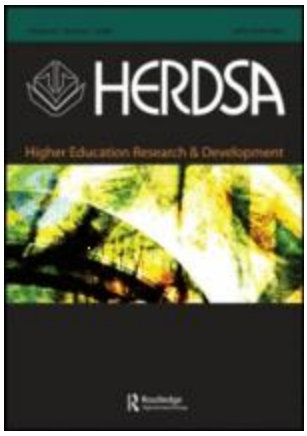

Facilitating self-efficacy in university students: An interactive approach with Flipped Classroom

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The aim of this study is to investigate the perceived self-efficacy of university students after experiencing several Flipped Classroom sessions at different time points: prior to the outbreak of the COVID-19 pandemic (onsite instruction) and after confinement at home (online instruction). The study's methodology followed a quantitative approach in which a total of 376 university students who had experienced the Flipped Learning sessions completed a general self-efficacy questionnaire. The results showed that the perceived self-efficacy is influenced by the academic year in which the students are enrolled, the modality in which the Flipped Classroom experience has been implemented (online or onsite) and the predisposition to innovation. In terms of practical implications, the Flipped Classroom applied in online formats could be a highly useful resource for designing active learning environments in which university students could improve their sense of self-efficacy. Consequently, their expectations and academic performance could also be improved.

Keywords: Flipped Classroom, self-efficacy, online, innovation

1. Introduction

The closure of educational institutions across all levels has led to an immediate transformation in higher education that has given a huge turn to teaching and learning processes (Almarzooq et al., 2020). Students started learning from home and teachers have been using their ingenuity, creativity and imagination to design learning that, until now, most of them were not used to. This is because an online mode of teaching was not how they would teach. In this complex and unexpected context, the guidance and instructions that teachers offer to their students, regardless of their educational stage, can be considered as one of the key factors for academic success. Distance education has thus become a reality that has been driven and supported by digital transformation. In turn, in the era of COVID-19, the need has arisen to incorporate innovative solutions

that optimize educational efforts through the adoption and use of technology, among many other actions. Virtual learning platforms and the application of active methodologies that are based on the use of these digital resources have the potential to respond to a diversity of learning cycles.

In Higher Education, it is convenient to completely redesign learning experiences and place the main focus on teacher-student and student-student interactions, and online training and student-centered approaches, respectively. In recent years, the positive effects of student-centered approaches to learning have been widely debated in the literature (Kong, 2015). It has been mentioned that this mode of learning has the potential to improve, among many other skills, the performance and perceived self-efficacy of students, as well as the social interactions that occur between students and teachers (Hwang & Lai, 2017). Student-centered learning environments require the application of active learning strategies that are completely different from traditional classroom instruction. Among these strategies, the need to involve the students' own presentations, work on problem-solving skills, establish self-assessment techniques and peer evaluation and, finally, enhance discussions in group formats has been pointed out as particularly relevant. Despite this, the creation of these learning environments continues to be a considerable challenge at any educational level (Mohanty & Parida, 2016).

Furthermore, in the context of Higher Education, the self-efficacy of students constitutes a key factor in the regulation of their learning behaviors (Van Dinther et al., 2011). In fact, the perception of self-efficacy mediates between various determinants of competence development (for example, skill, knowledge, ability, or former achievements) and their subsequent performances (Bandura, 2006). As a result of this important role, it is essential to know and analyze the development of the students'

perception of self-efficacy when active learning processes based on a Flipped Classroom methodology are implemented in the university classroom. Also, more research is needed to know on what basis implementation of Flipped Classroom explicitly benefits teaching and learning, in comparison to the traditional mode of teaching. At the same time, the improvement in perceived self-efficacy after experiencing Flipped Classroom sessions has to be measured considering the effects that different variables exert on it. Therefore, this research aims to evaluate the perceived self-efficacy of university students after being involved in several learning sessions with Flipped Classroom. We also aim to identify some personal and contextual factors that influence how student's self-efficacy perceptions improved based on Flipped Classroom methodology.

Specifically, the main objective of this study is to identify if university students who have participated in the Flipped Classroom sessions (both in an onsite and online format) perceive an improvement in their perception of general self-efficacy and in perception of their learning process. We also aim to analyse the relationships between different contextual variables (such as the way in which the Flipped Classroom experience has been implemented, the course in which they are enrolled, the predisposition to educational innovation and previous experience with innovation) and student`s perception of self-efficacy, respectively.

2. Behavioral framework for perceived self-efficacy and Flipped Learning

The pedagogical model known as Flipped Classroom, Flipped Learning or inverted classroom (among other names) allows the design and implementation of very diverse didactic modalities. Since its emergence, this methodology has been understood as a reversal of traditional classroom roles. In this way, the students lead the main role of the learning process and the teacher acts as a guide and mediator (Bergmann & Sams,

2012). Under this approach, the contents are consulted and studied by the students outside the classroom and, subsequently, the contact hours with the teacher are used to deepen and resolve possible doubts. As Tourón and Santiago (2015) point out, "inverting" the learning process does not refer only to a prior consultation of the contents. Rather, it is arranged as a comprehensive approach to learning.

Authors such as AlJaser (2017) highlight that the Flipped Classroom strategy is designed to respond to the needs for self-efficacy and skills development within a completely integrated system. And students feel self- efficacious when they are actively involved in the construction and dissemination of their own knowledge (Abey & Dawson, 2015). According to AlJaser (2017), this self-efficacy is understood as the beliefs of oneself in their own personal abilities to be able to motivate themselves and put in place the cognitive resources and action programs necessary to handle a certain situation. From a procedural point of view, it is defined as the mental image of the student about their personal abilities that would be derived from experiencing learning under a Flipped Classroom modality. Self-efficacy is what allows students to decide how much effort they are going to dedicate to a task, how long they will persist when they encounter obstacles, and how resistant they will be in difficult situations (Van Dinther et al., 2011). Therefore, the more robust the perception of self-efficacy, the greater the perseverance and effort that is put in (Bandura, 1997). And it is precisely the positive learning experiences that can increase both the performance and the perceived self-efficacy of students in the teaching-learning processes (Ajzen, 2005).

Perceived self-efficacy, which includes the belief that an individual has the ability to generate change through their own personal actions (Bandura, 2006), turns out to be a critical factor also in online learning modalities (Chyr et al., 2017). In the Flipped Learning model, while students work at their own pace, an increase in self-

confidence and self-esteem could occur which, at the same time, could lead to an improvement in the perception of self-efficacy (Kenna, 2014). In addition, it is worth mentioning that those people with a greater perception of self-efficacy have shown better levels of commitment to achieve certain goals (Bandura, 1997). Hommes and Van der Molen (2012) also identified that those students with consistent self-efficacy subsequently used and applied newly acquired learning. Self-efficacy is linked to expectations about one's future performance. Therefore, in Flipped Classroom settings, students are expected to have a greater sense of self-efficacy as they are exposed to more opportunities to process learning content through videos and other electronic materials (Thai et al., 2017).

Although the existing studies have shown that the Flipped Classroom model is established as an emerging and promising tool within the field of education, few studies have been carried out that offer evidence about the benefits it has on the perceived self-efficacy of students in the university environment (Namaziandost & Çakmak, 2020). In some of them (İyitoğlu & Erişem, 2017), the authors found positive relationships between perceived self-efficacy and academic success. In fact, from an educational perspective, students may need to experience more self-efficacy situations so that academic success is guaranteed. In this way, students who reported a positive effect of Flipped Classroom on their learning, also showed an increase in their self-efficacy (Ajzen, 2015).

In Bandura's social learning theory (1986) the reciprocity of student behaviors, personal and environmental factors was described. The theory suggests that the elements of the environment could determine learning behaviors and also influence students' self-efficacy beliefs (Van Dinther et al., 2011). Among the very diverse factors or elements that can shape perceived self-efficacy in learning with Flipped

Classroom, it has been highlighted that the modality in which these active learning experiences are applied is a clear determining factor. In this sense, some studies (Ibrahim & Callaway, 2014) have shown that Flipped Learning in fully virtual formats is an important incentive for the development of self-efficacy, self-directed learning and even self-esteem. Also Hwang and Lai (2017) found that the interactive approach to learning based on online materials could stimulate students to have stronger beliefs in learning than in the traditional classroom.

On the other hand, the perceptual dimension of each individual as well as their previous experiences have been gaining importance as researchers and organizations have become aware of the impacts that both elements (perceptions and experiences) have on some expected results (Kumar & Uzkurt, 2010). Specifically, for the field of innovation in education, no research has been carried out in which the effects of predisposition or previous experience with innovation on the perception of self-efficacy in Flipped Classroom experiences have been analyzed. The main expressions with which students link innovation refer to "creativity", "novelty" and "processes to generate ideas" (Edwards et al., 2009). Thus, when students have previously experienced the changes associated with any educational innovation project, their predisposition to learning and enthusiasm is expected to become more notable.

In addition to all this, it has also been found that the academic year in which university students are enrolled can shape their perception of self-efficacy when they are immersed in active learning situations. In this regard, Castedo et al. (2019) show that, during the first university years, the disparity of knowledge, predisposing attitudes and perception of self-efficacy are notably high. The literature on the relationships between the university course in which they are enrolled and the perception of self-efficacy with Flipped Classroom is scarce. Despite the lack of research in this area, in

recent years some authors (du Rocher, 2018) have stressed the importance of designing active learning practices throughout all university courses so that students' perception of self-efficacy is increased.

In summary, previous and recent studies suggest that active learning approaches can increase the perceived self-efficacy of University students. A few studies offer relevant findings about the effects that the format of the classes or the predisposition to innovation have on student perceived self-efficacy. Therefore, this study explores how Flipped Classroom sessions were related to the improvement in the perception of university students' general self-efficacy and in their learning process. In addition, a set of variables are considered as possible factors that explain differences in these levels of self-efficacy.

3. Research context and method

In the context in which this study has been developed, the Flipped Classroom experience was launched in various subjects of higher education. Students and professors from a Spanish university participated in the experience, specifically in the area of education. This Flipped Classroom project originated with the intention of providing better learning environments in which university students could develop their commitment and responsibility to tasks, as well as a more active type of learning. The subjects were selected to participate in the experience based on a series of logistical aspects that allowed the Flipped Classroom sessions to be successful: having sufficient technological resources, presenting a suitable learning content to be taught through the internet and have the allocation of the internal resources required for the Flipped Classroom design to be viable. The professors responsible for each of these subjects were previously informed of a series of minimum homogeneity criteria that should be respected to ensure the validity of the data collected. These criteria were intended to

ensure a similar development of the Flipped Classroom experience. The criteria presented were the following: first, it was requested that the theoretical contents be reserved for autonomous learning outside of class sessions. These class sessions could be carried out either as an onsite instruction in the university classroom (if the classes were held prior to the COVID pandemic) or as an online instruction (if the classes were held in a virtual format due to suspension of classroom attendance). In both cases, the main purpose of the class sessions (both online and in the classroom) was to deeply reflect on the material studied autonomously by each student and, thus, to be able to consolidate everything learned (Roach, 2014).

The Flipped Classroom experience in each of the subjects lasted for three weeks. During this time, the teachers responsible for each subject had to have planned the appropriate audio-visual material so that the students could receive the learning lessons from home. From the coordination of the project, they were recommended to rely on figures, diagrams, graphics and images as long as the content of the subject was adequate for it. In addition, it should be noted that the university students received the appropriate explanations about the Flipped Classroom methodology prior to the start of the experience. Given that it was a novel situation for all of them, the teachers repeatedly insisted on the need to access and view the audio-visual material that was offered to them from the corresponding virtual platforms. They were also informed of the need to complete some activities in online format that the teacher had designed. These activities were intended to review the content presented in the audio-visual material prior to the class session with the teacher. All this, with a weekly periodicity and prior to the onsite or online session (depending on when the experience was carried out). For the class sessions with the teacher, the coordination of the project offered different models of activities to the participating teachers that they could apply with

their students: quizz-type questions, elaboration of mind maps or design of questions to exchange with other classmates.

3.1. Participants and survey

Our sample is composed of 376 students during the first and second semesters of the 2019-20 academic year. The 75% of the sample was enrolled in the initial university courses and the remaining 25% of the sample was enrolled in the last courses (third and fourth year of university). Regarding the way, they did the experience with Flipped Classroom, 68% did it through an onsite instruction and 32% through an online instruction. The percentage of students with a predisposition to educational innovation was balanced: approximately 52% had an interest in innovation compared to almost 48% who did not. Finally, 36.70% of the sample had no previous experience with innovation while 63.30% did have some prior contact with this methodology.

The General Self-Efficacy Scale of (Baessler & Schwarzer, 1996) was used in order to analyse perceived self-efficacy of university students after being involved in various Flipped Classroom experiences. Using this scale, the feeling of personal competence is evaluated to effectively handle a wide variety of learning situations that can be challenging. Instead of adopting its original response format, a 10-point Likert-type scale was used that had already been previously validated by Sanjuán et al. (2000). The instrument consists of a total of 10 indicators that assess the perception of personal competence to effectively handle a wide variety of stressful situations. Students were asked to rate the ten indicators of self-efficacy after experiencing the Flipped Classroom sessions. In this way, they had to record their degree of agreement regarding the contribution of this active methodology to increase their general perceived self-efficacy and self-efficacy in learning.

3.2. Data analysis

Table 1 shows descriptive statistics for the self-efficacy scales (dependent variables), from strongly disagree (0) to strongly agree (10). In particular, the table shows the means, standard deviation, item total correlation (correlation coefficient between the score on the individual item and the sum of the scores on the remaining items) and the Cronbach's alpha coefficient if the individual item is deleted from the scale. There is a high agreement among all the indicators on the scale. Almost all of them exceed the average score of 7, except for EF6 item, which refers to "Develop the necessary skills to handle challenging learning situations". This item has been the one in which low agreement is observed within the whole scale. The respondents agreed most with the EF2 item ("Solve problems if I put in enough effort"; mean 7.98), followed by EF8 item ("Solve most tasks if I try my best"; mean 7.861). On the contrary (in addition to EF6 item), those questions in which less agreement is observed among students refer to EF7 item ("Handle any type of challenge that may occur"; mean 7.052) and EF9 item ("Find solutions or alternatives to challenging situations"; mean 7.223). Even so, it should be noted that the average score obtained in the degree of agreement of these indicators was considerably high.

The internal consistency of the concepts measured by Cronbach's alpha for the self-efficacy scale were reliable, ranging from 0.869 for "Handle any type of challenge that may occur" to 0.883 for "Finding a way to get what I want without someone opposing me"; and Cronbach's alpha for the overall scale was 0.886. Similar results (0.87) were obtained by Sanjuan et al (2000) with Spanish university students. On the other hand, the correlation coefficients of the score of each item with respect to the sum of all the scores of the rest of the items, also presented a similar trend.

Table 1 Descriptive statistics of self-efficacy scale.

Perception about self-efficacy (Cronbach's alpha = 0.886)	Mean	S.D.	Item total correlation	Cronbach's alpha
EF1. Finding a way to get what I want without someone opposing me.	7.288	1.756	0.456	0.883
EF2. Solve problems if I put in enough effort.	7.984	1.478	0.449	0.880
EF3. Persist in the proposed tasks until reaching the desired goal.	7.421	1.705	0.455	0.882
EF4. Have confidence in myself to handle different situations effectively.	7.252	1.588	0.427	0.870
EF5. Overcome unforeseen situations thanks to my resources and qualities.	7.537	1.456	0.425	0.870
EF6. Develop the necessary skills to handle challenging learning situations.	6.738	1.974	0.455	0.882
EF7. Handle any type of challenge that may occur.	7.052	1.674	0.425	0.869
EF8. Solve most tasks if I try my best.	7.861	1.422	0.434	0.873
EF9. Find solutions or alternatives to challenging situations.	7.223	1.572	0.425	0.870
EF10. Find different alternatives for solving the same problem.	7.249	1.732	0.426	0.870

Table 2 summarizes the sociodemographic factors and how they affected self-efficacy. These factors will be used as explanatory variables in the analysis. The choice of these variables has been based on the literature review on those factors that affect the perceived effectiveness of active methodologies in the university environment. Specifically, it includes the course in which the students are enrolled, the way in which the Flipped experience has been carried out, the predisposition or interest in educational innovation and, finally, previous experience with activities or experiences of innovation. Regarding the academic year, it was decided to capture two subgroups that divided the

variable into "first university levels", including 1st and 2nd year students, and "upper years of university" that may also include Master's level students. On the other hand, and considering that this Flipped Classroom experience was developed throughout the 2019-20 academic year (and, therefore, the second semester coincided with the outbreak of the COVID-19 pandemic), a second variable was proposed related to the way in which the logistical aspects had enabled the activities to be carried out. Within this variable, two categories were established: onsite instruction (if the experience was carried out in the first semester and, therefore, in the university classroom) and online instruction (if the experience started in the second semester after declaring the state of alarm). Finally, in the explanatory variables related to the predisposition to educational innovation and to previous experience with innovation activities, two categories were included: yes / no.

Table 2 Explanatory variables of students' affinity for the efficacy indicators.

Variables	Definition	Units	Mean	Std Dev
First courses	Dummy variable for students in the first and second years.	1=1st and 2nd year 0=Other year	0.706	0.457
Online experience	Dummy variable for type of experience with Flipped Classroom	1=Online 0=Onsite	0.379	0.486
Innovative	Dummy variable for students' willingness to innovate	1=Yes 0=No	0.456	0.499
Experience	Dummy variable for students' previous experience with innovative experience	1=Yes 0=No	0.621	0.486

3.3. Multivariate ordered probit model for self-efficacy estimates

Assessment of the determinants of perceived improvement in their perception of self-efficacy can be achieved using several approaches. One commonly used approach is to estimate a single equation such as ordered probit for each self-efficacy indicator, but it

ignores simultaneous behaviour. In the case of the indicators used in this study, it is worth noting that this simultaneous behaviour should not be ignored because they are all part of the same dimension called perceived "self-efficacy". Therefore, and with the aim of overcoming the shortfalls of using other techniques, we estimated multivariate ordered probit models (Greene and Hensher, 2010).

The econometric model that summarizes the behavioral framework presented so far includes as dependent variables (Y_{ik}) the self-efficacy indicator for students, where $i = 1, ..., N$ are students and $k = 1, ..., K$ are different self-efficacy indicators. This model was selected from the intuition that students are more likely to perceive self-efficacy for a variety of reasons than a single one. We consider a set of exogenous explanatory variables to evaluate the reasons --socio-demographic effects-- which are common to all the alternatives (X). The model is specified as follows:

$$
\begin{aligned}
&Y^*_{i1} = \beta_1' X_i + \varepsilon_{i1}, \text{ where } Y_{i1} = j_1 \text{ if and only if } \mu_{j-1,1} < Y^*_{i1} < \mu_{j,1} \\
&Y^*_{i2} = \beta_2' X_i + \varepsilon_{i2}, \text{ where } Y_{i2} = j_2 \text{ if and only if } \mu_{j-1,2} < Y^*_{i2} < \mu_{j,2} \\
&\quad \ldots\ldots \\
&Y^*_{ik} = \beta_k' X_i + \varepsilon_{ik}, \text{ where } Y_{ik} = j_k \text{ if and only if } \mu_{j-1,k} < Y^*_{ik} < \mu_{j,k}
\end{aligned}
\qquad (1)
$$

where β_k are parameters to be estimated, $\mu_{j,k}$ is the upper bound threshold for count level j of objective k ($\mu_{0,k} < \mu_{1,k} \ldots < \mu_{J,k}$; $\mu_{0,k} = -\infty$, $\mu_{J,k} = +\infty$ for each objective k). The threshold bounds define a range of the underlying latent continuous variable corresponding to each observed discrete outcome. The ε_{ik} a standard normal error term with:

$$
\begin{pmatrix} \varepsilon_{i1} \\ \varepsilon_{i2} \\ \ldots \\ \varepsilon_{ik} \end{pmatrix} \approx N\left[\begin{pmatrix} 0 \\ 0 \\ \ldots \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho_{12} & \ldots & \rho_{1k} \\ \rho_{21} & 1 & \ldots & \rho_{2k} \\ \ldots & \ldots & \ldots & \ldots \\ \rho_{k1} & \rho_{k2} & \ldots & 1 \end{pmatrix} \right] \text{ or } N[0, \Sigma]
$$

The off-diagonal terms of Σ capture the error covariance across the underlying latent continuous variables of the different objectives; that is, they capture the effect of

common unobserved factors influencing the perceived improvement in their sense of self-efficacy. Then, if ρ_{12} is positive, it implies that students with a higher than average propensity in their peer group to self-efficacy in the first indicator are also likely to have a higher than average propensity to self-efficacy in the second indicator. As is well known, if all the correlation parameters are zero, the model system in Equations (1) should be estimated as independent ordered response probit models for each indicator providing consistent and asymptotically efficient estimators for all model parameters.

4. Results and discussion

Tables 3 and 4 present results of the multivariate ordered probit model where determinants of self-efficacy scales are modelled jointly. Table 3 presents estimation results for the socio-demographic variables and Table 4 reports the correlation coefficients of the random components of each self-efficacy indicator. Following Greene and Hensher (2010) the multivariate ordered probit model provides more efficient results if and only if those correlations are jointly different from zero. At the end of Table 3 results of the statistical test for that condition is reported. Test result suggests that different statements are effectively correlated by unobserved factors and therefore this model improve the efficiency of the estimation, also Table 4 that all self-efficacy indicators are positively and significantly correlated, which means that are complementary, and consequently, students do not agree upon a single self-efficacy scale; instead, the probability of agreeing an item is conditional on whether other items have already been agreed.

The magnitude of the estimated coefficients in Table 3 do not have a direct interpretation, but we can say that an increase in a variable with a positive coefficient increases the probability of the dependent variable being in the highest category (high

self-efficacy), yet decreases the probability of it being in the lowest category. Then, regarding the results of the estimation of Table 3, firstly, the influence of the explanatory variable of the academic year on some of the indicators of the self-efficacy scale is observed. Those students enrolled in the first university courses are less likely to position themselves according to certain indicators of self-efficacy after experiencing the Flipped Classroom sessions. Specifically, there is a positive impact of taking the first degree courses on the perception of considering that Flipped Classroom helps "Persist in the proposed tasks until reaching the desired goal (EF3)" and "Solve most tasks with the necessary effort (EF8)". Although with a lower degree of significance, the students of the first years of the university are also less likely to agree on the improvement of the EF2 "Personal ability to solve problems" and EF9 "Find solutions or alternatives to challenging situations" with the Flipped Learning methodology. The trend found here is similar to the results offered by Elias et al. (2010). In their study, those students from higher university courses presented a greater adjustment (understood in terms of greater perceived self-efficacy and achievement motivation) compared to other younger students.

On the other hand, the way in which the Flipped Classroom sessions were carried out has practically had no impact on the self-efficacy declarations of university students. Even with this, it is appreciated that the students who took the classes in an online format are more likely to agree on the improvement that Flipped Classroom offers to their ability to "Solve most tasks with the necessary effort (EF8)" and for "Find different alternatives for solving the same problem (EF10)". For all other statements, there is no positive impact on the way in which the experience was shaped. These results are located in a similar line to that found in previous studies (Chu & Tsai, 2009) in which it is indicated that the acceptability of learning experiences in online

formats can be determined by study preference in these online support, among other factors. In addition, fully online learning formats can facilitate students' cognitive engagement and provide guidance to efficiently interact with the learning content (Ibrahim & Callaway, 2014). Consequently, the chances that the self-efficacy of university students will be improved are greater in those online Flipped Learning course formats. In these online learning environments, students must access the courses completely independently and plan their learning times, pace and strategies by themselves. This fact implies a totally self-directed learning (Lai, 2015).

Willingness to innovate had a positive impact on the self-efficacy scale, except for EF6, "Develop the necessary skills to handle challenging learning situations" with a non-significant result, suggesting that students are more likely to agree with the fact that the Flipped Classroom experience has the potential to enhance your sense of perceived self-efficacy. In most of the indicators of the scale, the significance of the impact of the students' predisposition towards innovation was high. The only two exceptions are found in EF7 "Handle any type of challenge that may occur" and in EF10 "Find different alternatives for solving the same problem".

Regarding the explanatory variable related to the previous experience of university students with educational innovation, it is not observed that it has a significant impact on most of the self-efficacy indicators of the scale. Only in the EF1 statement "Finding a way to get what I want without someone opposing me" is appreciated that students with previous experience were less likely to consider that the Flipped Classroom methodology improveed this indicator. Some studies on university professors (Ghaith & Yaghi, 1997), found relationships between experience and predisposition to innovation, the implementation of active learning practices and the perceived self-efficacy. In other studies carried out on a sample of professionals from

Turkey (Kumar & Uzkurt, 2010), a positive relationship was also found between readiness for innovation and perceived self-efficacy.

Table 3 Estimation results for the self-efficacy indicators.

	EF1	EF2	EF3	EF4	EF5	EF6	EF7	EF8	EF9	EF10
	Coef (Std Err)	Coef (Std Err)	Coef (Std Err)	Coef (Std Err)	Coef (Std Err)	Coef (Std Err)	Coef (Std Err)	Coef (Std Err)	Coef (Std Err)	Coef (Std Err)
First courses	-0.150 (0.138)	-0.236* (0.139)	-0.406*** (0.139)	-0.084 (0.136)	-0.004 (0.137)	-0.178 (0.136)	-0.177 (0.136)	-0.463*** (0.140)	-0.238* (0.137)	-0.167 (0.136)
Online exp.	-0.110 (0.129)	-0.067 (0.130)	0.163 (0.129)	0.058 (0.129)	-0.015 (0.130)	-0.004 (0.128)	0.045 (0.129)	0.233* (0.130)	0.210 (0.129)	0.305** (0.129)
Innovative	0.257** (0.121)	0.492*** (0.123)	0.435*** (0.121)	0.194* (0.120)	0.292*** (0.121)	-0.031 (0.119)	0.221* (0.120)	0.509*** (0.123)	0.269** (0.121)	0.223* (0.120)
Experience	-0.201* (0.123)	0.022 (0.123)	-0.101 (0.122)	0.165 (0.122)	0.190 (0.123)	0.138 (0.121)	0.033 (0.121)	-0.090 (0.123)	0.055 (0.122)	0.164 (0.122)
Equation test $\chi^2(4)$	11.17**	23.45***	23.62***	5.28	9.32*	2.94	5.81	30.47***	9.41*	10.27**
Global test $\chi^2(40)$	93.47***									
All rho=0 $\chi^2(45)$	882.25***									
Num. obs.	309									

Note: *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

Regarding the correlation coefficients in Table 4, highly significant correlations were observed between all variables. This sense of "unity" of the scale reveals a significant fact, and it is that in the same way that a high perception of self-efficacy is perceived in a certain indicator after experiencing the Flipped Classroom sessions, it will also occur in another indicator of self-efficacy. In all the indicators of the

questionnaire, the correlations were very high. Consequently, it was concluded that the scale was robust.

Table 4 Correlation coefficients of the random components of each self-efficacy indicator.

	EF1	EF2	EF3	EF4	EF5	EF6	EF7	EF8	EF9
EF2	0.670***								
	(0.036)								
EF3	0.438***	0.524***							
	(0.050)	(0.046)							
EF4	0.450***	0.484***	0.531***						
	(0.050)	(0.048)	(0.045)						
EF5	0.464***	0.489***	0.414***	0.694***					
	(0.049)	(0.048)	(0.052)	(0.033)					
EF6	0.260***	0.223***	0.277***	0.506***	0.564***				
	(0.057)	(0.060)	(0.057)	(0.046)	(0.042)				
EF7	0.362***	0.332***	0.433***	0.588***	0.617***	0.707***			
	(0.053)	(0.056)	(0.050)	(0.041)	(0.038)	(0.031)			
EF8	0.474***	0.643***	0.402***	0.494***	0.577***	0.397***	0.532***		
	(0.049)	(0.038)	(0.053)	(0.047)	(0.042)	(0.053)	(0.045)		
EF9	0.422***	0.444***	0.456***	0.536***	0.589***	0.587***	0.645***	0.554***	
	(0.051)	(0.051)	(0.049)	(0.044)	(0.041)	(0.040)	(0.036)	(0.044)	
EF10	0.419***	0.410***	0.434***	0.521***	0.615***	0.611***	0.676***	0.585***	0.769***
	(0.051)	(0.053)	(0.051)	(0.045)	(0.039)	(0.039)	(0.034)	(0.042)	(0.026)

Note: *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

5. Conclusions

According to the results of this study, the Flipped Classroom improves students' self-efficacy, regardless of the online or onsite virtual format. This methodology in online format is a good possibility for this next course marked by the uncertainty of the evolution of the COVID-19. Currently, the beginning of the course is mostly onsite but online teaching can become mandatory at any time. The educational field is one of the many affected by this pandemic in many countries (Almarzooq, 2020; Telles, 2020; Wyse et al., 2020) and therefore alternative solutions must be considered in this situation. Thus, these online Flipped Learning environments also allow the student to be the protagonist of their own learning and the reduction of that social distance when there is no presence, thanks to the dynamic sessions and online participation of students with teachers (Telles, 2020). Likewise, this distance with the teacher is reduced with the

immediate feedback that the students receive after the activities. These tasks are presented in electronic format at the end of the viewing of the material provided and prior to the online discussion session. This whole process makes the students constantly active during the elaboration of their own knowledge with greater autonomy, always counting on the teacher as a guide in their process and with the supervision of the students' progress on their part (Schwarzenberg, 2020).

The use of Flipped Classroom as a teaching resource is an important advance within an educational system that prioritizes innovation and the development of a wide range of skills. Precisely in these moments of pandemic, the digitalization of education and a greater use of new technologies is being imposed (Telles, 2020). All this is causing changes in the way classes are taught (Almarzooq, 2020). The case of COVID-19 has accelerated the need for innovative solutions to optimize education efforts (Almarzooq, 2020) and could be considered as a provider of educational technology (Wyse et al., 2020). This has meant an imposition of new strategies and formats that must be incorporated in an emergent way into the teaching-learning process and that pose challenges to teachers, students and families (Wyse et al., 2020). For example, the online Flipped Learning is an innovative, effective methodology that positively impacts higher education students by enhancing their learning (Dooly & Sadler, 2020). Its application in the classroom would be the beginning of the updating of society and an impulse towards an innovative education of the 21st century by making frequent and/or permanent use of online teaching (Telles, 2020).

It is important to bet on a type of self-directed learning for students, since it would help them to learn better and at their own pace, at any time and in any place (O'Flaherty and Phillips, 2015). It is concluded that the online Flipped Classroom format is the ideal environment for students to feel more confident during online

discussions because they have previously seen and worked on the learning content before the class (Halili et al., 2015). Therefore, with the online turnkey classroom format, faculty can provide the opportunity for their students to seek academic help on their own and continue to develop their participation, self-esteem, and perceived self-efficacy (Chyr et al., 2017).

Finally, this study could be complemented with an analysis of teachers' views as professionals involved in this teaching-learning process. Future research could investigate what factors lead these professionals to decide to apply or not the Flipped Classroom in their classrooms and, at the same time, explore their perspectives on the influence of this methodology in the self-efficacy of the students. Future research could also validate our findings in other educational stages, to obtain a more global vision of online or in-situ teaching with the Flipped Classroom method and its impact throughout the different formative stages.

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Table 1 Descriptive statistics of self-efficacy scale.

Perception about self-efficacy (Cronbach's alpha = 0.886)	Mean	S.D.	Item total correlation	Cronbach's alpha
EF1. Finding a way to get what I want without someone opposing me.	7.288	1.756	0.456	0.883
EF2. Solve problems if I put in enough effort.	7.984	1.478	0.449	0.880
EF3. Persist in the proposed tasks until reaching the desired goal.	7.421	1.705	0.455	0.882
EF4. Have confidence in myself to handle different situations effectively.	7.252	1.588	0.427	0.870
EF5. Overcome unforeseen situations thanks to my resources and qualities.	7.537	1.456	0.425	0.870
EF6. Develop the necessary skills to handle challenging learning situations.	6.738	1.974	0.455	0.882
EF7. Handle any type of challenge that may occur.	7.052	1.674	0.425	0.869
EF8. Solve most tasks if I try my best.	7.861	1.422	0.434	0.873
EF9. Find solutions or alternatives to challenging situations.	7.223	1.572	0.425	0.870
EF10. Find different alternatives for solving the same problem.	7.249	1.732	0.426	0.870

Table 2 Explanatory variables of students' affinity for the efficacy indicators.

Variables	Definition	Units	Mean	Std Dev
First courses	Dummy variable for students in the first and second years.	1=1st and 2nd year 0=Other year	0.706	0.457
Online experience	Dummy variable for type of experience with Flipped Classroom	1=Online 0=Onsite	0.379	0.486
Innovative	Dummy variable for students' willingness to innovate	1=Yes 0=No	0.456	0.499
Experience	Dummy variable for students' previous experience with innovative experience	1=Yes 0=No	0.621	0.486

Table 3 Estimation results for the self-efficacy indicators.

	EF1	EF2	EF3	EF4	EF5	EF6	EF7	EF8	EF9	EF10
	Coef (Std Err)	Coef (Std Err)	Coef (Std Err)	Coef (Std Err)	Coef (Std Err)	Coef (Std Err)	Coef (Std Err)	Coef (Std Err)	Coef (Std Err)	Coef (Std Err)
First courses	-0.150 (0.138)	-0.236* (0.139)	-0.406*** (0.139)	-0.084 (0.136)	-0.004 (0.137)	-0.178 (0.136)	-0.177 (0.136)	-0.463*** (0.140)	-0.238* (0.137)	-0.167 (0.136)
Online exp.	-0.110 (0.129)	-0.067 (0.130)	0.163 (0.129)	0.058 (0.129)	-0.015 (0.130)	-0.004 (0.128)	0.045 (0.129)	0.233* (0.130)	0.210 (0.129)	0.305** (0.129)
Innovative	0.257** (0.121)	0.492*** (0.123)	0.435*** (0.121)	0.194* (0.120)	0.292*** (0.121)	-0.031 (0.119)	0.221* (0.120)	0.509*** (0.123)	0.269** (0.121)	0.223* (0.120)
Experience	-0.201* (0.123)	0.022 (0.123)	-0.101 (0.122)	0.165 (0.122)	0.190 (0.123)	0.138 (0.121)	0.033 (0.121)	-0.090 (0.123)	0.055 (0.122)	0.164 (0.122)
Equation test $\chi^2(4)$	11.17**	23.45***	23.62***	5.28	9.32*	2.94	5.81	30.47***	9.41*	10.27**
Global test $\chi^2(40)$	93.47***									
All rho=0 $\chi^2(45)$	882.25***									
Num. obs.	309									

Note: *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

Table 4 Correlation coefficients of the random components of each self-efficacy indicator.

	EF1	EF2	EF3	EF4	EF5	EF6	EF7	EF8	EF9
EF2	0.670***								
	(0.036)								
EF3	0.438***	0.524***							
	(0.050)	(0.046)							
EF4	0.450***	0.484***	0.531***						
	(0.050)	(0.048)	(0.045)						
EF5	0.464***	0.489***	0.414***	0.694***					
	(0.049)	(0.048)	(0.052)	(0.033)					
EF6	0.260***	0.223***	0.277***	0.506***	0.564***				
	(0.057)	(0.060)	(0.057)	(0.046)	(0.042)				
EF7	0.362***	0.332***	0.433***	0.588***	0.617***	0.707***			
	(0.053)	(0.056)	(0.050)	(0.041)	(0.038)	(0.031)			
EF8	0.474***	0.643***	0.402***	0.494***	0.577***	0.397***	0.532***		
	(0.049)	(0.038)	(0.053)	(0.047)	(0.042)	(0.053)	(0.045)		
EF9	0.422***	0.444***	0.456***	0.536***	0.589***	0.587***	0.645***	0.554***	
	(0.051)	(0.051)	(0.049)	(0.044)	(0.041)	(0.040)	(0.036)	(0.044)	
EF10	0.419***	0.410***	0.434***	0.521***	0.615***	0.611***	0.676***	0.585***	0.769***
	(0.051)	(0.053)	(0.051)	(0.045)	(0.039)	(0.039)	(0.034)	(0.042)	(0.026)

Note: *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.