ASSESSMENT OF THE USE OF ICT AND FLIPPED LEARNING METHODOLOGY IN THE SUBJECT´S PRACTICES: CLOSING THE STUDENTS TO THE LABOUR MARKET

Beatriz Urbano-López de Meneses[1], Fernando González-Andrés[2]

[1] *University of Valladolid (SPAIN)*
[2] *University of Leon (SPAIN)*

Abstract

The National Agency for the Higher Education Quality (2016) advices to reinforce the actions to close the studies to professional sectors in order to support the students in their access to the labour market. In this sense, an innovative education action to approach the engineering students to the labor market, by means of the practices of the subjects, using as tools, the ICT and the flipped learning methodology was developed. The action included four steps: The first step was to prepare real study cases of interest for the companies, in which the students worked during the course. Secondly, the students approached the real cases proposed and gave different solutions for the problem, choosing the most adequate ICT to solve the case. By that moment, all the necessary theoretical concepts that the students needed, were arising, and using the technique of the flipped classroom they were facilitated by the teacher. Following with the flipped classroom technology, the third step was the presentation of the solutions adopted by the students, including the ICT used, to the classroom, establishing a feedback from the students and the teacher, in order to consolidate the learning. Finally, the teacher solved and linked the theoretical concepts to the real cases solutions. To assess the impact of this innovation education action, data basis were created, teacher´s focus groups were conducted and students and teachers surveys were carried out. The teachers remarked, among others i) the lack of alignment between the problems that the companies need to solve and the curricula of the students, ii) the technological companies reticence to share their problems with the academia, iii) the difficulty of application of the methodology for fundamental subjects and iv) the difficulty of application of the methodology with students of very different knowledge level. It was found a higher motivation of the students during the process that could drive to a higher students´ performance. The students appreciate their active participation in the process of design their own subject practices. They also positively marked the use of ICTs, which are familiar technologies for them, to help them to face the problems of the engineering. According to the flipped methodology proposed, the teachers pointed out that it promotes a collaborative and autonomous learning and that the autonomous learning precedes the collaborative learning. The methodology revealed a better monitoring and assessment of the students´ subject practices. The innovative education action concluded an improvement of the practical teaching in Higher Education by the use of real labour market problems, the enhancement of the use of ICT tools to solve them and the improvement of the overall teaching-learning process.

Keywords: Engineering Higher Education, Practical Education, Labour Market, Flipped methodology.

1 INTRODUCTION

The Spanish National Agency for the Higher Education Quality (2016) advices to reinforce the actions to close the studies to the professional sectors in order to support continuously the students in the access to the labour market.

The public Universities in Spain harbour offices for the assessment and management of the quality of the academic system. The student´s satisfaction report presented for such offices in general shows the need to improve the practical activities included in the face-to-face teaching hours, which in Spain are called “subject’s practices”, both at the Undergraduate and the Master students. The students remark the need to adapt the subject´s practices to the learning competences and to the professional profile. Despite the fact that the students appreciate the theoretical lessons, they declared that practices are improvable (Assessment and Quality Office, 2016).

Additionally, the teaching and learning process proposed by the Bologna process, encourages an active participation of the student in the learning process. More relevant become these statements for

engineering studies due to the need of its pragmatic approach. In these studies, the enterprise, the research and the universities must be collaborating closely.

Moreover, in 2014, the European Commission presented the Agenda for the Higher Education Modernization in order to align the modernization of the higher education with the objectives of the Europe Strategy 2020 (EACEA, 2014). The agenda established the priority to adjust the higher education studies to the labour market promoting the entrepreneurial spirit and enhancing the links between education, research and enterprise.

1.1 Flipped learning

Flipped learning is a pedagogical strategy that reverses the traditional learning environment. The flipped classroom describes a **reversal of traditional teaching** where students gain first exposure to the topic by the practices, and then class time is used to do the harder work of assimilating the knowledge through strategies such as discussion or debates that take the students to the concepts (Brame, 2013) (Fig. 1).

"Flipping the classroom" has become a common word in education during the last years, driven in part by high profile publications in *The New York Times* (Fitzpatrick, 2012); *The Chronicle of Higher Education* (Berrett, 2012); and *Science* (Mazur, 2009).

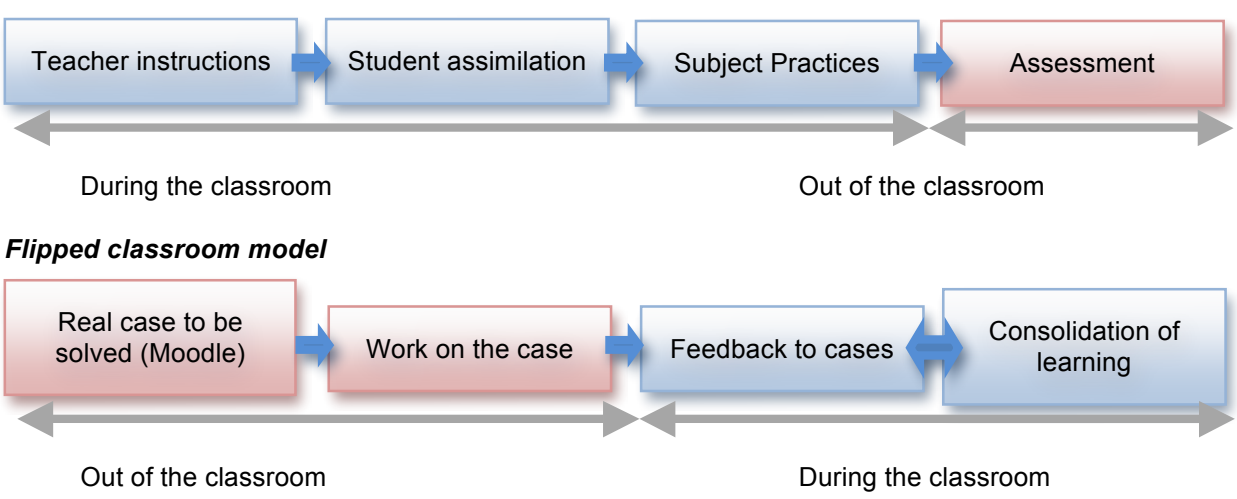

Fig. 1 Flipped classroom model versus traditional classroom model. Adapted to the case presented in this work, from http://www.theflippedclassroom.es/what-is-innovacion-educativa/

1.2 Innovation and Communication Technologies (ICT)

One of the most prominent characteristic of the present generation is their technology savviness and use of that technology in almost every aspect of their lives. The students spend on average of 33 hours per week on the internet (Kilian *et al*., 2012), with 83% being engaged with online social networking sites (Zickuhr, 2010). Almost all the students in developed countries have a smart phone (Miller, 2014). It is estimated that it won't be long before one-third of the world population will engage in some shape or form with social media. Facebook is the number one global social media site followed by YouTube, QQ, WhatsApp, Qzone, Twitter, SinaWeibo, WeChat, Google+ and Instagram (Web empresa, 2015). Moreover, Facebook is the principal social media in America, Europe, Oceania, part of Asia and Africa, while Twitter is the principal social media in Japan (Web empresa, 2015).

The aim of the innovative teaching action presented is to close the engineering students to the labour market solving real cases affecting the companies of the sector, using the ICT with the flipped classroom methodology.

2 METHODOLOGY

The methodology chosen for the implementation of this innovative teaching action was the flipped classroom plus ICTs, according to the following stages (Fig. 2):

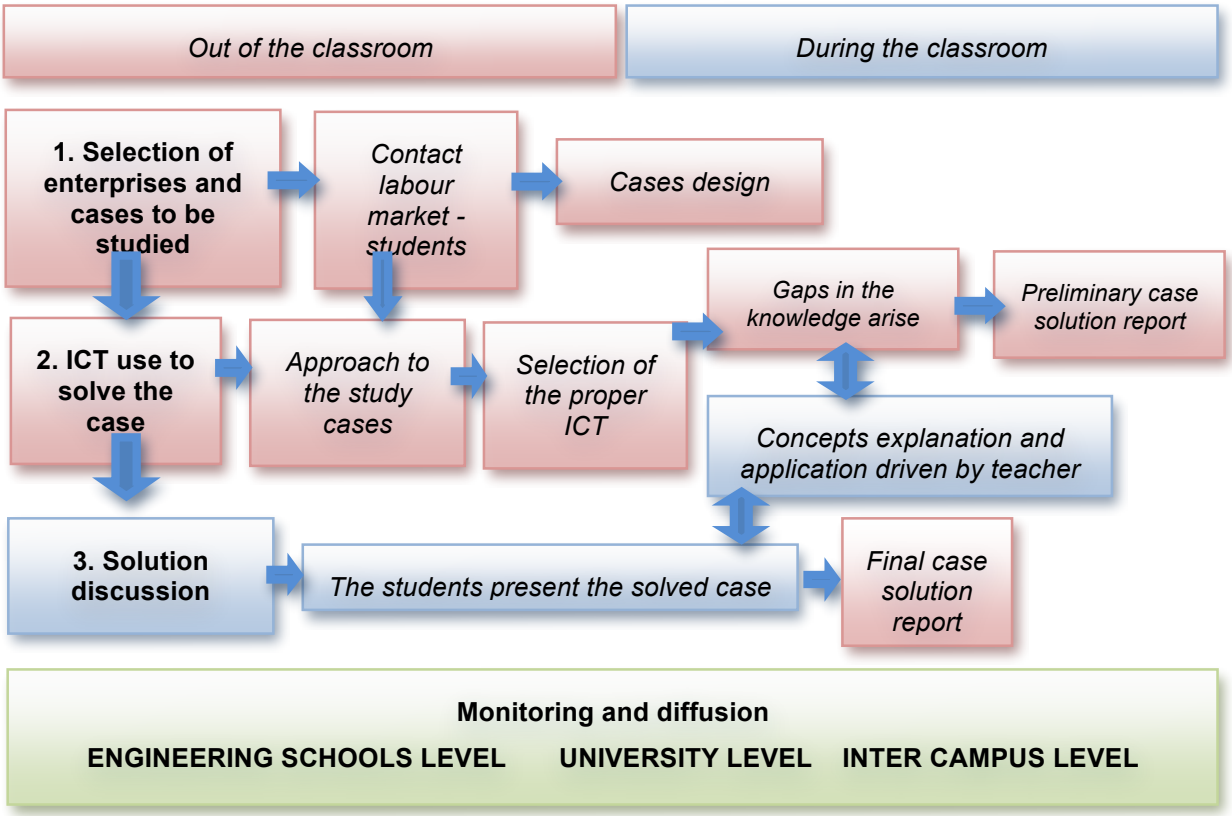

Fig. 2 Description of the methodology for an ICT practices in flipped classroom

2.1 Selection of study enterprises and cases

2.1.1 Putting in contact the labour market and the students

The teachers introduced or invited a representative from companies of the sector, as for example trade unions, professional associations or and enterprise, who approached the students to the problems of the specific business sector. This presentation was face-to-face or alternatively recorded and loaded to the e-learning Moodle platform. The students had their first contact with the business sector, and they had an image of the difficulties to be solved in the professional sector.

In order to choose the companies for this pilot experience, the students were invited to contact with companies of their interest, in order to know their needs or problems, and to prepare by themselves a case of their own interest to be solved during the course. Moreover, the teachers involved also provided specific companies to be studied, from their own collaborative agreement in research or consultancy.

2.1.2 Cases design

Teachers in collaboration with the companies elaborated case studies to be solved by students (using ICTs) during the course. The teacher wrote the rules to solve the cases and, also fixed the deliverables to be presented by the students. Rules were uploaded to the e-learning Moodle platform.

2.2 Technology incorporation

2.2.1 Approach to the study cases

The students studied the case to be solved at the beginning of the course. The practices preceded the theoretical concepts, following a “flipped classroom” technique. The first step of the teaching-learning process was to identify the problems that the companies of the sector needed to solve. The class time

was used to give conceptual and theoretical skills needed to solve the proposed study cases. Teacher actively guided students in order to apply the concepts to create the subject contents.

2.2.2 Selection of the proper ICT

The student selected the proper ICT to solve the case proposed. Some ICTs used were: i) recording of production processes, ii) on-line survey to the stakeholders for a given market, iii) software to promote products; iv) social media product test.

At this point the student collected information from bibliography, companies, social media and teachers that help them to solve the study case. Special attention was given to the use of social media. The teacher conducted the interaction of the students with the companies in order to limit the company participation in this activity, within reasonable limits for the two parts.

2.2.3 Concepts explanation and application driven by the teacher

After the student has approached the study case, the teacher explained the concepts related to the study cases and the subject. The concepts help the student to solve the study case.

2.2.4 Preliminary report of the solution to the case

The student wrote a proposed solution for the study case. Special attention was given to the use of ICTs to solve the problem. The report explained the decisions taken and the possible alternatives including the advantages and disadvantages.

2.3 Solution discussion

2.3.1 Presentation of the study case by the students

The student presented the study case and the solution chosen, including an ICT, to the rest of the students. The rest of the students asked about alternatives and possible solutions for the problem. Then, a discussion about the problem and solutions started. At this point, it was established a feedback between the students which present the case in the one hand, and the rest of the students driven by the teacher in the other. As a consequence more concepts, of a higher knowledge level, were introduced in the system.

2.3.2 Assessment and selection of study cases

To assess the impact of this innovation education action; data basis were created, teacher´s focus groups were conducted and students and teachers surveys were carried out (Table 1).

Table 1. *Satisfaction data digital questionnaires for students and teachers involved in the innovative flipped learning project.*

Students	Teachers
1. Did you like to work in a real case study in the subject practices?	1. Which problems you found in the preparation of the practice?
2. Did you like to use ICT to solve the study case?	2. Which problems you had to overcome during the project ongoing?
3. It was useful to you to start by the practices to reach the subject´s concepts?	3. Which problems you found in the assessment of the project?
4. Did the subject practices were useful approach you to the professional sector?	4. Point out the strengthens in the use of this methodology
5. Global mark for this subject practice	5. Grade the ICT used by the students
	6. Grade the sector interest
	7. Grade the students motivation

Personal data like gender, age, type of studies and years at university studies were asked. Satisfaction data were collected to measure the students´ perception of the innovative methodology developed. To collect the data, digital questionnaires were used and data were analyzed by means of frequencies and contingent analysis.

Optionally, the teacher selected some of the solutions given by the students, to be presented to the companies, which can use the information obtained to improve their activity. This step gives the chance to present the students´ abilities to the employers. This reinforces the link between university, companies and research.

2.4 Monitoring and diffusion

2.4.1 Engineering schools level

The teachers involved assessed the learning process and wrote down the strengths and lessons learned. The teachers shared the experience with the rest of the colleagues of the teaching innovation group. The teaching innovation group discussed about the need to transfer the results to other subjects and studies, and described good practices for the application of this methodology. The conclusions were shared with the teaching staff at the Engineering Schools.

2.4.2 University level

The experience is being presented in the teaching innovation forums at the University, in order to spread the results at the University level. The methodology and results will be published in the institutional webpage to be accessed by the University community.

2.4.3 Inter universities level

The participation at international forums will disseminate the methodology and results contributing to flipped lessons and to close the students to the labour market through the subject practices.

3 RESULTS

The methodology has been implemented in nine subjects, i) Crop Production, ii) Agribusiness Marketing, iii) Rural Development, iv) Agri-food products Commercialization, v) Wine Marketing, vi) Bioenergy, vii) Biotechnological processes, viii) Biofuels and ix) Cropping Systems of Graduate and Master level of Engineering Studies. Half of the sampling (52.73%) were undergraduate students.

The profile was an average of 24 years old student, half of them men (54.5%) with an average of 2.4 years studying in the current level and half of them (56.36%) with a previous university studies. By the moment of this communication, January´2017, a total of 54 companies study cases were presented by the students.

The students point 4.13 over 5.0 the satisfaction to work in a real study case (Fig. 3).

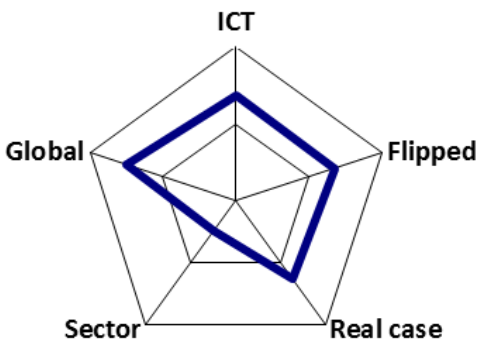

Fig 3. Spider diagram of order satisfaction of the students with the practices methodology developed using ICTs, flipped learning and real study cases.

The results show motivated students, in some cases due to their participation in choosing the topics for their practices, and for those who did not choose the topic, because of the stimulant effect of merging the academic and the labor worlds, observing the applicability of the subject practices to the real professional sector. It is concluded that one of the results is the students´ motivation that could drive to a higher students´ performance.

The students point 4.18/5 the use of ICTs in the subject practices. The use of ICTs, which are familiar technologies for the students, helps them to face the problems of the engineering, and to solve them.

It is concluded that the students are highly involved at the technological innovation and communication means.

The students appreciate (4.18/5) to start practicing to reach the concepts, flipped learning methodology. The lower marks were given to the ability of this methodology to close the students to the labour market (3.75/5).

The global value given by the students to the methodology was 4.25 proven their satisfaction.

The students´ satisfaction according the practices methodology was lower in Master Degree students than undergraduate students (Table 2). The Master students appreciate the use of ICT and to work in a real study case more than the graduate students. The undergraduate students appreciate most to start by the practices in the subject (flipped learning).

Table 2. *Students´ satisfaction marks to the practices methodology according to the student level.*

Satisfaction	Undergraduate students	Master students
ICT	4.04	4.28
Flipped learning	4.21	4.08
Real case studies	4.0	4.28
Sector approach	3.76	3.68
Global	4.26	4.19

By gender, it was showed that ladies students´ satisfaction was higher than men. The women appreciate most the use of ICT while men the reverse methodology starting with the subject´s practices. The item less marked was the ability of the developed methodology to approach the students to the labor market for both (Table 3).

Table 3. *Students´ satisfaction marks to the practices methodology according to the student gender.*

Satisfaction	Men	Women
ICT	3.97	4.36
Flipped learning	4.07	4.24
Real case studies	3.97	4.32
Sector approach	3.55	3.92
Global	4.19	4.27

Taking into account the students´ age it was found the students over 24 years, appreciate more the innovative methodology but less to start by the practices in the subject than the younger ones. This result can be caused due to the inertia of traditional learning processes that make older students to feel uncomfortable with reverse methodology. The older students appreciate most to work on a real case study in the subject´s practices putting in value the need to close the studies to the labor market (Table 4). In the other hand the younger appreciate most to start by the practices.

Table 4. *Students´ satisfaction marks to the practices methodology according to the student age.*

Satisfaction	<24 years (60%)	>=24 (40%)
ICT	4.00	4.36
Flipped learning	4.22	4.04
Real case studies	3.94	4.41
Sector approach	3.62	3.91
Global	4.07	4.37

The teachers marked out that during the implementation of the methodology proposed they have observed the following contingencies to overcome:

1 the lack of alignment between the problems that the companies need to solve and the curricula of the students,

2 the technological companies reticence to share their problems with the academia,

3 the difficulty of application of the methodology for fundamental subjects and

4 the difficulty of application of the methodology with students of very different knowledge level.

The teachers´ assessment concluded that the implementation of the flipped methodology leads to a better monitoring and assessment of the subject practices. Starting the course by the practices, allows the teachers a better follow-up of the learning progress. The flipped classroom causes a higher implication of the students at the teaching-learning process. The students are driven to the concepts through the real study cases. In this sense, it is proven that the methodology reinforces the Bologna process.

They also marked out flipped methodology promotes a collaborative and autonomous learning. The autonomous learning precedes the collaborative learning that induces the student creativity. The group presentations drive the students to the collaborative learning with the feedback of the rest of the students. Finally, the teacher contribution to the concepts of the subject facilitates to complete an integral teaching learning process.

They also appreciate the interaction between the teachers involved in the teaching innovation group that helps to improve the methodology. It would be interesting to include a feedback from the rest of the academic community at the international level, not only from the seminars at the national or international level, but also by a suggestions mailbox in the webpage where the action is presented.

It can be summarize that this teaching innovation project results are, i) the improvement of the practical teaching in Higher Education by the use of real cases coming from the professional sector, ii) the enhancement of the use of ICT tools to solve real study cases and iii) the improvement of the teaching-learning process by the application of the concepts to real problems of the engineering sector.

4 CONCLUSIONS

The students have had the opportunity of actively participate in the process of design their own subject practices giving their opinion and showing their interest in the professional sector. As the students have chosen the topic or enterprise in which they worked during the course, they became a part of the learning process since its design.

The practices precede the theoretical concepts, following a “flipped classroom”. The flipped methodology promotes a collaborative and autonomous student learning. The flipped classroom reinforces the teaching-learning process. The subject practices drive the students to the theoretical concepts of the course. The students learnt the concepts by its application to real cases.

The students are highly involved at the technological innovation and communication means. The use of ICTs in the teaching-learning process motivates the students. The students learn how to solve real study cases by the application of ICT.

There is a feedback between students regarding the solutions proposed to the cases, which reinforces the teaching-learning process. The students´ experience how their colleagues ask about possible different solutions or alternatives to the cases analysed, and they have to consider different viewpoints. The interaction between students is an essential part of the flipped methodology.

The subject´s practices in the professional sector enhance the motivation of the students.

According to the implementation of the methodology it was concluded that women appreciate most the use of ICT while men the reverse methodology starting with the subject´s practices. The younger students appreciate most start by the practices and the older to work on a real case study in the subject´s practices. The Master students appreciate the use of ICT and to work in a real study case while the Graduate students appreciate to start by the practices in the subject (flipped learning).

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