, 2022**



## CONFERENCE PROCEEDINGS



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**Edited by**

Luis Gómez Chova, *University of Valencia, Spain*  
Agustín López Martínez, *University of Barcelona, Spain*  
Joanna Lees, *CEU Cardinal Herrera University, Spain*

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# ENHANCING ENGAGEMENT OF DENTAL UNDERGRADUATES BY FLIPPING HISTOLOGY

**María Pilar Álvarez-Vázquez<sup>1</sup>, María Teresa Angulo-Carrere<sup>2</sup>, Carmen Bravo-Llatas<sup>3</sup>**

<sup>1</sup>*Cell Biology Department, School of Medicine, Universidad Complutense de Madrid (SPAIN)*

<sup>2</sup>*Nursing Department, School of Nursing, Physiotherapy and Podiatry, Universidad Complutense de Madrid (SPAIN)*

<sup>3</sup>*Teaching and Research Support Service, Universidad Complutense de Madrid (SPAIN)*

## Abstract

Histology is a basic science dealing with the study of microscopic composition and organization of tissue and organs. Medical and dental curricula include human histology as part of their preclinical years. Nevertheless, in many universities the preclinical curriculum has been compressed or an interdisciplinary integration of pre-clinical and clinical subjects has been adopted with a loss of curriculum time spent in basic disciplines such as Histology. In this context, it is not uncommon that this subject is perceived as difficult to pass and high failure rates reduce learners' interest and engagement.

Adaptative flipped classroom (AFC) is a student-centred teaching methodology based on interaction between instructor and students prior to face-to-face sessions. Students are required not only to watch videos, read papers, or study some texts but also to complete some tasks that should make them reflect on the subject while allowing to prove their study. Assignments ought to develop learners' critical thinking and reveal the most difficult and complex topics so that the instructor could tailor its teaching to their needs and spend time to dive into problems, cases, and discussions.

A limited and blended AFC approach was implemented in the subject Cell Biology and Histology which is part of the dentistry curriculum in the Complutense University of Madrid. AFC was applied in 5 tissues that represent 8 units out of 25 of the syllabus. For each tissue, students received an instructive and engaging email, detailing what they were expected to do, tasks and deadlines as well as some suggestions, attached materials and linked videos files. Three types of tasks (initial, previous study check and quizzes) were designed in Google forms and Moodle. Those students who carried out the 15 assignments would achieve one point bonus and the rest would get a bonus proportional to the number of completed activities. An exam comprising the 14 units, 6 of cell biology plus 8 of flipped histology, was carried out. A week later students received a last instructive email asking them to fill in 5 final forms. A statistically analysis was performed using Excel and SPSS to describe frequencies, means, and standard deviations of variables related to personal and academic characteristics as well as participation in AFC assignments.

High rates of participation were obtained as on average 84% of students filled in the forms. As the weeks progressed, commitment increased since percentage of early delivery previous study check forms raised. Nearly 82% of the enrolled students achieved a bonus between 1 and 0.73 points. Students stated that they spent around three hours and half on average to prepare each topic.

Although most of the class didn't know about AFC and students were split into two halves that turned weekly to attend online or face-to-face, undergraduate dental students welcomed AFC methodology for teaching and learning histology and results of this first experience were satisfactory.

**Keywords:** Dental degree, Histology, Adaptative flipping classroom, Student engagement.

## 1 INTRODUCTION

Histology is a basic discipline that examines the microscopic structure of tissues and organs in health. It is crucial for medical and dental students to master the foundations of normal structure and function before moving on to subjects as histopathology. It must be borne in mind that histology remains imperative for an accurate diagnosis of many diseases. Despite their significance, in many medical and dental syllabus the preclinical curriculum has been compressed entailing a loss of number of hours (Lallier 2014; Gilliland 2017; McLean 2018). Not surprisingly, histology has high failure rates and students feel disgruntled as they experience problems with contents and appropriate study approach (Beylefeld et al 2008; Hortsch & Mangrulkar 2015; Mortensen & Nicholson 2015).

Educational strategies for teaching and learning basic medical sciences have grown in the last years from traditional lectures and microscopy to active and interactive environments. The flipped classroom is becoming increasingly popular in health schools. Engaging the learner with the content is crucial to improve learning, increase pass rate and get a rewarding teaching and learning experience. Flip teaching involves two major components. The first one is the individual study through specific material provided before face-to-face sessions. The second one includes different activities and discussions in groups in the classroom. Three are the main goals: (i) students get familiar with concepts and theoretical aspects, so they could think and reflect on them before arriving in the classroom; (ii) students maintain a high level of concentration and positive learning attitudes during face-to-face class time and (iii) class time can be spent to clarify misconceptions and emphasize the key points with more advanced activities which develop skills and increase interactions among learners and between them and the instructor (Cheng et al 2016; Angadi et al 2019). A variety of didactic materials from lectures, PowerPoint presentations, videos, podcasts to questionnaires and quizzes, must be prepared to encourage individual learning, engagement and active self-performance at own's pace and timetable. Benefits of flipping teaching go beyond stimulating positive attitudes, they also include improving learning and academic outcomes (Cheng et al 2016; Hew & Kwan 2018; Aristotle et al 2021).

Adaptative flipped classroom (AFC) is a more refined approach based on interaction between instructor and students prior to face-to-face sessions. Students are required not only to watch videos, read papers, or study presentations but also to complete some tasks that should make them reflect on the subject while allowing proving their study (Prieto Martín 2017). Two are the major objectives: (i) to develop learners' critical thinking and knowledge building and (ii) to reveal their difficulties so the instructor could adapt its face-to-face teaching to their needs, to solve doubts and queries, and to spent time to focus and discuss on problems, cases, and questions in groups.

The aim of this study is to present students' behavior when a limited and blended AFC approach was applied in the histology program of a dental degree to enhance engagement and active learning.

## 2 METHODOLOGY

The subject Cell Biology and Histology is part of the dental degree curriculum in the Complutense University of Madrid. A previous study has shown a remarkable diversity among first-year undergraduates according to their origin and culture as well as age and way of access to the degree (Alvarez et al 2021). In 2021-22 course students were asked to fill a profile card with some personal and academic data.

A limited approach of AFC was implemented this course to enhance engagement and to reduce failure rate. After a 6 units part dedicated to the cell biology taught in traditional lectures, 8 units out to 19 of the histology program were chosen, related to 5 tissues, namely: epithelial, connective, adipose, blood and cartilage tissues. A detailed schedule was planned, and a bonus was offered to enhance students' engagement and achieve a significantly level of participation.

The limited approach of AFC employed is illustrated in Fig. 1. For each tissue, students received an instructive and motivating email, detailing what they were expected to do, assignments and terms as well as some suggestions. Didactic resources were attached and specialized video lessons, part of them in English, were linked. Three types of assignments to do prior to classes were created: (i) an initial form on the tissue to be studied, that should be completed before starting to work on it; (ii) a previous study check form, in which students could identify their difficulties, the concepts they think necessary or not to delve into, include an abstract and summarize the main ideas, reflect the time spent and rate in a 10-point scale their self-learning; and (iii) a Moodle matching quiz set with a single attempt. Deadlines for each task were clearly stated. Students ought to fill up initial forms within 48 hours after receiving each email, previous study check forms within one week and make quizzes on sessions' eves. One point bonus would be assigned to those students who achieved the 15 activities, and the rest would get a bonus proportional to the number of completed tasks. An exam comprising the 14 units, 6 of cell biology plus 8 of flipped histology, was carried out. A week later students received a last instructive email asking them to fill in 5 final forms that were the same than the initials. Results were analyzed with SPSS v. 25.

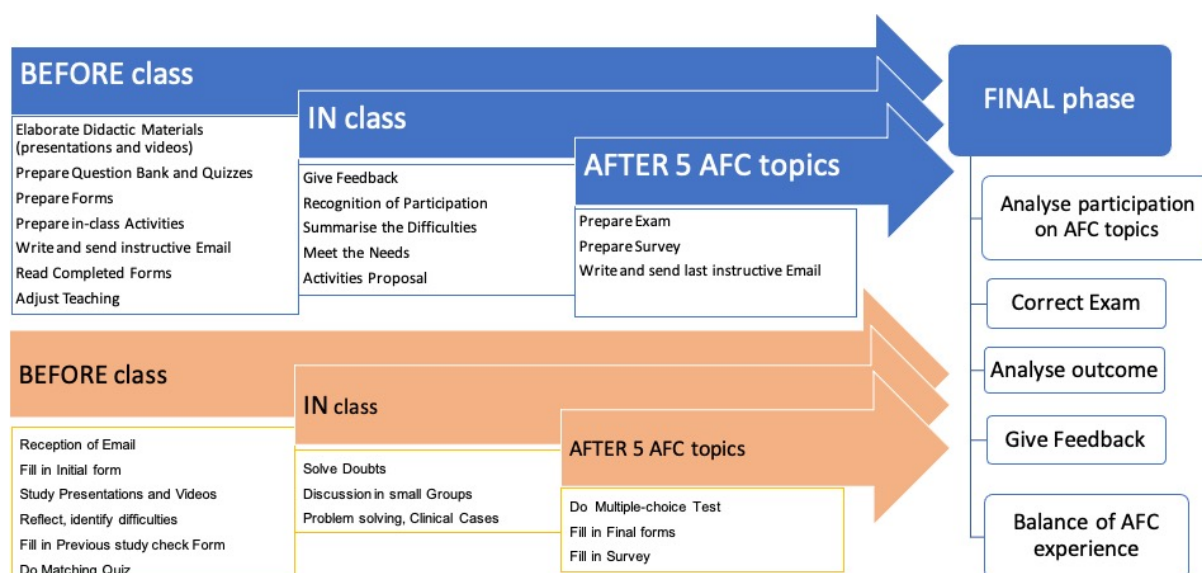


Figure 1. Schematic diagram showing the AFC planning and teaching model. The content in blue is referred to the instructor and in orange what students are expected to do.

It is necessary to point out that AFC was undertaken in a blended system. Because of the sanitary restrictions due to the pandemic, half of the students went to face-to-face classes while the other half attended classes online via Microsoft Teams. The two halves turned weekly.

At the beginning of each session, an overview of the previous work done was presented. The instructor thanked the students by showing the names of participants in a slide as well as the weekly pace of filled forms delivery, the average time declared and the average of self-learning scores. After that, instructor briefly reviewed the initial form highlighting those questions with worse results and summed up the main queries and urgent doubts pointed out in the previous study check form. This way, session focused on solving doubts, clarifying misconceptions, and addressing needs and there was also time to raise problems and clinical cases and work in small groups. At the end of the five AFC topics, a badge was given to students who have shown greater commitment and engagement.

Data collected in profile cards and in participation records were processed and a statistically analysis was performed using Excel and SPSS v. 25 to describe frequencies, means, and standard deviations of variables.

### 3 RESULTS

115 students enrolled the subject, 22.6% of which were repeaters. Their age ranged from 18 to 41 years ( $19.6 \pm 3.41$ ). The demographic and academic details of students are tabulated (Tables 1 and 2).

Table 1. Demographic characteristics of the students.

Gender		Mother tongue		Spanish proficiency	English proficiency
Male	Female	Spanish	Others	High	High
21%	79%	79%	21%	98%	77%

Table 2. Academic characteristics of the students.

Previous studies in		Educational background			University admission
Spain	Other countries	High School	Vocational School	Higher Education	1 <sup>st</sup> choice: Dental degree
87%	13%	83%	14%	3%	71%

Didactic materials provided to study were basically PDF presentations created by the instructor and Spanish and English videos obtained from open sources. Students were asked to study a total of 6 presentations and 44 short videos. Some of the videos were interactive, that is, videos with hotspots or clickable areas where multiple choice or fill blank questions were embedded and students must answer to be able to view forward. Interactive video makes viewing active instead of passive, creating a game-like experience much more engaging and entertaining than linear videos.

The number of questions in initial and final forms ranged from 11 in topics I and V, to 14 in topics II and IV and 16 in topic III. Most of them were closed questions with three answers (true, false and I don't know), being possible to choose only one option. This type of forms is useful as they can be transformed in questionnaires so hits and mistakes can be quantified, and marks obtained. Nevertheless, no marks were given to the students.

Regarding the previous study check forms, the number of questions ranged from 7 in topics III and V to 11 in topics I, II and IV. In this case, students needed to reflect and elaborate their own answers. They were also asked to mark their self-learning after studying each tissue and to measure the time spent in each topic (Table 3).

Table 3. Questions in previous study check forms

<b>Topics I (Epitheliums), II (Connective) and IV (Blood)</b>	<b>Topics III (Adipose) and V (Cartilage)</b>
Identify the three main ideas	Identify the main idea
Which aspects should be clarified in class?	
Write an abstract of less than 100 words	
Which aspect was the most difficult to understand?	Which aspect was the most difficult to understand?
Is there any urgent doubt to solve?	Is there any urgent doubt to solve?
Which aspects you don't need to be explained in class?	Which aspects you don't need to be explained in class?
Write a question you are now able to answer	
Choose the best/worst provided material	Choose the best/worst provided material
How could materials be improved?	
Mark your self-learning (10-point scale)	Mark your self-learning (10-point scale)
How much time did you spend? (min.)	How much time did you spend? (min.)

Engagement of students to the AFC proposal was very high as shown in Table 4. The average number of students that completed both initial and final forms was 94 and the same average figure was obtained referring to previous study check forms. This means that more than 81% of the class has done the assignments from the beginning to the end. Regarding quizzes, participation was even higher. The differences among forms and quizzes figures should be attributed not only to people who decided to do or not to do a form or a quiz but to changes in enrolment figures.

Table 4. Number of students that completed forms and quizzes. Mean $\pm$ SD (as number and %)

<b>Topics</b>	<b>No. of students that filled forms</b>				<b>No. of attempts</b>
	<b>Initial</b>	<b>Final</b>	<b>Initial &amp; Final</b>	<b>Previous study check</b>	<b>Matching quizzes</b>
I, epitheliums	109	102	98	112	108
II, connective	102	102	94	92	107
III, adipose	96	102	92	89	99
IV, blood	99	101	93	88	97
V, cartilage	96	102	92	87	95
Mean $\pm$ SD	100.4 $\pm$ 5.41 87.3% $\pm$ 4.71%	101.8 $\pm$ 0.45 88.5% $\pm$ 0.39%	93.8 $\pm$ 2.49 81.56% $\pm$ 2.17%	93.6 $\pm$ 10.45 81.39% $\pm$ 9.09%	101.2 $\pm$ 5.93 88% $\pm$ 5.16%

Students' commitment is clearly stated as at least 92% of the class delivered previous study check forms on time. Although more than half of class filled in these forms on days 6 and 7, as the weeks progressed,



percentage of early delivery (days 0 to 3) increased from 8.9% and 6.5% in topics I and II to 20.2%, 23.9% and 23% in topics III, IV and V, respectively (Fig.2).

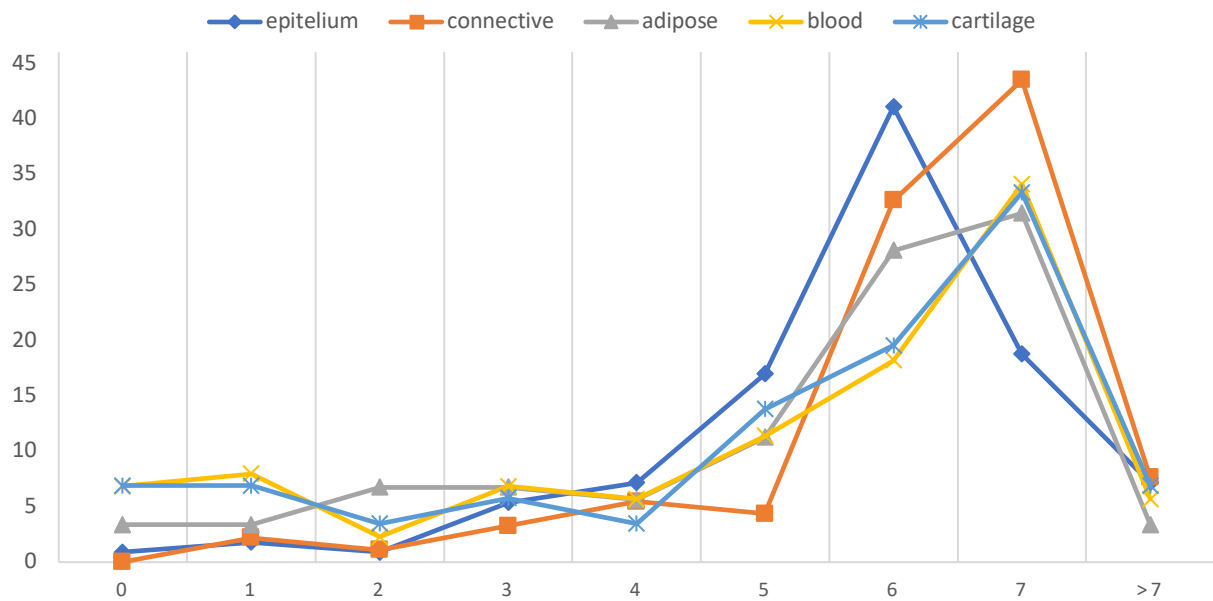


Figure 2. Weekly pace of delivery of completed previous study check forms (as %). Day 0 is the day students received instructive emails with attached materials and links

Weekly pace delivery is closely related to time devoted to study and prepare each topic and this is an important variable since students shouldn't be overloaded. Students were asked to measure time spent in each topic so the instructor could have a rough idea and see if substantial differences among the topics might exist. The average time spent declared by students varied from 154.96 ( $\pm 87.53$ ) minutes in cartilage tissue to 245.42 ( $\pm 130.49$ ) minutes in epithelial tissue (Fig. 3, left). The total average was 201.61 ( $\pm 107.71$ ) minutes which means students needed around three hours and a half to watch videos, study presentations, and fill up forms and quizzes in each topic. Although dental undergraduates are usually academically well-performing students, it is not uncommon they feel overwhelmed and lost when getting to university. When asked to score their perceptions of self-learning in AFC topics, the lowest figure was achieved in topic III with a minimum average of 5.7 ( $\pm 1.2$ ) out of 10 and the highest was obtained in topic I with a maximum average of 6.6 ( $\pm 1$ ) out of 10 (Fig. 3, right). These appraisals indicate the need to improve students' self-confidence specially when implementing active methodologies they never used before.

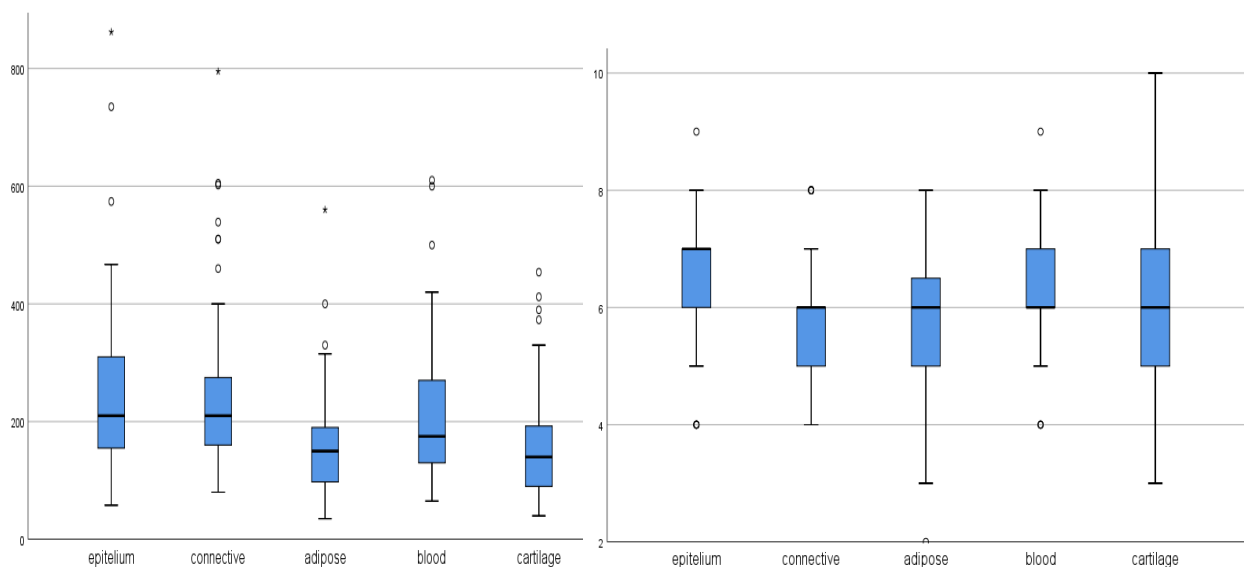


Figure 3. Box and whisker chart displaying time devoted to each topic (left, in min.) and self-appraisals of learning (right)

Finally, the high rates of participation enabled students to achieve a bonus. 55.7% of the enrolled students managed to complete the 15 assignments before classes and obtained 1 extra point while 26.1% achieved a 0.73 to 0.93 extra points as they have filled in a number of forms between 11 and 14.

## 4 CONCLUSIONS

It is known that flip teaching is a pedagogical strategy that enhances motivation and engagement and improves academic performance, producing a rewarding teaching experience for both instructor and learners. Our study demonstrates that although most of the class didn't know about AFC and students were split into two halves that turned weekly to attend online or face-to-face, undergraduate dental students welcomed AFC methodology for teaching and learning histology. Results of our blended and restricted approach have been satisfactory based on very high percentages of students that meet deadlines for tasks and achieved a total or partial bonus. AFC methodology has also fostered attendance as well as participation in class. The successful experience encourages us to pursue this path and keep working on the quality of new resources to spread AFC to more units and subjects.

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