ESTUDIOS

Revista **Complutense de Educación**
ISSNe: 1988-2793

EDICIONES COMPLUTENSE

https://dx.doi.org/10.5209/rced.67851

Does the teaching-learning model based on the flipped classroom improve academic results of students at different educational levels?

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Recibido: Febrero 2020 / Evaluado: Abril 2020 / Aceptado: Mayo 2020

Abstract. The teaching-learning model that still predominates in higher education is the traditional one, based on the master class taught by the teacher. However, it is necessary to resort to other models of teaching and learning that are more flexible and active for students. For this reason, the main objective of this paper is to apply the flipped classroom teaching-learning model in order to test and compare if the academic results of students with the flipped classroom model improve with respect to the traditional model at different educational levels. In addition, the students' assessment of this teaching-learning model and the use of Information and Communication Technologies is analyzed. This study presents the experience of teaching innovation based on the inverted class model, which has been carried out with 155 students belonging to different educational levels and with six subjects related to the Financial Economics discipline. For this, a descriptive statistical analysis is performed, as well as analysis of contingency tables to detect the degree of association between the educational level and the teaching-learning model applied for the evaluation of the students. Evidence is obtained that university students obtain better academic results with the traditional model, while non-university students achieve better grades with the flipped classroom model. However, the students' assessment of the flipped classroom model has been very positive, regardless of educational level. The results suggest that the flipped classroom model improves the academic results of non-university students because they are more accustomed to the application of new technologies than university students.
Keywords: educational levels; flipped classroom; learning experience; teaching innovation; traditional classroom.

[es] ¿El modelo de enseñanza-aprendizaje basado en la clase invertida mejora el rendimiento académico de los estudiantes en diferentes niveles educativos?

Resumen. El modelo de enseñanza-aprendizaje que todavía predomina en la educación superior es el modelo tradicional basado en la clase magistral por parte del profesor. Sin embargo, es necesario recurrir a otros modelos de enseñanza y aprendizaje que sean más flexibles y activos para los estudiantes. Por este motivo, el principal objetivo de este artículo es aplicar el modelo de enseñanza-aprendizaje basado en la clase invertida para contrastar y comparar si mejora los resultados académicos de los estudiantes con respecto al modelo tradicional en diferentes niveles educativos. Además, también se analiza la valoración de los estudiantes sobre este modelo activo de enseñanza-aprendizaje y sobre el uso de las Nuevas Tecnologías de la Información y de la Comunicación. Este estudio presenta la experiencia de innovación docente basada en el modelo de clase invertida, que ha sido llevada a cabo con 155 estudiantes pertenecientes a diferentes niveles educativos y con seis asignaturas relacionadas con la disciplina Economía Financiera. Para ello, se realizan análisis estadísticos descriptivos y análisis de tablas de contingencia para detectar el grado de asociación entre el nivel educativo y la metodología de enseñanza-aprendizaje aplicada para la evaluación de los estudiantes, así como la valoración de los estudiantes sobre esta metodología activa de enseñanza-aprendizaje. Se obtiene evidencia de que los estudiantes universitarios consiguen mejores resultados académicos con la metodología tradicional mientras que los no universitarios logran mejores calificaciones con la metodología basada en la clase invertida. Sin embargo, la valoración de los estudiantes sobre la metodología basada en la clase invertida ha sido muy positiva, independientemente del nivel educativo al que pertenecen. Los resultados sugieren que el modelo basado en la clase invertida mejora los resultados académicos de los estudiantes no universitarios porque ellos están más acostumbrados a la aplicación de nuevas tecnologías que los alumnos universitarios.
Palabras clave: clase invertida; clase tradicional; niveles educativos; innovación docente; experiencia de aprendizaje.

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Cómo citar: González-Velasco, C.; Feito-Ruiz, I.; González-Fernández, M.; Álvarez-Arenal, J. L.; Sarmiento-Alonso, N. (2021). Does the teaching-learning model based on the flipped classroom improve academic results of students at different educational levels?. *Revista Complutense de Educación,* 32(1), 27-39.

1. Introduction

The traditional teaching-learning model, still very widespread in university teaching, is based on the master class taught by the teacher. Subsequently, students must assimilate the contents of these classes and carry out activities to improve assimilation, as well as tasks to consolidate what they have learned. However, these classes are oftentimes not useful for students because they cannot capture all the information transmitted to them, they feel unmotivated and unable to solve certain problems and sometimes cannot attend for medical, family or personal matters.

This traditional model, which could even be described as a teaching model only and not one of learning, stimulates mechanical learning, where much of the content is learned by heart and encourages a passive reception of knowledge. This passive learning neglects the need to develop learning regarding how to learn, as well as learning's relationship to processes, cognitive factors and external factors associated with it (Salas Vinent, 2009).

This situation requires a change of roles in the classroom, both of the student and the teacher, based on active teaching-learning models (Campbell, Cabrera, Ostrow Michel, & Patel). In addition, among the new demands of the student is the acquisition of meaningful content that has a useful application to the reality in which they must be developed.

The teaching-learning model that still predominates in higher education is the traditional one, based on the master class taught by the teacher. This model has several drawbacks, as indicated above. For this reason, it is necessary to resort to other models of teaching and learning that are more flexible and active and that can facilitate the study and assimilation of content by the student and motivate him or her to improve and consolidate learning. This is the main objective of this proposal.

For this, an experience of teaching innovation will be carried out with the teaching-learning model based on the flipped classroom. This model has 4 fundamental pillars, which derive from the acronym F-L-I-P (Yarbro, Arfstrom, Mcknight, & Mcknight, 2014): Flexible Environment, Learning Culture, Intentional Content and Professional Educator. This acronym has been extended by some researchers (Chen, Wang, Kinskuk, & Chen, 2014) adding three letters, F-L-I-P-P-E-D, which refer to these other three pillars: Progressive Activities, Engaging Experiences and Diversified Platforms. This model has been applied in recent research (Yarbro et al., 2014, Naccarato, & Karakov, 2015, Tanner, & Scott, 2015, Wakabayaski, 2015, Caligaris, Rodríguez, & Laugero, 2016, Hao, 2016, Hao, & Lee, 2016, Peterson, 2016; Sohrabi, & Iraj, 2016; Lopes, & Soares, 2018; Yamarik, 2019 and Awidi, & Paynter, 2019, among others) but is still not widespread.

Flipped classroom is a learning alternative in which the elements of the class and the traditional tasks of a course are inverted; before class, the students receive the contents, fundamentally in the form of videos, which they then must assimilate and study. Later, during the class, the student performs activities to improve their learning, and the teacher will be the point of support to consolidate their learning. It represents a unique combination of constructivist ideology and behavioral principles that can be used to bridge the gap between didactic education and practical performance (Hawks, 2014).

The main advantages of this model are the following (Halili, & Zainuddin, 2015): students are more motivated and safe when they discuss in class because they come prepared having already watched the contents, videos fundamentally, before the class, and class activities are focused on the student and not the teacher, who acts as a facilitator, not an exhibitor. However, it also has the disadvantage that, since it is a relatively new learning model, not all teachers and students are ready to apply it (Halili, & Zainuddin, 2015, Al-Zahrani, & Abdulrahman, 2015).

The paper is structured in the following sections. The second section defines the theoretical framework with the justification and presentation of the research questions to be contrasted. The third section describes the experience of teaching innovation with its phases and virtual tools used. The fourth section describes the sample used, the data sources, as well as the procedure used to analyze the information. The fifth section shows the results obtained and provides the discussion. The last section offers some conclusions based on the teaching innovation experience.

2. Theoretical framework

2.1. Influence of educational level in which the flipped classroom model is applied on the academic results

Despite the fact that the perception of the majority of students about the flipped classroom is generally positive, the results obtained may vary depending on the level of education. In this sense, undergraduate and masters students today

come from an educational system in which they were completely passive, where they were limited to listen to the teacher and their participation in the classroom was very low. We could fall into the temptation of thinking that they are used to doing homework and therefore individual work outside the classroom, based on their previous educational stages (Martín, & Santiago, 2016). However, the traditional system was based on a greater weight of the class and a lower percentage of self-engagement. In the system based on the flipped classroom, students are asked to build new knowledge by using videos or attractive digital formats and understand it, and this requires great perseverance, strength of will, good study habits and a level of effort to which they are not yet accustomed (Garcia, Traver and Candela, 2001).

On the other hand, students from lower educational levels have grown up and have been educated in an environment with a significant digital component. Thus, they are more adapted to new ways of learning based on a class with a greater technological and audiovisual content and one that is more innovative (Lage, Platt, & Treglia, 2000). For them, the class is an extension of the gamification that they are so used to and they experience it as a challenge. In addition, given that they use technology to which they are so used to from very early on, they do so with more interest than the university students.

That is why there may be differences in the results obtained. The younger generations, that is, those who are in lower levels of education today, are more used to of this type of methodology and therefore experience it in a more natural way. On the other hand, students in higher educational levels may be more reluctant to try this type of experience, and this situation may have implications on the results, as they do not feel as comfortable with this type of methodology. Taking into account these arguments, the following hypothesis is offered:

Hypothesis 1: *The educational level in which the flipped classroom model is applied may influence the academic results of students*.

2.2. Students' perception of the flipped classroom model at different levels of the education system

The flipped classroom is a teaching-learning model that has been adapted to practically all levels of the educational system, from basic education to higher education levels.

The largest number of examples in the literature on the flipped classroom can be found at the university level. Along these lines, the work of Bishop and Verleger (2013) is particularly noteworthy. The authors review more than 20 studies about the flipped classroom at the university level in different courses and subjects. In general, the results show that despite the fact that there are differences between the subjects within university studies, the perception of the students about the flipped classroom is positive. However, they also conclude that students prefer face-to-face lessons to video lessons but also indicate that they like the audio-visual lessons because they are shorter. Regarding the results, the trend observed is that the use of the flipped classroom improves results. However, the authors note that future experiences applied more consistently are necessary to come to more robust conclusions.

Regarding subjects in the area of finance management, Mombourquette and Findlay-Thompson and Monbourquette (2014) obtained interesting results from a teaching experience with a group of students in Business Administration, mostly between 18 and 24 years of age. To evaluate the experience of the flipped classroom, seven students were selected, six of them were in that age range and one was older, and were subjected to a personal interview. The results obtained from students' views indicate that the older student was the only student clearly opposed to the flipped classroom. In relation to the results obtained in the tests, no significant differences were found compared to other topics of the subject in which this method was not applied.

With regard to secondary education, the examples of the flipped classroom are fewer. At this level of education, Bergmann and Sams (2009) used the flipped classroom to teach chemistry in an educational establishment in Colorado. Despite the fact that students welcomed the experience, the results do not differ from those obtained before turning the traditional classroom. Fulton (2012) analyzed the flipped classroom in an institute of Minnesota with high marks in mathematics that also applied the flipped classroom method. In this case, the results after using this model are slightly above those of traditional teaching, despite the fact that they vary depending on the part of the subject being evaluated.

The flipped classroom has also been applied in lower levels of education, such as basic education. Lai, & Hwang (2016) used it in primary education by comparing different methods of this model. Their results indicate that the flipped classroom allows students to build their own knowledge. However, the results are compared with traditional teaching to see whether there are significant differences.

According to previous studies, it seems that there is a general consensus that the implementation of the flipped classroom is valued positively by students at different educational levels, with some exceptions that tend to be associated with older age.

Taking into account the above arguments the following hypothesis is proposed:

Hypothesis 2: *The perception of the students regarding the flipped classroom is positive, regardless of educational level*.

2.3. ICT and its impact and acceptance in different educational levels

Baccalaureate and vocational training students usually cover the adolescence age group, and the university and post-university cover the youth age group. According to the World Health Organization, teenagers are between 10 and 16 years old, and youth are between 16 and 27 years old, although in studies on the use of ICT resources there is often a

consensus defining teenagers as being 14 to 18 years of age and youth as being 16 to 25 years of age, if one takes into account the use and assessment of the resources in their everyday life, despite the fact that they are all digital natives.

With regard to the use of ICT in these two generations, students in the early years of baccalaureate and vocational training develop solid skills in information processing and their time horizon is based on immediacy and superficiality; the multiplicity of information is motivated by the high level of information saturation. In this sense, the evolution of the use of digital resources, and especially of the smartphone with online connection, is one that has resulted in great change in terms of the interaction of the students with the real / virtual world. These ICT resources allow a permanent connection between teens and the access to an interactive multimedia world with thousands of applications. This generation is synchronized and develops interactive and sequential learning compared to the more linear learning of earlier times with classroom-based learning.

For its part, university students develop a selection process that is more defined and carried out a hierarchy of technological use according to the subject of study. In this sense, Tully (2004) suggested the introduction of the technology component in the definition of this generation.

Therefore, while baccalaureate students become 'carnivorous computer scientific', as Schirmarcher (1983) called them, that is to say, large consumers of digital information with a high self-teaching component that translates into a domestication of technology (Gómez Cruz, 2002) in a process of enlargement of the real with the virtual, university students focus on knowledge and mastery of digital tools as a complement to their learning process. This process, according to Livingstone, (2008) and Haddon (2011), goes from a commodification of resources to technological and renewed feedback.

According to Gil et al. (2003), students become prosumers, that is to say, producers and consumers of digital media. Despite the small size of the age gap between students from one stage to another, university students consider ICT very necessary for learning, compared to a smaller group that considers it not entirely necessary. As Maquilón Sánchez, Mirete Ruíz, García Sánchez, & Hernández Pina (2013) found, those students who measure better in ICT use, preferably the deep approach, in such a way that the use of ICT does not encourage deep learning, may be prevented and discouraged from surface learning. College students use more ICT resources because they are more focused on having deep learning where a better understanding is necessarily higher, compared to non-university students who focus much more on learning that is more superficial.

On the basis of all these arguments the following hypotheses are proposed:

Hypothesis 3: *The assessment of the more autonomous ICT-based learning is independent of the level of education*.

Hypothesis 4: *The use of these resources is more intense in university students than in non-university students*.

3. Description of the teaching innovation experience

This teaching innovation experience was carried out in the 2016-2017 academic year, for approximately 30 weeks (15 weeks in each semester). It was applied to six subjects related to the Financial Economics discipline of four educational levels (Master, Degree, Baccalaureate and Vocational Training).

The main objective of this experience of teaching innovation is apply the flipped classroom model in six subjects related with the Financial Economics discipline in order to contrast and compare if the results of student learning with this teaching-learning model improve with respect to the traditional model based on the master class at different educational levels. In addition, the students' assessment of this teaching-learning model and the use of information and communication technologies (ICT) is analyzed. For this, some descriptive statistical analysis are performed, as well as analysis of contingency tables to detect the degree of association between the educational level and the teaching-learning model applied for the evaluation of the students.

The following phases were followed in the teaching innovation experience: (i) Presentation to students the proposal of teaching innovation that consists in the development of the flipped classroom model through the application of the following digital tools: digital platform for content hosting (Moodle), video capture and editing tool (Camtasia Studio), application for online evaluation (Socrative and Google Forms) and tool for student motivation (Credly.com). The flipped classroom model was applied to a thematic block of each subject and the traditional model to another of similar difficulty at the teacher's discretion; (ii) Hosting contents of the thematic block (videos, presentations, news, etc.) for each subject in the Moodle platform. In this phase the teachers have created the videos with the video capture and editing tool Camtasia Studio; (iii) Assimilation of contents by the student in a limited period; (iv) Description of the tasks of the subject (resolution of cases or problems related to the current economic-financial situation and real news comments). These first four phases will take place before the face-to-face classes; (v) Completion of tasks by students; (vi) Evaluation of two thematic blocks of each subject with Socrative. In addition, teachers have conducted two 20-item student surveys with Google Forms, one initial at the end of the first Socrative test and another final at the end of the second Socrative test, in order to assess students' opinions about the flipped classroom model and the use of the ICT; (vii) Assignment of four digital badges with Credly.com to motivate the students: to students who correctly answer all the answers, to those who answer the question correctly with greater difficulty, to those who obtain the highest qualification and to those who better justify all the answers. The student who has four digital badges will have an increase in the thematic block score of 10% and the one with the least badges will apply the proportional increase; (viii) Comparison of

results between thematic blocks, one in which the flipped classroom model has been applied and another in which the traditional model has been applied; (ix) Comparison of results in the different educational levels involved in the teaching innovation experience; and (x) Report writing and dissemination of the findings.

4. Methods

4.1. Sample

The participants were 155 students of the Master in Actuarial and Financial Sciences, Degree in Finance, Degree in Economics, Bachelor in Social Sciences and Technician in Administrative Management (Table 1). It includes all the students of the 6 subjects analyzed from the 4 educational levels, one by teacher and all of them related to the financial economics discipline.

Table 1. Characteristics of the students in the sample

Characteristics		**Students (percentage)**
Educational Level	Master	7%
	Degree	66%
	Baccalaureate	15%
	Vocational Training	12%
Titles	Master in Actuarial and Financial Sciences	6%
	Degree in Finance	31%
	Degree in Economics	36%
	Bachelor in Social Sciences	15%
	Technician in Administrative Management	12%
Subjects	Analysis and management of fixed income assets	6%
	Financial Management II	21%
	Market, instruments and financial institutions	10%
	Analysis of financial operations	36%
	Fundamentals of administration and management	15%
	Auxiliary treasury operations	12%

The horizon has been the academic year 2016-2017 over 30 weeks, spread over two semesters for the university level subjects and on an annual basis for non-university level subjects. The flipped classroom is a teaching-learning model that has been adapted to practically all levels.

The sample selection was not probabilistic and was established according to the criteria related to the characteristics of the research (Bisquerra, 2004): number of students of the subjects involved and number of teachers who participated in the experience, one per subject.

4.2. Data sources

The data used for the analysis come from two sources. The first refers to the detailed marks obtained by students in the two selected thematic blocks of each subject, one in which the flipped-classroom model has been applied and in the other the traditional model. The second derives from the students' answers to two items of the initial survey and one item of the final survey:

- Item 8 (initial survey): *How often do you use ICT in your teaching-learning process?* with three response options: Daily, weekly or biweekly.
- Item 10 (initial survey): *Do you prefer learning more directed to the traditional or more autonomous way using ICT?* with two response options: More directed or more autonomous with ICT.
- Item 20 (final survey): *Overall assessment of the teaching innovation experience based on the inverted class model*, with 5-points Likert-type scale response: Very negative, negative, indifferent, positive and very positive.

4.3. Methodology

The methodology used has focused on a statistical analysis of all the detailed data by subject, educational level and in an aggregate manner. In order to facilitate the analysis, contingency tables were used to detect the association or dependence between educational level and the teaching-learning model used for the evaluation of the students, as well as the relationship between educational level and the assessment of the flipped classroom model and the use of ICT by the students. The analysis have been performed with the statistical package Stata v. 13.

The analysis of contingency tables is a technique used to study the relationship between two or more qualitative or categorical variables. The purpose of this analysis is to determine whether there is a dependency relationship or association between the variables considered through the reading and interpretation of the data in the table, to carry out a statistical contrast to determine whether the relationship is statistically significant by analyzing the strength or intensity of that relationship through different measures of association of variables, as well as to determine the direction of that association in the case of ordinal variables and their nature by detailing the general form in which the data in the table are distributed and the way in which the dependent variables are distributed for different categories of the independent variable (López-Roldán, & Fachelli, 2015).

To test the null hypothesis, which states that the variables are independent, we used the Pearson chi-square ($\chi 2$) (Pearson, 1911). The chi-squared value will be zero when the variables are completely independent of the observed variable and the expected frequencies are equal, and the value will be greater as the difference between these frequencies is greater, leading to a greater relationship between variables.

Another test that we used is the likelihood-ratio chi-square test (Fisher, 1924, Neyman, & Pearson, 1928). In this case, the test also rejects the null hypothesis of independence between variables when the significance of this statistic is less than or equal to 0.05.

However, these statistics serve to verify the existence or not of an association or dependence among variables but not the degree or intensity of the dependence, which can be weak, moderate and strong, as these statistics are very sensitive to the size of the sample and the number of cells in the contingency table.

To solve this limitation of the statistical chi-square test, we use three usual measures of association of variables (the phi coefficient, Cramer's V and the contingency coefficient) to attempt to correct the value of this statistic, delimiting its value between 0 and 1 in order to minimize the effect of the size of the sample on the quantification of the degree of association between the variables (Rodríguez Jaume, & Morar Catalá, 2001).

5. Results and discussion

This section shows the results of the analysis used to test the hypotheses. First of all and with respect to the academic results obtained by the students, it can be observed in contingency Table 2 that the masters and undergraduate students have obtained better results with the traditional model (60% of the total of masters students and 49% of undergraduate students), while baccalaureate and vocational training students have achieved higher grades with the flipped classroom model (83% of all baccalaureate students and 47% of vocational training students). Therefore, it is deduced that the university level students (masters and undergraduate) have obtained better academic results with the traditional model, while the non-university level students (baccalaureate and vocational training) have obtained better qualifications with the flipped classroom model. It is worth noting that these differences are even greater if the students who did not complete evaluations at the university level (undergraduate) and non-university level (vocational training) were not taken into account.

To contrast this association or dependence between educational level and model applied for the evaluation of the students, an analysis of contingency Table 2 was carried out through the chi-square statistic test, the likelihood ratio and three measures of association of variables related to the chi-square statistic: the phi coefficient, Cramer's V (Cramer, 1946) and Pearson's contingency coefficient. The results of this analysis show that the chi-square statistic and the chi-square likelihood-ratio have positive values and are far from zero. However, these statistics are not reliable because the expected frequency is less than 5 in 50% of the cells in the contingency table (8 of 16). For this reason, it is necessary to regroup the categories of educational levels that have fewer students with those with more students to eliminate the effect of sample size on these statistics and redo the analysis. The results of the regrouping of the categories of educational levels (master's degree and bachelor's degree with vocational training) show that university-level students obtain better results with the traditional model (51% on the total) and non-university students obtain the best grades with the flipped classroom model (67% of the total). In addition, it is also worth noting in this case that these percentages increase to 58% and 74%, respectively, if students who have not participated in the teaching innovation experience are not taken into account. We proceed to verify whether this association or dependency between the educational level and the model that has been applied for the evaluation of the students is statistically significant through the chi-square statistic and the likelihood ratio chi-square. In this case, the problem presented by the previous analysis has been solved since the expected frequency is less than 5 in 25% of the cells (2 of 8). In addition, the null hypothesis that establishes independence between the educational level and the model applied for the evaluation of the students is rejected since the probability is lower than the level of significance of 5%, and therefore, the alternative hypothesis of the existence of dependence between these two variables is accepted. To verify the degree or intensity of this dependence, the association measures of variables related to the chi-square statistic are

used, and it is observed that the three used measures have positive values higher than 0.30 (phi coefficient: 0.38; Cramer's V: 0.38 and contingency coefficient: 0.35) (Annex 1). Therefore, it can be deduced that there is a moderate relationship between the educational level and the model applied for the assessment of the students, which allows accepting hypothesis 1, which establishes that the educational level with the flipped classroom model can influence the results obtained.

Table 2. Students with better academic results in each teaching-learning model (4 educational levels)

		MODEL				
		Flipped classroom	**Traditional classroom**	**Indifferent**	**Did not attend evaluation**	**Total**
EDUCATIONAL LEVEL	**Master's**	0	6	4	0	10
		0%	60%	40%	0%	100%
	Undergraduate	30	51	8	14	103
		29%	49%	8%	14%	100%
	Baccalaureate	19	1	3	0	23
		83%	4%	13%	0%	100%
	Vocational training	9	6	0	4	19
		47%	32%	0%	21%	100%
	Total	58	64	15	18	155
		37%	41%	10%	12%	100%

Source: own elaboration.

Note: the first rows of each educational level show the number of students and the second shows the percentage of the number of students of the total of that educational level.

Secondly and with respect to the valuation of the flipped classroom model by students, the majority of the students participated in the two surveys, 90% in the initial survey and 70% in the final survey.

As shown in contingency Table 3, the majority of the students of all the educational levels evaluated the flipped classroom model in a very positive way, as excellent and very good (60% of master students, 72% of undergraduate students, 58% of baccalaureate students and 86% of vocational training students). Therefore, it can be deduced that the majority of students at all university levels have valued this model in a very positive way.

To contrast this association or dependence between educational level and the assessment of the flipped classroom model by the students, an analysis of contingency Table 3 was carried. Also, in this case is necessary to regroup the categories of educational levels that have fewer students with those with more students to eliminate the effect of sample size on these statistics and redo the analysis. We accept the null hypothesis that establishes independence between educational level and the assessment of the flipped classroom model by the students since the probability associated with these statistics is higher than the level of significance of 5% (Annex 2). In addition, it can be deduced that there is independence between educational level and the assessment of the flipped classroom model by the students, which allows us to accept hypothesis 2, which establishes that students' perception of the flipped classroom is positive regardless of the educational level.

Table 3. Valuation of the flipped classroom model by students (4 educational levels)

		VALUATION OF STUDENTS				
		Excellent	**Very good**	**Good**	**Unsatisfactory**	**Total**
EDUCATIONAL LEVEL	**Master's**	1	5	3	1	10
		10%	50%	30%	2%	100%
	Undergraduate	19	28	15	3	65
		29%	43%	23%	5%	100%
	Baccalaureate	2	9	4	4	19
		11%	47%	21%	21%	100%
	Vocational Training	6	6	2	0	14
		43%	43%	14%	0%	100%
	Total	28	48	24	8	108
		26%	45%	22%	7%	100%

Source: own elaboration.

Note: the first rows of each educational level show the number of students and the second shows the percentage of the number of students on the total of that educational level.

Thirdly and with respect to the assessment of ICT tools by students in the teaching-learning process, contingency Table 4 shows that the majority of university and vocational training students and almost half of the baccalaureate students prefer a more autonomous type of learning with ICT resources than a more directed learning. Therefore, it can be deduced that the majority of students at all university levels have valued the use of ICT resources in the teaching-learning process in a very positive way.

To contrast this association or dependence between educational level and the assessment of ICT resources in the teaching-learning model, an analysis of contingency Table 4 was carried out. In this case, we accept the null hypothesis that establishes independence between educational level and the assessment of the most autonomous form of learning with ICT resources by students since the probability associated with these statistics is higher than the level of significance of 5% (Annex 3). Therefore, it can be deduced that there is independence between educational level and the valuation of the most autonomous form of learning with ICT resources by the students. Thus, we can accept hypothesis 3, which establishes that there is an independency relationship between level education and the preference of students for a more autonomous form of learning with ICT resources.

Table 4. Student assessments of learning with ICT resources (4 educational levels)

		MOST VALUED LEARNING BY STUDENTS		
		More autonomous with ICT resources	**More directed**	**Total**
EDUCATIONAL LEVEL	**Master's**	7	3	10
		70%	30%	100%
	Undergraduate	55	38	93
		59%	41%	100%
	Baccalaureate	10	11	21
		48%	52%	100%
	Vocational Training	10 67%	5 33%	15 100%
	Total	82	57	139
		26%	45%	100%

Source: own elaboration.

Note: the first rows of each educational level show the number of students and the second shows the percentage of the number of students on the total of that educational level.

Finally and with regard to the frequency of use of ICT resources in the teaching-learning process, contingency Table 5 shows that the majority of university students and almost half of non-university students used ICT tools daily in their process of teaching-learning. Therefore, it follows that the majority of students at all university levels frequently use ICT resources in their teaching-learning process.

Table 5. Frequency of use of ICT resources by students (4 educational levels)

		FREQUENCY OF USE OF ICT RESOURCES			
		Daily	**Weekly**	**Every two weeks**	**Total**
EDUCATIONAL LEVEL	**Master's**	7	1	2	10
		70%	10%	20%	100%
	Undergraduate	63	27	3	93
		68%	29%	3%	100%
	Baccalaureate	9	10	2	21
		43%	48%	9%	100%
	Vocational Training	7 47%	6 40%	2 13%	15 100%
	Total	86	44	9	139
		62%	32%	6%	100%

Source: own elaboration.

Note: the first rows of each educational level show the number of students and the second shows the percentage of the number of students on the total of that educational level.

To compare this association or dependency between the educational level and the frequency of use of ICT resources by students, contingency Table 5 is analyzed. Also, in this case is necessary to regroup the categories of educational levels that have fewer students with those with more students to eliminate the effect of sample size on these statistics and redo the analysis. In addition, the null hypothesis that establishes independence between educational level and the frequency of use of ICT resources by students is rejected since the probability associated with these statistics is lower than the 5% significance level (Annex 4). Therefore, it can be deduced that there is a dependency relationship between educational level and the frequency of use of ICT resources by students, which allows us to accept hypothesis 4, which establishes that the use of ICT resources is more intense in university students.

6. Conclusions

At the beginning of this article, the main objective was to test and compare if the academic results of student with the flipped classroom model improve with respect to the traditional model at different educational levels. In addition, the students' assessment of this teaching-learning model and the use of ICT was analyzed.

It can be concluded, based on the data used, that students in non-university levels (vocational training and baccalaureate) have obtained better academic results with the flipped classroom model than with the traditional one, while the opposite occurred for university students since the current undergraduate and masters students come from an educational system in which they were totally passive and where they limited themselves to listening to the teacher because their participation in the classroom was very limited. Meanwhile, the students of lower educational levels have already grown up and been trained in a more digitalized environment and are more adapted to new forms of learning based on a class with more audiovisual and technological content and one that is more innovative. The flipped classroom is, for them, a further extension of the gamification of content to which they are so accustomed and which they experience as challenging. In addition, since they use a form of technology that they have been brought up in, they do it with more enthusiasm than the university students. However, the students' assessment of the flipped classroom model has been very positive, regardless of the educational level to which the student belongs.

This flipped classroom model is closely related to the more autonomous learning process with ICT resources, and it has been found that most students prefer this type of learning to a more directed model, regardless of the level of education. In addition, the frequency of use of these ICT resources is higher in the case of university students since they are focused on deeper learning than non-university level students.

The flipped classroom model has allowed us to improve and consolidate the learning of our students. However, it should not be applied independently but in combination with the traditional model since the direct relationship with the teacher is key in certain subjects that are more practical and require more personalized support. We consider that "more theoretical" learning is more useful in the flipped classroom system, although "more practical" learning requires further personal tutelage and teaching by the teacher when doubts arise on the part of the students, especially in the development of problems. In addition, this experience has saved learning time due to the materials made available to students for study and assimilation. Indeed, the student comes to the classes with pre-formulated doubts and questions on specific aspects that he or she finds difficult.

This learning model could be extended to other subjects of the educational levels studied, as it is a model that combines online learning with classroom learning, becoming a tool for higher education in the future. Above all, it can be a useful tool for those subjects that require more dedication, as it facilitates students' understanding and facilitates repetition by means of videos and other available resources. However, it is recommended that the flipped classroom model be introduced gradually and in combination with the traditional model.

This teaching innovation experience has been very enriching for the participating teachers of different educational levels. It has allowed the exchange of opinions and experiences of teaching innovation in different educational levels since we have detected differences that have led us to reflect on the different academic results and opinions of students.

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Annex 1. Stata results of the hypothesis 1 test

Variable	Categories
EDUCATIONAL_LEVEL	2
MODEL	4
Product of Categories	8

Measures of Association	Value
Phi Coefficient	0.378695
Cramer's V	0.378695
Contingency Coefficient	0.354151

Test Statistics	df	Value	Prob
Pearson X2	3	22.22849	0.0001
Likelihood Ratio G2	3	22.50385	0.0001

Note: Expected value is less than 5 in 25.00% of cells (2 of 8).

Count % Row		MODEL (Students with better academic results in each teaching-learning model)				
		Flipped classroom	Traditional	Indifferent	Not attended	Total
EDUCATIONAL_LEVEL	Universitary	30	57	12	14	113
		26%	51%	11%	12%	100%
	Non-universitary	28	7	3	4	42
		67%	17%	7%	9%	100%
	Total	58	64	15	18	155
		37%	41%	10%	12%	100%

Annex 2. Stata results of the hypothesis 2 test

Variable	Categories
EDUCATIONAL_LEVEL	2
VALUATION	4
Product of Categories	8

Measures of Association	Value
Phi Coefficient	0.130434
Cramer's V	0.130434
Contingency Coefficient	0.129338

Test Statistics	df	Value	Prob
Pearson X2	3	1.837403	0.6068
Likelihood Ratio G2	3	1.737798	0.6286

Note: Expected value is less than 5 in 12.50% of cells (1 of 8).

Count % Row		VALUATION (valuation of the flipped classroom model by students)				
		Excellent	Very good	Good	Unsatisfactory	Total
EDUCATIONAL_LEVEL	Universitary	20	33	18	4	75
		27%	44%	24%	5%	100%
	Non universitary	8	15	6	4	33
		24%	46%	18%	12%	100%
	Total	28	48	24	8	108
		26%	45%	22%	7%	100%

Annex 3. Stata results of the hypothesis 3 test

Variable	Categories		
EDUCATIONAL_LEVEL	4		
APRENDIZAJE	2		
Product of Categories	8		
Measures of Association	Value		
Phi Coefficient	0.119645		
Cramer's V	0.119645		
Contingency Coefficient	0.118798		
Test Statistics	df	Value	Prob
Pearson X2	3	1.989775	0.5745
Likelihood Ratio G2	3	1.963900	0.5732

Note: Expected value is less than 5 in 12,50% of cells (1 of 8),

Count / % Row		LEARNING (most valued learning by students)		
		More autonomous with ICT	More directed	Total
EDUCATIONAL_LEVEL	Master	7	3	10
		70%	30%	100%
	Degree	55	38	93
		59%	41%	100%
	Baccalaureate	10	11	21
		48%	52%	100%
	Vocational Training	10	5	15
		67%	33%	100%
	Total	82	57	139
		59%	41%	100%

Annex 4. Stata results of the hypothesis 4 test

Variable	Categories		
EDUCATIONAL_LEVEL	2		
ICT_USE	3		
Product of Categories	6		
Measures of Association	Value		
Phi Coefficient	0.310803		
Cramer's V	0.310803		
Contingency Coefficient	0.296798		
Test Statistics	df	Value	Prob
Pearson X2	2	14,39316	0.0007
Likelihood Ratio G2	2	14,40014	0.0007

Note: Expected value is less than 5 in 16,67% of cells (1 of 6).

Count / % Row		ICT_USE (frequency of use of ICT resources)			
		Daily	Weekly	Biweekly	Total
EDUCATIONAL_LEVEL	Universitary	70	28	5	103
		67%	27%	5%	100%
	Non-universitary	16	26	4	46
		35%	56%	9%	100%
	Total	86	54	9	149
		58%	36%	6%	100%