Evaluation of online training based on the Flipped classroom-based model

Evaluación de una formación *online* basada en *Flipped classroom*

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Abstract

This research analyses the effectiveness of the flipped classroom pedagogical model on the performance and satisfaction of future teachers studying towards a master's degree in teacher training in a completely online environment. It uses a quantitative methodology with a quasi-experimental design and a non-equivalent control group. The control group comprises 103 students and the experimental group 119. The academic performance of both groups before and after the intervention is compared through a knowledge questionnaire and evaluation of the results of their learning throughout the semester. In addition, it considers their opinions on the experience through a satisfaction questionnaire at the end of the course. Although both groups display equivalent levels of knowledge at the pretest stage, we found differences upon completion of the intervention, where the experimental group achieved higher levels, with a medium effect size (r = 0.66). The activities used to evaluate the results of the learning show the existence of statistically significant differences, with higher mid-ranges in the experimental group in all activities, with a very large effect size in three of

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them (r = 0.89, r = 0.90, and r = 0.96) and large in another (r = 0.68). In relation to the students' degree of satisfaction with the process that was implemented, all of the dimensions analysed have scores above 3.56 (on a scale of 1 to 4). We observed a highly positive effect after implementing the flipped classroom model with improved student learning, both in performance and in motivation, commitment, and interaction between students and teacher. We conclude that there is a need to incorporate the flipped classroom model in the initial training of teaching staff.

Key words: Flipped classroom, collaborative learning, performance factors, higher education, virtual classroom.

Resumen

En esta investigación se analizan los efectos del modelo pedagógico *Flipped classroom* en el rendimiento y la satisfacción de futuros docentes, estudiantes del Máster de formación de Profesorado, en un entorno íntegramente *online*. Se sigue una metodología cuantitativa con un diseño cuasiexperimental con grupo control no equivalente. El grupo control está constituido por 103 estudiantes y el experimental por 119. Se compara el rendimiento académico de ambos grupos, antes y después de la intervención, con un cuestionario de conocimientos y valorando los resultados de su aprendizaje a lo largo del semestre. Además, se ha estudiado su opinión sobre la experiencia realizada mediante un cuestionario de satisfacción al finalizar la asignatura. Los grupos parten de un nivel de conocimientos equivalente en el pretest y se han encontrado diferencias al finalizar la intervención, donde el grupo experimental obtiene unos niveles mayores, siendo el tamaño del efecto medio (r=0,66). Las actividades utilizadas para valorar los resultados de aprendizaje muestran la existencia de diferencias estadísticamente significativas, siendo los rangos promedio mayores en el grupo experimental en todas las actividades, con un tamaño de efecto muy grande en tres de ellas (r=0,89, r=0,90 y r=0,96) y grande en otra (r=0,68). En relación con el grado de satisfacción del alumnado con la experiencia desarrollada, todas las dimensiones analizadas obtienen puntuaciones superiores a 3,56 (en una escala de 1 a 4). Tras la implementación del modelo *Flipped classroom* se ha determinado un efecto altamente positivo en la mejora del aprendizaje del alumnado, tanto en el rendimiento, como en la motivación, el compromiso y la interacción entre estudiantes y docente. Se concluye la necesidad de incorporar el modelo *Flipped classroom* en la formación inicial del profesorado.

Palabras clave: Flipped classroom, aprendizaje colaborativo, rendimiento académico, educación superior, aula virtual.

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Introduction

One of the fundamental pillars of the quality of a country's educational system is the initial training of future teachers (Murray, Durkin, Chao, Star, & Vig, 2018). For this training to be effective it must integrate theoretical, pedagogical, and practical knowledge (Council of the European Union, 2014).

In Spain, future secondary, baccalaureate, professional training, and language teachers have to complete a one-year master's degree (60 ECTS credits) after their bachelor's studies, which, as shown by the results of the TALIS report (*Teaching and Learning International Survey*), does not provide the necessary level of pedagogical and practical training for working as a teacher (Ministerio de Educación, Cultura y Deporte, 2014).

The need to give students a leading role and for them to be actively involved in their learning has become established as the main assumption of learning in the 21st century, to which we can add the use of information and communication technology (ICT). It is, therefore, vital that future teachers experience the advantages of active learning in their initial training, becoming the central figures in their learning, which is guided and supported by the teacher (Martín & Santiago, 2016; Romero-García, Buzón-García, & Tourón, 2019).

Consequently, the flipped classroom model is especially interesting as it combines the main trends in education: active learning and the use of digital technology.

The flipped classroom is, on the whole, a pedagogical model that is opposed to the traditional transmission-reception teaching model, in both space and time as it moves direct instruction out of the classroom, into what it refers to as "individual space", while it uses class time, also called "group space", for solving problems and applying the learning content (Flipped Learning Network, 2014).

The systematisation of the flipped classroom model is due to the Americans Jonathan Bergmann and Aaron Sams who, in 2006, started recording their classes at Woodland Park High School (Colorado) and publishing them online for students who for various reasons had been unable to attend class (Bergmann & Sams, 2012). This is how the flipped classroom was born: content is presented ahead of the face-to-face class in an autonomous learning space, through short videos, audio recordings, readings, and other media, which students review as preparatory work for the class. The face-to-face class then focusses on dynamic and interactive activities, which are mainly cooperative and which use the content the students have previously covered, and the teachers resolve doubts and guide the students in their learning process. In this way, teachers can personalise teaching and respond in an individualised way to the obstacles that hinder the students' learning.

In 2014, the Flipped Learning Network (FLN) defined flipped learning as a pedagogical focus in which direct instruction moves from the group learning space to the individual learning space, making the classroom a space for dynamic and interactive learning where the teacher guides students on how to apply the concepts they learn engaging themselves creatively in the subject matter.

The foundation of this methodological focus is based on enhancing the time students spend in the physical classroom to resolve problems, interact with their classmates and the teacher, and consider content in greater depth (Bergmann & Sams, 2012), always on the basis of their prior knowledge (Zainuddin & Halili, 2016). The foundations of the flipped classroom focus on use of digital platforms and materials, created or selected by the teacher (Long, Cummins, & Waugh, 2017; López Belmonte, Pozo Sánchez, & Del Pino Espejo, 2019) and used by students before coming to class (Abeysekera & Dawson, 2015; Long *et al.*, 2017).

Therefore, the flipped classroom model features an inversion of learning moments compared with the traditional methodology, as content can be viewed and taught outside of the conventional class and so class time can be used to increase interactions between the teacher, the students, and the content (López Belmonte *et al.*, 2019, Mengual Andrés, López Belmonte, Fuentes Cabrera, & Pozo Sánchez, 2020).

This is an integrated learning focus that combines direct instruction with constructivist methods and activities to involve students and engage them with the course content and improve their conceptual comprehension (Tourón & Santiago, 2015). When applied successfully, it supports all of the phases in a learning cycle like that suggested by Bloom' taxonomy (Anderson & Krathwhol, 2001). Students work on the lower-order thinking skills from Bloom's taxonomy at home ahead of class, and class time is then used for doing collaborative activities working on the higher-order thinking skills from Bloom's taxonomy.

To implement flipped learning, teachers must incorporate the following four pillars in their teaching practice (FLN, 2014): 1) a flexible

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environment, reconfiguring the physical learning space, encouraging collaborative or individual work, and ensuring each student has flexible expectations of the learning sequence and the evaluation of the learning; 2) learning culture, responsibility for instruction moves towards a student-centred focus, using time in class to create richer learning experiences and ensure students are actively involved in the construction of knowledge while they evaluate and participate in their own learning; 3) intentional content, teachers create or select accessible and relevant content for all of the students; 4) a professional educator, during class time, the teacher gives students ongoing and close monitoring, immediately providing relevant feedback and evaluating their work.

Various studies have reported the effectiveness of flipped learning compared with using traditional teaching methods. Indeed, it has been shown that the inversion of the traditional teaching and learning schemes and moments in flipped learning leads to an increase in students' motivation (Fuentes, Parra-González, López, & Segura-Robles, 2020; Tse, Choi, & Tang, 2019); improved attitude to learning (Lee, Park, & Davis, 2018); makes it possible to work on multiple intelligences, in both the individual and the group space (Santiago, 2019); promotes interaction, participation, and socialisation between the actors involved (Aguilera, Manzano, Martínez, Lozano, & Casiano, 2017; Castellanos, Sánchez, & Calderero, 2017; Chen, Wu, & Marek, 2017; Jong, Chen, Tam, & Chai, 2019; Kwon & Woo, 2018; Matzumura, Gutiérrez, Zamudio, & Zavala, 2018; van Alten, Phielix, Janssen, & Kester, 2019); at the same time as making it possible to cater for individual differences and encourage self-regulation of learning (Tse et al., 2019; Tourón & Santiago, 2015).

All of this has a positive influence on students' performance and the results obtained by students at various educational levels – from primary school to university (Arráez, Lorenzo, Gómez, & Lorenzo, 2018; Awidi & Paynter, 2019; Cheng, Ritzhautp, & Antonenko, 2018; Dehghanzadeh & Jafaraghaee, 2018; Espada, Rocu, Navia, & Gómez-López, 2020; Galindo, 2018; Gillette *et al.*, 2018; Hew & Lo, 2018; Hinojo, Mingorance, Trujillo, Aznar, & Cáceres, 2018; Hu *et al.*, 2018; Matzumura *et al.*, 2018; Sola, Aznar, Romero, & Rodríguez-García, 2019).

This wide range of advantages means that implementation of the flipped classroom model has increased at all educational levels in recent years (Lo, Lie, & Hew, 2018; Pérez, Collado, García, Herrero, & San Martín, 2019; Sola et al., 2019). In fact, its implementation in higher education is growing and teachers increasingly experiment with using it in class. This is not just because of its already proven benefits, but because the model is aligned with the principles that the European Higher Education Area (EHEA) promotes (Reyes, 2015), which not only require attaining the appropriate practical skills for the subject, but also acquiring theoretical knowledge through practical activities.

While it has been shown that flipped learning improves students' learning in face-to-face classes, there is little evidence regarding the use of this flipped teaching focus in fully online courses (Sacristán, Martín, Navarro, & Tourón, 2017).

The aim of this study is to evaluate the effects of the flipped classroom focus on the performance and satisfaction of future teachers, students on the "Curriculum Design" module on the Master's in Secondary Education, Baccalaureate, Professional Training, and Language Teacher Training at the Universidad Internacional de La Rioja (UNIR) in a fully online setting.

Method

In this research we used a quantitative methodology with a quasiexperimental design and a non-equivalent control group.

Sample

We used non-probability convenience sampling as we carried out the experiment in the groups the researchers taught. The sample comprised students from the Curriculum Design module in the Biology and Geology and Mathematics specialisms of the Master's in Secondary and Baccalaureate Teacher Training in the Faculty of Education of an online university during the 2018-2019 academic year. The total number of participants in the sample was 222 from a population of 393, who were informed of the research in which they were going to participate and in which their anonymity was guaranteed. All of them agreed to take part.

The participants formed two different groups: the experimental group, in which the flipped classroom model was implemented and the control with which a traditional or transmission-reception model was used. The control group comprised 103 students, 47.6 % female and 52.4 % male,

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with a mean age of 25 to 35 years and the experimental group comprised 119 students, 61.7 % female and 38.3 % male with a mean age of 25 to 35 years. Regarding previous teaching experience, 62.4 % of the students had none, 16.8 % had less than 1 year, 16 % had between 1 and 3 years, and 4.8 % had over 5 years' experience.

The variable being studied after the intervention was students' academic performance, measured by carrying out a knowledge test and by the scores from four activities selected as a learning outcome and evaluated using a rubric. We also analysed the students' satisfaction with the flipped classroom model.

Instruments

We designed a test of knowledge of the subject which we applied before and after the intervention with the intention of measuring the impact of the flipped classroom model on academic performance and determining the homogeneity of the control group and experimental group, in other words, whether they started from the same level of knowledge of the content. In addition, this test established whether there were differences in knowledge between the control group and the experimental group at the end of the experiment. The knowledge test consisted of 30 questions with four answer options and was marked out of a total of 30 points. Analysis of the reliability of the instrument gave a Cronbach's alpha value of 0.835, and so we considered that the instrument displayed adequate reliability (Nunnally, 1978).

We also analysed the scores in four learning activities. The students did these activities outside of class, either individually or in groups. Activity 1 was done individually and involved selecting a competence and suggesting a series of activities for working on it. In activity 2, the students in groups of 4-6, had to simulate a departmental meeting to reach agreements prior to drawing up a unit plan. Activities 3 and 4 were individual and involved drawing up a unit plan and developing one of the teaching units proposed in the plan.

We evaluated the activities using rubrics with an *ad hoc* design. Firstly, expert reviewers provided a validation process of the content of the rubrics including quantitative and qualitative evaluation. Validation by experts has shown its efficacy in the design of instruments from various areas, including the social sciences (Adams & Wieman, 2010; Adams *et al.*, 2006). For each indicator, the experts evaluated the clarity of the wording, its relevance, and whether the levels of achievement and points assigned to each of them was appropriate. The evaluation used a Likert-type scale (1 Strongly disagree, 2 Disagree, 3 Agree, 4 Strongly agree). Each indicator had a section for comments. For all of the indicators, and in each category evaluated, there was 100 % agreement in the valuations the three experts issued.

Subsequently, we determined the degree of agreement between the evaluations by two teachers who evaluated the activities of the same group of students (Weir, 2005). The index we used for measuring the degree of agreement was the intraclass correlation coefficient (ICC), which gives a figure ranging from 0 to 1. Values close to 1 indicate a high level of agreement and, therefore, shows that the teachers evaluated all of the students with very similar marks. The ICC for activities 1, 2, and 4 was very high and indicated almost perfect agreement. For activity 3 it was slightly lower but can be regarded as a very good value. In all cases the values were significant (Table I). The rubrics designed were considered to be a reliable evaluation instrument.

TABLE I. Reliability study of activity evaluation instruments

	Activity 1	Activity 2	Activity 3	Activity 4
ICC	0.956	0.985	0.886	0.951
p	0.000	0.000	0.000	0.000
N	10	10	10	10

Source: Own elaboration

To determine students' satisfaction with their experience in the virtual classroom, we designed an *ad-hoc* questionnaire. This instrument comprised seven different dimensions. The first consisted of questions intended to establish the sample's sociodemographic data. The other six comprised a varying number of items referring to content presentation, planning, learning, evaluation, interaction with the group, and the training received. Each item was evaluated using a Likert-type scale (1 Totally disagree, 2 Disagree, 3 Agree, 4 Totally agree). We analysed the

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instrument's reliability, obtaining a Cronbach's alpha figure of 0.862 for content presentation, 0.839 for planning, 0.894 for learning, 0.769 for evaluation, 0.769 for interaction with the group, and 0.701 for training received. At a global level, the instrument obtained a Cronbach's alpha of 0.980, and so we can consider that the instrument has adequate reliability.

We prepared the questionnaires using *Google Forms* and shared them with the students through the teacher-student communication forum in the learning platform normally used. We also used this platform to share the rubrics with the students.

Procedure

At the start of the module, we measured the level of knowledge of the students in the control group and experimental group (pretest). After collecting the data, we implemented the intervention with the aim of improving learning and then performed another evaluation (posttest). After implementing the intervention, we distributed the satisfaction questionnaire to discover the students' opinion of their experience during the semester and, at different moments, we evaluated the activities used as learning outcomes in both groups.

The experience was implemented in the Curriculum Design module in the Biology and Geology and Mathematics specialisms of the Master's in Secondary and Baccalaureate Teacher Training at an online university. The syllabus for both modules comprises 14 topics and was delivered in 15 live virtual sessions of 120 minutes duration each, which took place once a week, and 5 sessions of 60 minutes that were spread throughout the semester. The sessions were delivered synchronously in a virtual classroom using the *Adobe Connect* software, which enables the teacher to play video and audio, share the blackboard and material, exchange comments with students through an interactive chat function, and divide the class into independent breakout rooms that simulate the distribution into groups in a face-to-face class where each group works independently.

To implement the flipped learning model, we designed 20 sessions for working with the students in which the following teaching design was followed:

- We presented content and detected students' preconceptions using videos recorded by the lecturer and enriched with questions on the *Edpuzzle* platform or documents shared with the students using the *Perusall app*.
- All of the sessions included synchronous online collaborative activities supported by different digital tools to put the theoretical content into practice. The purpose of the activities designed was to enable the students to learn how to draw up a unit plan applying current educational legislation.
- At the end of the session, each group's work was shared in a plenary session with commentary on corrections to each piece of work so that all of the students could see their classmates' work and consider possible improvements.

In the control group, the time in the live virtual sessions was used to explain the content of each of the topics in the module. No activities were done in the virtual classroom. The students had to submit as learning outcomes the same activities as the students who were in the experimental group.

Firstly, to check whether the data on academic performance obtained followed a normal distribution, we used the Kolmogorov-Smirnov and Shapiro-Wilk tests. Secondly, and following on from the previous test, we used non-parametric tests to analyse the data relating to academic performance. Specifically, we used the Mann-Whitney U test to determine whether there were differences in the level of knowledge, both in the pretest and in the posttest and in the grades for the activities between the control group and the experimental group at the end of the intervention. This test compares the ranges of the groups and this range is a transformation of the original scale of the variables of results (test of knowledge and marks for activities). The values are ordered from highest to lowest to provide an ordinal distribution. For example, the student with the lowest score is assigned value 1, the next student 2, and so on. and once they have been put in order, the mid-ranges for each group are compared. Therefore, a higher mid-range, is equivalent to a higher score by the group. We organised, codified, and analysed the data using the SPSS 24.0 statistics package.

Results

We first compared the control and experimental groups to ensure they were starting from an equivalent level of knowledge, in other words, that they had the same level of knowledge before the intervention. After analysing the data obtained from the knowledge questionnaire (Table II), we found that at the start of the experiment (pretest) the control group had a mean score of 16.76 points while the experimental group had a mean score of 15.38. After the intervention (posttest), the mean for the control group was 19.75 points, and that of the experimental group was 25.34 points.

TABLE II. Pretest-posttest statistical data for the control and experimental groups

GROUP		*N*	Minimum	Maximum	Mean	Standard deviation
Pretest_Total	CONTROL	21	11.00	27.00	16.76	0.761
	EXPERIMENTAL	115	5.00	23.00	15.38	0.347
Posttest_Total	CONTROL	16	14.00	26.00	19.75	0.955
	EXPERIMENTAL	50	19.00	29.00	25.34	0.335

Source: Own elaboration

We used the Kolmogorov-Smirnov test with the Lillefors test and the Shapiro-Wilk test to test for a normal distribution in the scores from the knowledge questionnaire (Table III). The values for the pretest were 0.918 (p = 0.079) for the control group and 0.982 (p = 0.116) for the experimental group, while for the posttest, the values were 0.949 (p = 0.478) for the control group and 0.907 (p = 0.001) for the experimental group. These results showed that the posttest data in the experimental group did not have a normal distribution, as $p < 0.05$. Consequently, we used non-parametric statistics to compare the results.

TABLE III. Normality test of the prior knowledge pretest for the control and experimental groups

GROUP		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Pretest_Total	CONTROL	0.166	21	0.137	0.918	21	0.079
	EXPERIMEN-TAL	0.070	115	0.200	0.982	115	0.116
Posttest_Total	CONTROL	0.117	16	0.200	0.949	16	0.478
	EXPERIMEN-TAL	0.210	50	0.000	0.907	50	0.001

Source: Own elaboration

We used the Mann-Whitney U test (Table IV), finding that for the pretest $z = -1.339$ ($p = 0.181$) and for the posttest $z = -4.662$ ($p = 0.000$). The results showed that there were no initial (pretest) differences between the groups (experimental and control) but that there were in the posttest, where the experimental group had a mid-range of 39.66 compared with the control group's mid-range of 14.25. The mid-range was therefore higher in the experimental group, with a large effect size (r = 0.66) (Tomczak & Tomczak, 2014).

TABLE IV. Mid-range for the pretest-posttest

GROUP		*N*	Mid-range	Sum of ranges	Z	Asymp-totic sig. (2-sided)	Effect Size
Pretest_To-tal	CONTROL	21	79.05	1660.00	-1.339	0.181	
	EXPERIMEN-TAL	115	66.57	7656.00			
Posttest_To-tal	CONTROL	16	14.25	228.00	-4.662	0.000	0.66
	EXPERIMEN-TAL	50	39.66	1983.00			

Source: Own elaboration

To analyse the impact of the programme on students' performance, we took the grades they obtained after doing four activities and analysed

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the difference between the control group and the experimental group. We used the Kolmogorov-Smirnov test to check whether the scores had a normal distribution (Table V). These results showed that the posttest data in the experimental group did not have a normal distribution, as $p < 0.05$. Consequently, we used non-parametric statistics to compare the results.

TABLE V. Test of normality for the activities completed by the control and experimental groups

GROUP		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Activity 1	CONTROL	0.126	56	0.027	0.944	56	0.011
	EXPERIMENTAL	0.229	91	0.000	0.792	91	0.000
Activity 2	CONTROL	0.114	56	0.066	0.932	56	0.004
	EXPERIMENTAL	0.247	91	0.000	0.719	91	0.000
Activity 3	CONTROL	0.082	56	0.200	0.973	56	0.234
	EXPERIMENTAL	0.215	91	0.000	0.817	91	0.000
Activity 4	CONTROL	0.097	56	0.200	0.912	56	0.001
	EXPERIMENTAL	0.226	91	0.000	0.818	91	0.000

Source: Own elaboration

Therefore, we used the Mann-Whitney U test (Table VI), which for activity 1 gave $z = -9.480$ ($p = 0.000$), for activity 2 $z = -9.353$ ($p = 0.000$), for activity 3 $z = -10.356$ ($p = 0.000$), and for activity 4 $z = -6.528$ ($p = 0.000$).

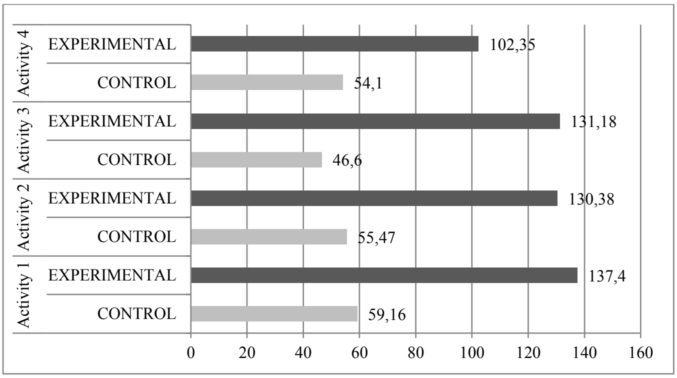
TABLE VI. Mid-ranges for the four activities performed

GROUP		*N*	Mid-range	Sum of ranges	z	Asymptotic sig. (2-sided)	Effect Size
Activity 1	CONTROL	91	59.16	5384.00	-9.480	0.000	0.89
	EXPERIMENTAL	113	137.40	15526.00			
Activity 2	CONTROL	86	55.47	4770.00	-9.353	0.000	0.90
	EXPERIMENTAL	107	130.38	13951.00			
Activity 3	CONTROL	78	46.60	3635.00	-10.356	0.000	0.96
	EXPERIMENTAL	115	131.18	15086.00			
Activity 4	CONTROL	70	54.10	3787.00	-6.528	0.000	0.68
	EXPERIMENTAL	92	102.35	9416.00			

Source: Own elaboration

These results show the existence of statistically significant differences in the four activities, with the mid-ranges being higher in the experimental group in all of the activities (Figure I), with a very large effect size in activity 1 ($r = 0.89$), activity 2 ($r = 0.90$), and activity 3 ($r = 0.96$), and a large effect size in activity 4 ($r = 0.68$).

FIGURE I. Mid-range of the activities done in the control group and experimental group



Source: Own elaboration

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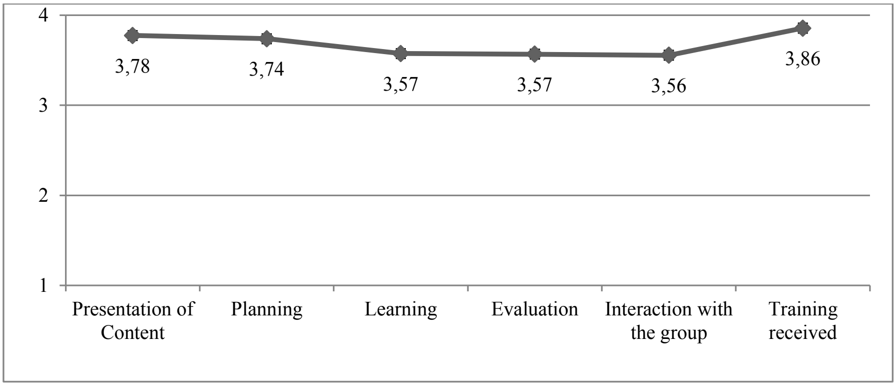
In relation to the experimental group's level of satisfaction with the experience, we analysed six dimensions: content presentation, planning, learning, evaluation, interaction with the group, and training received.

As Figure II shows, all of the dimensions scored higher than 3.56 (on a scale of 1 to 4). The dimensions the students valued most highly were those referring to *training received* (3.86) and *presentation of content* (3,78).

FIGURE II. Means of all dimensions analysed



Source: Own elaboration

With regards to the first dimension, *presentation of content* and as can be seen in Figure III, all of the items that make up this dimension exceeded the value of 3.5 (on a scale of 1 to 4), the best valued items being: *the teacher tells the students the objectives of the topics that will be covered* (3.87), *the teacher presents key questions relating to the objectives of the topic to catch the students' attention* (3.8), and *the teacher relates the theoretical knowledge to the activities* (3.84).

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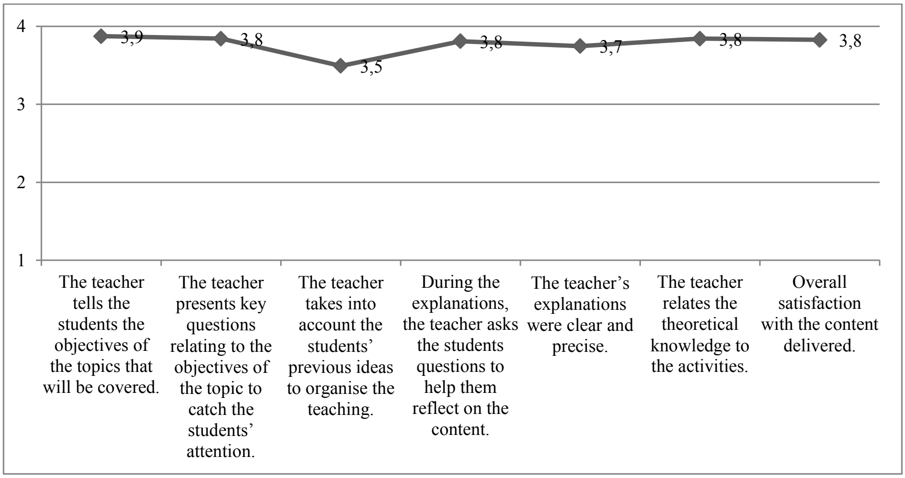
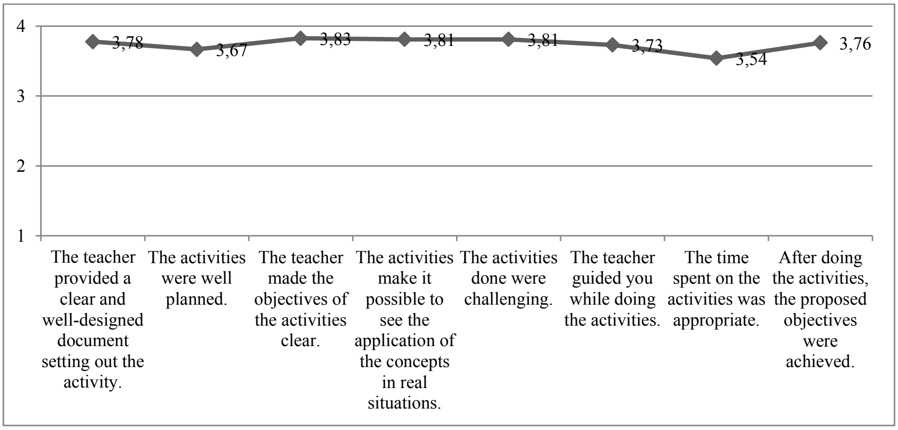
FIGURE III. Means of items from the content presentation dimension



Source: Own elaboration

With regards to the second dimension, *planning* (Figure IV), all of the items exceeded the value of 3.5, with the highest valued items being: *the teacher made the objectives of the activities clear* (3.83), *the activities make it possible to see the application of the concepts in real situations* (3.81), and *the activities done were challenging* (3.81).

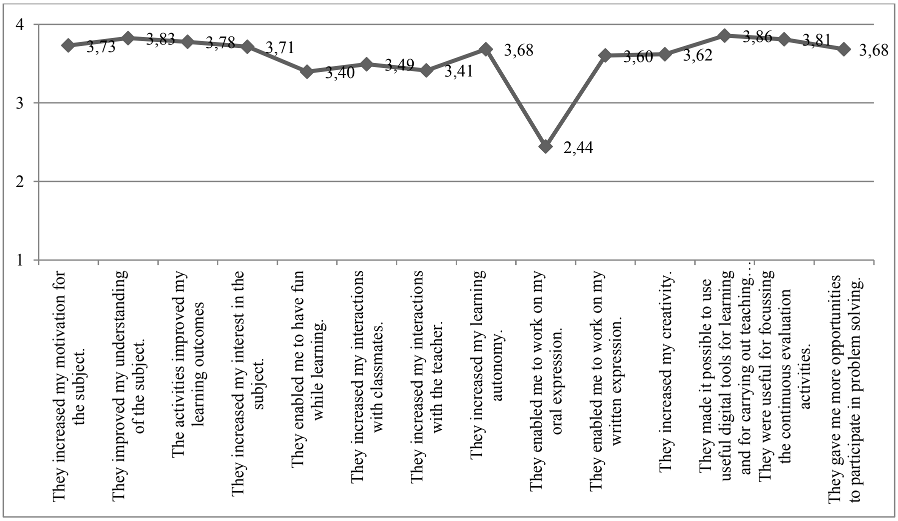
FIGURE IV. Means of items from the planning dimension



Source: Own elaboration

The third dimension relates to whether the design of the activities helped the students in their *learning*. As Figure V shows, in this dimension the items with the highest scores were: *the activities made it possible to use useful digital tools for learning and for carrying out teaching work* (3.86), and *the activities improved my understanding of the module* (3.83).

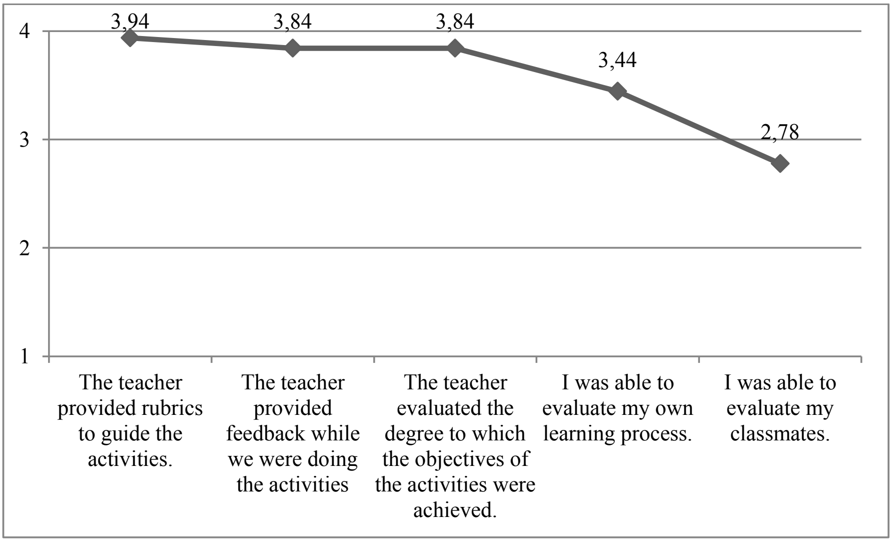
FIGURE V. Means of items from the activities dimension



Source: Own elaboration

Another dimension analysed was *evaluation* (Figure VI). The results obtained showed that the items with the highest scores are those relating to: *the teacher provided rubrics to guide the activities* (3.94), *the teacher provided feedback while we were doing the activities* (3.84), and *the teacher evaluated the degree to which the objectives of the activities were achieved* (3.84).

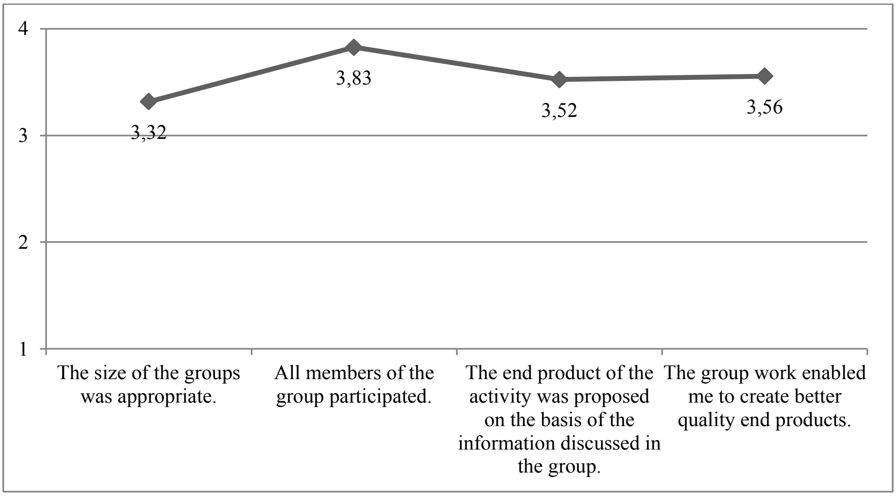
FIGURE VI. Means of items from the evaluation dimension



Source: Own elaboration

In the fifth dimension, *interaction with the group*, all of the items exceeded the mean of 3.32 (Figure VII). The items that achieved the highest scores were those relating to *all members of the group participated* (3.83) and *the group work enabled me to create better quality end products* (3.56).

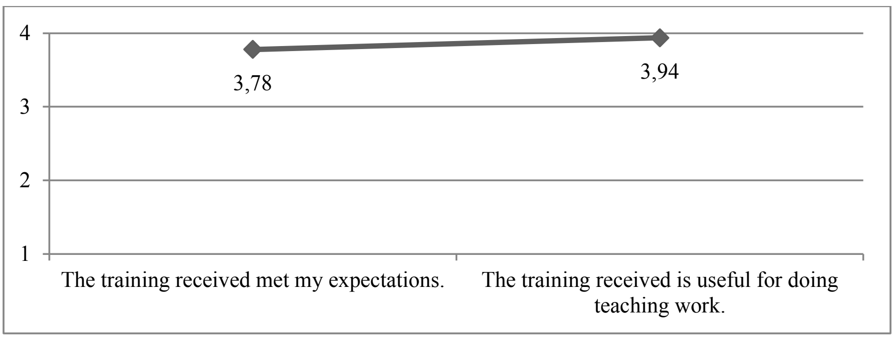
FIGURE VII. Means of items from the interaction with the group dimension



Source: Own elaboration

Finally, the sixth dimension analysed related to *training received* (Figure VIII). In this sense, we should note that the students felt that *the training received is useful for doing teaching work* (3.94) and that *the training received met their expectations* (3.78).

FIGURE VIII. Means of items from the training received dimension



Source: Own elaboration

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Conclusions

In this work we present the results of an intervention in which we implemented the flipped classroom pedagogical model in a virtual class for training future teachers. The instruction provided incorporated the four pillars proposed by the FLN (2014), making the classroom space flexible and inverting the learning stages.

After implementing the model, we observed a very positive effect with regards to improvements in students' learning, as they obtained better grades than those who learnt in a traditional model. Similar results are found in other works that show the effectiveness of the flipped classroom model in higher education (Espada *et al.*, 2020; Matzumura *et al.*, 2018). The meta-analysis by Sola *et al.* (2019) on the implementation of the model in different subjects and educational levels, with quasiexperimental designs similar to those used in this work, concludes that the flipped model improves the academic performance of students assigned to the experimental group. Focussing on higher education, the meta-analysis by Zheng et al. (2020) includes 78 studies in which the model's positive effect on academic performance is apparent. In this regard, Mengual-Andrés *et al.* (2020) state that the activities are a basic pillar for the potential improvement in learning resulting from the flipped classroom model. The studies by Fuentes *et al.* (2020) and Wai *et al.* (2019) also attribute to the inversion of the learning phases an increase in motivation that might have a positive influence on the results obtained by the students (Arráez, Lorenzo, Gómez & Lorenzo, 2018; Mengual-Andrés, 2020). Furthermore, the results presented highlight the efficiency of an integral learning focus that directly involves students in the course content and which, when applied successfully, results in an improvement in their conceptual understanding, as Martín and Santiago (2016) and Tourón and Santiago (2015) note. Nonetheless, it is worth noting that some studies do not find differences in the grades of students who studied with the flipped classroom model (Gillette *et al.*, 2018).

Focussing on student satisfaction, a very positive evaluation is apparent of those aspects regarded as key in the design of instruction to obtain good results in students' learning, such as content presentation, design of activities, motivation, and participation in the learning and evaluation process. Numerous works agree that flipped instruction promotes interaction, participation, and socialisation between the agents involved (Aguilera *et al.*, 2017; Jong, Chen, Tam & Chai, 2019; Van Alten, Phielix, Janssen, & Kester, 2019) while at the same time making it possible to react to individual learning needs. In this line, the students valued very positively the feedback provided by the teacher during the activities to meet the specific needs of each student, favouring self-regulation of learning and ultimately a meaningful learning, as Tourón and Santiago (2015) and Tse *et al.* (2019). In contrast, appropriate design of the learning activities and preliminary work in order to cover them in class is presented as a key factor that affects the encouragement of motivation and determines the students' perception of the efficacy of the flipped model and their satisfaction with it (Pérez *et al.*, 2019; Prieto & Giménez, 2020).

Although numerous works report advantages of this model with regards to students' motivation and attitude and improvements in their performance, there is less evidence for its effectiveness in completely online teaching models, and in studies where the model is implemented in online teaching, it is not applied in synchronous virtual sessions, with the exception of the work by Sacristán *et al.* (2017) in which they conclude that there is also an increase in students' academic performance and satisfaction.

According to the TALIS report, the use of models in which aspiring teachers are actively engaged in students' learning process and take responsibility for it is necessary as a way to achieve appropriate pedagogical training to underpin their teaching practice. It is important to have teachers who are trained in constructivist models like the flipped classroom, but can future teachers to understand a model they have not experienced? The study by López Belmonte *et al.* (2019) on the implementation of this model in different educational centres shows that teachers, even when they are familiar with the model, display shortcomings relating to digital skills when implementing it in the classroom as well as misgivings regarding innovative practices. The results of the present work enable us to support ideas from other studies, which find that experiencing the advantages of learning under this model, in which students are the true protagonists of the learning process under the guidance and direction of the teacher, might lead to the use of this model in class (Martín & Santiago, 2016).

In conclusion, the flipped classroom model applied in a virtual classroom has positive effects. It has permitted better performance by

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students and an improvement in their perception of their learning. It increased motivation and engagement, encouraging interactions between classmates and the perception of the teacher's role as a learning guide in the classroom. The study by Zainuddin and Halili (2016) displays similar results after analysing twenty works on experiences of the implementation of the flipped model in different subjects and at different educational levels.

Some of the limitations encountered relate to the size of the sample used in this study, and so it would be interesting to repeat this experiment and apply the model in other modules on the master's to corroborate the results provided by this result.

Ultimately, taking into account the 21st century trend towards educational models that focus on students' learning and in view of the results presented, the flipped classroom model should be incorporated in initial teacher training and it is important to continue to examine in greater depth its effects on teaching skills.

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