

## “Flipped classroom” as new challenge in higher education: a multi case study

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“Flipped classroom” is an emergent concept in educational discourses in higher education. In a short papers’ inventory in Scopus database of peer-reviewed research, it was possible to find out only one paper in 2009 and a rising number of papers in following years – in 2014 ,137 papers were included in Scopus labeled with this keyword.

“Flipped classroom” means a pedagogical inversion of traditional class: actions that are used in class are now prepared by students previously to classroom. Therefore, when students come into class they already know what is main topic and more important problems that will be under scope. Classroom is used to debate, to do exercises, to perform experimental protocols, to further discuss main implications of scientific issues related with course subject matter. This implies more active role of students and more challenging task of lecturers.

This paper aims identify and characterize courses in UPorto that are using flipped classroom idea (not the expression) as the main pedagogical strategy. Furthermore, it relates such strategy with active learning practices and discusses its effectiveness.

A multi case study focused in these courses is running to reach these objectives. Documental analyses and interviews with lectures are used to collect empirical data.

**Keywords:** Higher education pedagogies, “Flipped classroom”; active learning, student’s participation in classroom

### Introduction

“Flipped classroom” is an emergent concept in educational discourses in higher education. In a short papers’ inventory in Scopus database of peer-reviewed research, it was possible to find out only one paper in 2009 and a rising number of papers in following years – in 2014 ,137 papers were included in Scopus labeled with this keyword.

“Flipped classroom” means a pedagogical inversion of traditional class: actions that are used in class are now prepared by students previously to classroom. Therefore, when students come into class they already know what is main topic and more important problems that will be under scope. Classroom is used to debate, to do exercises, to perform experimental protocols, to further discuss main implications of scientific issues related with course subject matter. This implies a more active role of students and a more challenging task of lecturers. This inversion of the traditional classroom has been associated with the learning practices mobilized by students, allowing them to revisit concepts of greater difficulty, to take notes and to make revisions; to develop the study at their own pace and to have control over the learning process (Kay and Kletskin, 2012), giving them more responsibility in the learning process and in the achievement marks.

Four main questions could be raised to organize a framework that supports flipped classroom practices: what **motivations and aims** underlie the decision to use it in higher education classroom; what could be the **core of classroom work**, including a reflection about students' role; what is the importance of **ICT resources** and devices, and, finally, which are the **main effects** of flipped classroom, both in students' motivation and learning and in HE configuration.

## 1

Literature stresses two larger entanglements that frame motivations to flip classroom, from the point of view of lecturers: to attend diversity of students and their constraints to access education and to increase the effective involvement of students in class and with their own learning.

Regarding this second motive it must be also considered that the aim follows the idea of an active learning that supports many other pedagogical strategies within a constructivist purpose. The specificity of this particular approach in such active learning trend is that the constellation of techniques used (Martin, 2015) "represents the combination of learning theories once thought to be incompatible - active, problem-based learning activities founded upon constructivist ideals and instructional lectures derived from direct instruction methods founded upon behaviorist principles. (Bishop & Verleger 2013).

However the most referred motive to flip classroom is to attend students diversity, either it comes from students' age, students' learning style, as stressed by Tourón & Santiago when they wrote "The further the students are either above or below the «standard» age group profile, the more serious this situation becomes. Such is the case of the more able students, whose specific cognitive and non-cognitive abilities are brought to light through differentiated attention, with particular mention of precociousness and pace of learning. (Tourón, & Santiago, 2015: 33). Also, ICT resources allow to attend other students' diversities, coming from their circumstances, as they do not need to learn in the same place at the same time, listening to a lectures (Boudet, & Talón, 2012). This is understood as a way to meet fight against dropout as could be compatible with a blended classroom (Rutherford & Rutherford, 2013). This also demands lectures to define a "core curriculum that can meet learners where they are in a digitally oriented world, enhance the relevance and retention of knowledge through rich interactive exercises" (Prober & Khan, 2013, 1407).

## 2

The **core of classroom work** is changed due to flipped classroom. If Classroom is not anymore the place to contact, for the first time, with subject matter, two questions arise: how students prepare themselves to attend class and what is the core of classroom work?

Literature revised identified the students' preparation for lectures by reading some introductory material (previously available in the learning platform), as watching short lecture videos and completing required in-video quiz questions. "Over 50 videos were created for this course, and each week students were expected to review the videos related to the upcoming week's topics". (Rockland, 2013).

During lecture, the main concern is making room for interactive activities (Wilson, 2013). The students worked through exercises with the support of the lecturer (Campbell, 2014); explore the value of cognitive and metacognitive elements underlying their understanding to promote active learning (Davis, 2013). Debates and students' engagement within lecture are more frequent. Sometimes, "assessments are developed for learning outcomes for each week, along with assessments on the students' perception of the effectiveness on the video material" (Rockland, 2013).

### 3

**ICT resources** are important in flipped classroom. Assuming that there is not a mandatory book to be learned by heart as in medieval Universities, knowledge is at a mouse click distance and that democratize the access to information. ICT resources play a huge difference in such access as they allow cheap and flexible environments to learn. Furthermore, diversified platforms using web 2.0 and web 3.0 technologies promise a new world and challenge installed learning cultures. This is the case of the use of a "new, low-cost, state-of the-art CRS (Top Hat Monocle) which allows students to use their mobile devices (phones, tablets, laptops) to respond to a variety of numerical, multiple-choice, short-answer and open-ended discussion questions posed during face-to-face workshops" that Lucke et al. published in 2013. This is also the case of the increasing access to low-cost screen casting software and Web-based course and video management tools, which uses were researched by Van Veen (2013). As technology is more and more available and cheap it allows students to reconstructs knowledge from information. As Rutherford and Rutherford stress, "the flipped classroom is not necessarily a new idea, in fact, it developed from such things as hybrid or blended classrooms. But flipping the classroom does have different pedagogical implications for student learning (Rutherford & Rutherford, 2013).

### 4

Regarding the main effects of flipped classroom that literature reports it is possible to organize three large sets. One is related with pedagogical implications of using this framework, both for curriculum development as for teachers' role.

The studies that refer the new classroom organization and the curriculum development implications focus the features of progressive activities and engaging experiences that curriculum development options must provide.

Also Kurup stresses: "The 'Flipped Classroom' model seems to combine the best of both worlds. It allows the learner to assimilate basic information (lower order cognitive skills) from material that is placed online, allowing asynchronous learning. It frees up the teacher to use the face-to-face interaction time in the operating room and classroom for training the student in advanced concepts (higher order cognitive skills (Kurup, 2013).

In addition, this is challenging to lecturers' role as they need to reorganize their practices and need other training opportunities. In a recent study, published in 2014, Burns and Schroeder conclude that "ninety-two percent [of teachers] agreed or strongly agreed the readings and discussions were relevant to their work and life. [Therefore] This modified flipped classroom process enhances Community Nutrition Educators understanding and application of new information. Current staff development opportunities now include this modified flipped classroom model".

The other main effect is related with Institutional organization, including websites and technological platforms. The studies reported, as previously stated, the increase of using of new technological programmes and devices and the necessary adjustment of resources to be committed to the purpose. Concerning the issue, Baepler, P., et al. (2014) conclude: "Our findings demonstrated that in an active learning classroom, student faculty contact could be reduced by two-thirds and students achieved learning outcomes that were at least as good, and in one comparison significantly better than, those in a traditional classroom. Concurrently, student perceptions of the learning environment were improved. This suggests that pedagogically speaking, active learning classrooms, though they seat fewer students per square foot, are actually a more efficient use of physical space."

However, studies are generally designed in a small scale or reporting case studies and the institutional effects are missing as a research object.

The third one is related with students learning, satisfaction, motivation and effectiveness.

Dickson & Stephens (2014) present an empirical study that reveals the effective the methodology is. This authors reveals that the satisfaction risen significantly in a study with a meaningfully data (N=384).

Furse (2013) refer that satisfaction is the outcome of more interaction. On the other hand, Strayer (2012) says that students experiment less satisfaction of structuring, but they were satisfied regarding the use of collaborative work and methods used.

Motivation is broadly a consequence of satisfaction. As students declare themselves satisfied they get more motivation to participate. This was referred by Lucke et al. (2013) by the great show of commitment from students about the goals of class. Touchton (2015) presented similar results of his experimental study: students feel more motivated over traditional classes, for that reason prefer the inverted classes.

"I find flipping the classroom gives students statistically significant advantages in difficult, applied areas emphasized in class. Furthermore, students in the flipped classroom feel they learned more and enjoyed the course more than those in a traditional classroom. I argue students' affective preference for a flipped classroom is important for student motivation, recollection, and future use of quantitative data analysis. Flipping the classroom entails high start-up costs, but it can merit implementing to improve both effective and affective instructional outcomes." Touchton (2015)

When comparing flipped classroom with simulation based learning, Davies et al. (2013) found that " a technology enhanced flipped classroom was both effective and scalable; it better facilitated learning than the simulation-based training and students found this approach to be more motivating in that it allowed for greater differentiation of instruction."

Relating motivation, flipped classroom and students' autonomy, Chiang & Wang (2015) conclude "that students in an in-flipped classroom exhibit better individualization than those in a traditional classroom and have increased interest in cooperative learning. The study also finds that students are more easily engaged in lectures and develop self-directed, self-regulating, and self-determined skills through the proposed method."

In a research revision conducted in 2013, Bishop and Verleger report that studies of "student perceptions of the flipped classroom are somewhat mixed, but are generally positive overall. Students tend to prefer in-person lectures to video lectures, but prefer interactive classroom activities over lectures".

In terms of effectiveness of this methodology, Furse (2013) refers that results risen significantly (N=30), and identify as motive of this the interaction as a motive for satisfaction of students. Also, Critz (2013) advocates that this methodology was a big success to students and faculty. Nevertheless and as it was found regarding institutional effects there are few studies relating methodology and students achievement and a more diverse and specific research into the effectiveness of the flipped classroom approach is needed. (Abeysekera & Dawson 2015).

This paper aims identify and characterize courses in UPorto that are using flipped classroom idea (not the expression) as the main pedagogical strategy. Furthermore, it relates such strategy with active learning practices and discusses its effectiveness from the perspective of lecturers' perception.

## Methodology

A pilot study focused in these courses was developed to reach these objectives.

The methodology sounds adequate as 'Flipped Classroom' is quite recent phenomenon in Portuguese higher educational context. It allows a first look on the issue and opens the debate regarding the subject, as it is innovative within the context and shows the constrains as well it highlights the philosophical choices behind the pedagogical approach. The study focus on two courses that were selected by systematical procedure to find out, among courses delivered by all Schools of a large university in Portugal, which of them put in practice the expression "Flipped Classroom". Courses' documents available in the web were analyzed to reach the purpose – to find the use of the expression. The selections process aloud the identification of these two cases, one from School of Engineering and the other from Medical School.

Interviews with lecturers were the instruments used to collect empirical data.

The interview was of a semi-structured type and was designed to collect information and lecturers perceptions regarding four main issues: teaching philosophy approach; curriculum aims and structure; course results and methodological effects (table 20).

Dimensions	Objectives
Characterization of learning and teaching philosophy approach	To Identify the curriculum of teaching options
Organization of the course and intended purposes	To Characterize the teaching work associated with the implementation of the Flipped classroom methodology;
	To Identify produced and mobilized resources;
Results and effectiveness	To Study the adhesion of students to the methodology
	To Study the constraints associated with its implementation ;
Effects on teaching	To Analysis of the effects of the methodological approach in teaching and lectures' role

Table 20: Interview dimensions and objectives

Referred structure was used as framework for analyzing the interviews. However as analysis was done with NVivo software assistance, some of categories were deployed in a more substantive subcategories, whenever it applies. For the analysis purpose, meaningful sentence or period was considered the data unit - reference. Sentences and periods were coded in a not exclusive way. It means that the same sentence could be coded in more than one category and subcategory.

## Results

### Cases features

A Course from Engineering and a Course from Medical School were selected. Courses belong to masters programs, but the one from Medical School is an integrated master, which means that there are not first and second cycle differentiated programs (according to Bologna process). However course analyzed is currently attended by second year students. The course from engineering belongs to a Master degree program and course is currently attended by students in its second semester. Students are older than their colleagues from medical School and some of them are also workers. This feature is important as students are aged differently and their maturity and autonomy are diverse. Courses subject matters were disregarded as a relevant issue to analyze differences.

### What is the perspective of FC the interviewee presents?

	A Course from Engineering	A Course from Medical School
FC	22	16
1. FC vs B-learning	0	2
2. Teaching philosophy	9	1
3. Origin of the idea	2	2
4. Resources used	10	9
5. Video's	5	6

Table 21: Categories and subcategories distribution on FC approach according to courses

### A Course from Engineering

The analysis of the empirical material enabled to understand the interviewee perspective regarding Flipped classroom methodology. He contacted with this methodology through entrepreneurship training developed by Steve Blank, who began to put on the internet content related to entrepreneurship. Under the entrepreneurship training, the flipped classroom (FC) is introduced from a so-called Lean Startup platform.

From the perspective of this interviewee, the Flipped Classroom is the best teaching methodology, in the area of entrepreneurship.

Classes started by a quiz, delivered at the first 5 minutes that is answered by whom is enrolled in the course and was present in the classroom ( to do so, it's placed a password, that lets see who is present in class). Quizzes were related with videos that students saw previously. Viewing the videos were the task to be performed by students, previously. Quizzes were the kicking-off, but these lessons were not based only on the quiz, as students hold presentations, weekly, that mobilized many of the concepts that were covered in the videos.

However, for those who don't have availability to view the videos, there is a possibility to read the transcripts of those videos through software device, entitled Udacity. This platform is a free application for smartphone and allows the users to download the videos. Thus, the students can view videos at any time of the day and at any place. Also, FC aloud students to mobilize what other courses have been working and articulate them in a fruitful way.

The teacher follows a teaching philosophy that is based on flexibility and availability, primarily to support students who don't have as much autonomy as it was necessary and experience more difficulties.

### **A Course from Medical School**

The interviewee presents its FC methodology definition comparing it to the B-Learning methodology. In this sense, she considers that the FC depends of students' commitment and homework and it requires time from students to do, at home, what traditionally they did in class. Materials available to aloud this first contact are videos, displayed by lecturer at Course platform. These videos are free and were chosen by the teacher through YouTube and even from foreign university websites.

Students could /should saw videos, in advance. In other words, there is an information acquisition period at home and a period of application of this information in the classroom. In turn, the B-Learning model requires a vesting period of presence information or remotely, and the information applied in person or remotely. In short, this lecturer argues that FC is like B-Learning, but adapted. Emphasizing the application of subject matter in class could aloud students to go deep in their learning.

### **What are the reasons for lectures' to use the methodology?**

#### **A Course from Engineering**

To this teacher, using this methodology is an opportunity that Lean startup platform made available to entrepreneurship courses. To use it a resource is scientifically unquestionable, since it is accepted by the academic community to which he belongs. Furthermore, it is easily accessible as it is possible, through the mobile learning concept, to access videos to publish presentations and other materials to get feedback from partners, even if they are at a long distance.

The Lean Startup platform allows the teacher to control the videos' views as well as the Moodle allows the quiz fulfillment. To access this platform is necessary to make a hiring service. After payment, you can access the area of Flipped Classroom, where several videos are available and organized by subject. It is the easy way of access that is of the utmost importance to the interviewee. He explained the range of uses that this platform provides, and

its flexible way of exploring by taggets. The time saved in the organization of classes is other reason referred to use this platform. The teacher justifies that those videos are short time – about 5 minutes, address a set of concepts and are relevant form a scientific perspective. In addition, they allow deepening and addressing other related concepts.

This platform also provides another tool that allows teachers to control the viewing of videos that the students do, which is a device that contributes to better information concerning who saw which videos. It is of the utmost importance to adopt different approaches and teaching methods regarding different levels of students' autonomy. To this teacher, his previous experiences told him the importance of work differently with different students, and give them the freedom to find other ways of action, or deliver a greater supervision if students don't cope well with this freedom.

### **A Course from Medical School**

The course presented by the interviewee, is linked to the microscopic imaging. In this sense, the teacher promotes the videos previewing before class so that students can better understand what they would have to do in class. In other words, the videos viewing replace the theoretical exposition of the teacher. In addition, the previous display of videos would allow them to be better prepared for the practical classes, in order to facilitate their learning, as well as their ratings. Thus, the videos were chosen for each practical class in order to show what the student would view on the blades in schematic form and according to a three-dimensional component. This is a more contextualized and realistic way to display relevant information, according to lecturer.

The easy access was one of the factors that led her to mobilize the videos as a resource, as students can access the videos on their tablets, smartphones or computers whenever they want. Nevertheless, viewing the videos is optional.

Some features led this professional to use this methodology. The imaging feature of her course subject and the desired competences of students regarding these images interpretation is an important argument. Above all, lecturer sought to exploit the new technologies of information and communication to achieve better learning levels among students. In addition, promote motivation, facilitate learning, and improve student achievement are other goals in lecturer discourse.

### **What features a course using this methodology?**

From the discourse of lecturers it is possible to identify three kinds of features concerning the main issues that characterize the FC methodological practices they implemented: the curriculum options; the expected work to be performed by students, the role of the students; and the aspects that constrain the implementation of FC methodology.

	A Course from Engineering	A Course from Medical School
Curricular options	62	28
Course evaluation process	22	6

Characterization of students	6	4
Curriculum contextualization	7	3
Student's work control	15	4
Easiness and access	3	4
Partial option of curriculum development	7	12
Classroom framework	29	22
Peer instruction	4	0
Student's expected work	19	8

Table 22: Categories and subcategories distribution on curricular options according to courses

### A Course from Engineering

The participation of students sustains the organization of classes as this happens if the student doesn't fulfill its tasks, this is if they don't saw previously the videos, they don't do quizzes and they don't prepare their presentations the class doesn't happen. Class runs in an interactive way as students present developments in their work and receive feedback. This explains why assessment and control over the students' work is closely related with class organization and got the majority of references coded. Every task performed by students is to be assessed and serves also as evaluation device of curriculum development. It is also important to stress that peer instruction is a strategy that happens or is required by course.

The teacher provides the methodology manual for the students had access to the principles implicit in this.

### A Course from Medical School

At the time of interview, the lecturer uses partially the FC methodology, assuming this as an experimental stage. This means that she flips some classes, but others she doesn't. In this sense and because of the partial nature of the application of teaching methodology, she says that not much has changed in the way of her classes' organization. Also, she hasn't any kind of penalty to students that don't view videos previously. Instead, viewing previously the videos is an option for students of two of the five classes enrolled in the same course. Lecturer doesn't refer anytime any peer instruction strategy or other group work as important to develop course outcomes.

Every student could see the videos but videos are only available previously to classes for these students from these two classes. This procedure allowed students to review the theoretical part of subject and prepare themselves for practical tasks conducted within the class. As stated before the course materials chosen follow a realistic and contextualized approach of tasks to perform.

	A Course from Engineering	A Course from Medical School
Student's expected work	19	8

Table 23: Categories and subcategories distribution regarding students' expected work according to courses

### A Course from Engineering

Under the entrepreneurship area, it's also important for students to sustain and argue an idea mobilizing the appropriate language. In order to achieve these goals students must be responsible, committed and diligent. Tasks designed to they performed, out and in class, train and improve these competencies. Such tasks are active learning character and include: watch videos, read the texts, do the quiz, participate in class, bring a project proposal, contact and interact with other professionals/experts, do further research, make presentations in the classroom, engage in debate, ask questions, put their projects on the platform, take responsibility for the performance of their duties.

Lecturer also stresses that working with adults means that they must be responsible, fulfilling its part of the agreement of learning job. Thus, he concluded that one of the key tools of this teaching methodology is the students' responsibility.

### A Course from Medical School

Due to the methodological option followed by this lecturer, students can view the videos available to prepare for classes, although the viewing of videos is optional. This appeals to the students' responsibility. Viewing the videos; solve the exercises that are available online, to allow a better understanding of videos content, are the expected tasks to students develop so they can achieve better results. Students still need to strive further to ensure the quality of their work.

	A Course from Engineering	A Course from Medical School
Constrains	11	18

Table 24: Categories and subcategories distribution on constrains according to courses

### A Course from Engineering

There is a set of constraints that obstacle the use of this methodology. They come from institutional features as the high number of groups or students in class. The more students are in class more difficult is to implement end control the teaching and learning process.

The main constraint comes from students' attitude as they hardly participate in debate when it is related with other colleagues work. It seems that students only participate in a reactive manner, when their own work is on focus. Also the higher number of work groups is due from conflicts that arose in one of the groups. Three elements have failed to reconcile their views and it was not possible to remain as a group, bringing the need to work individually.

The Udacity - the platform that allows viewing of videos and reading texts - makes the number of video views through the Lean Startup left adulterated. Therefore teacher control on the video views or reading texts is, sometimes, not reliable.

Another constraint may be attached to the lack of experience in FC methodology development that lecturer considers as somewhat limited. He is expecting that the use could give the expertise and the opportunity to improve.

### **A Course from Medical School**

The selection process of videos confront teacher with a problem: videos are not so short, focused, challenging, interesting and informative as she desired. Some of them were very monotonous and had fixed images with audio recording associated.

The control of the videos viewing was another constraint as the platform access had a informatics bug and didn't allowed to controlled which students access, in fact, to videos.

### **What is expected and characterizes the work of lectures'?**

	A Course from Engineering	A Course from Medical School
Effects on teaching	34	13
Teaching reflection improvement	10	2
Lectures' training	13	0
Collaborative teaching work	8	0

Table 25: Categories and subcategories distribution on teaching effects according to courses

### **A Course from Engineering**

Teaching work is characterized above all by an active listening regarding students' performance and learning.

This teacher defines his own action in accordance with the following dimensions: support and guidance of the student, flexibility/availability to answer questions, attention to the students' difficulties in the adaptation to this way of working. In a role definition, teacher prepare quizzes, do mentoring and assessing, develop and redefine the course, and articulate curriculum goals with other courses belonging to the same program.

### A Course from Medical School

To lecturer her role is a learning process facilitator defined by guiding than driving. This professional also stressed that guide and drive are very similar words, but there is a huge semantic difference illustrated by car driving metaphor: the driver of a vehicle decides everything and the copilot will give directions. In this sense, the teacher shift driving chair for co-pilot seat.

### What are the effects on students?

	A Course from Engineering	A Course from Medical School
Effects on students	20	11
Students' commitment	3	0
Soft skills development	3	2
Impact on other courses	4	2

Table 26: Categories and subcategories distribution on students effects according to courses

### A Course from Engineering

Regarding the effects related with the use of this teaching method, the teacher said that there is an improvement of the results, although it cannot specify them because the semester isn't over. At the time of the interview, lecturer noted that students' attendance to classes increased, and it is connected with individual responsibility of students in fulfilling their tasks. In addition lecturer said that methodology motivated students for individual work, and group work - peer instruction.

### A Course from Medical School

Students who viewed the videos were motivated, curious and more active during classes. In this sense, the better the students prepared themselves for classes, the better the class ran, giving space to do other activities.

The teacher couldn't made an assessment of the effectiveness of the methodology process, but she thinks there is a positive trend. Students were happier, more motivated and tend to have better results. However, it was not possible to find a difference connected to the students' ratings.

### Discussion and Conclusion

Curriculum options was the most referred category while effects on the students' results and effectiveness was the less referred. This is in line with this paper answer to leading objectives. So far, lecturers are mostly concerned with

curricular organization features and teaching options. This is an innovative approach and time was not enough to evaluate the experience.

These lecturers work is changing as they are highly committed with students' active learning promotion. Reported curricular options as Course evaluation process, previous characterization of students, curriculum contextualization, students' work control and peer instruction were highlighted as important features of classes.

Students' expected work is other main issue of FC approach as it crucial to perform FC as it is closely related with students' commitment. Such results are in line with findings from Wilson (2013) and Bishop (2013). Furthermore, as much as students are involved with subject matter as much the classroom is an interactive place to learn. ICT resources and ICT lecturers' abilities are important to flip class and was reported both as a constraint and as a strength of FC model.

Flipped classroom is related with active learning practices and with enhancing students' motivation and satisfaction. However, learning effectiveness is still not very well demonstrated. This is in line with literature revision and connects with previous short time of experiment (Abeysekera & Dawson 2015).

From the perspective of the lecturers, FC is a promising methodology to teach and learn as it increases students commitment and satisfaction, but time is needed to change students' attitude regarding they own role into more active participation. Also lecturers' training needs to be more focused.

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