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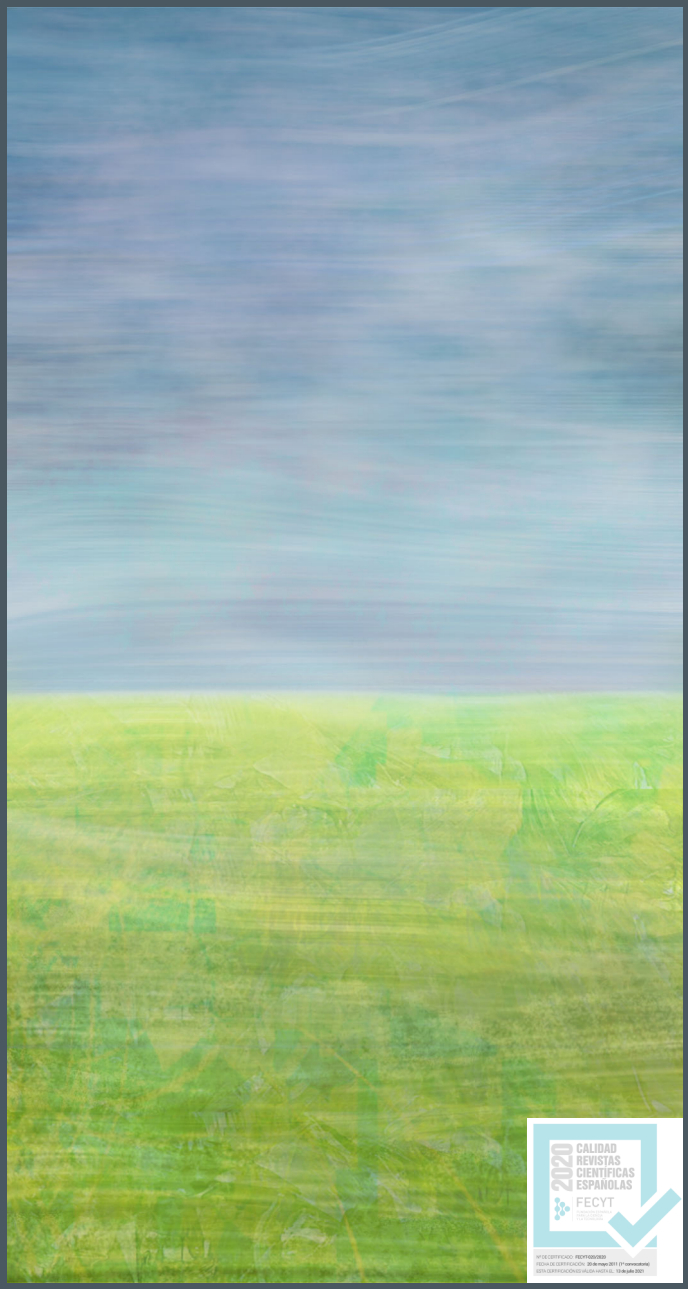

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Presentation

Revista de Educación is a scientific journal published by the Ministerio de Educación, Cultura y Deporte. Founded in 1940, and since 1952 called *Revista de Educación*, it has been a privileged witness of the development of education in the last decades, and an acknowledged means for the dissemination of education research and innovation, both from a national and international perspectives. It is currently assigned to the Instituto Nacional de Evaluación Educativa within the Dirección General de Evaluación y Cooperación Territorial and it is published by the Subdirección General de Documentación y Publicaciones of the Ministerio de Educación, Cultura y Deporte.

Each year we publish four issues. Starting next issue (No. 361), the magazine will have three sections: Research, Essays and Education Experiences, all of them submitted to referees. In the first issue of the year there is also an index of bibliography, and in the second number a report with statistic information about the journal process of this period and the impact factors, as well as a list of our external advisors.

From 2006 to the second number of 2012 (May-August 358), *Revista de Educación* was published in a double format, paper and electronic. The paper edition included all the articles in the especial section, the abstracts of articles pertaining to the rest of sections, and an index of reviewed and received books. The electronic edition contains all articles and reviews of each issue, and it is available through this web page (www.mecd.gob.es/revista-de-educacion/), where it is possible to find more interesting information about the journal. From the 358 number *Revista de Educación* becomes exclusively an online publication.

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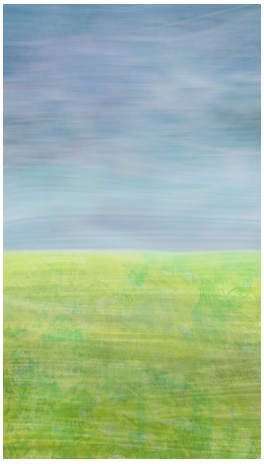

Monographic section

The flipped classroom model: a challenge for student-centered teaching

Javier Tourón
Universidad Internacional de La Rioja (UNIR)

The proposals for changes and improvements in the education system are becoming more and more evident, as technological developments become more accessible due to their cost and simplicity of operation, it is true that they are not always based on evidence. Actions that are common today were unthinkable just a few decades ago; personal computing broke out in the eighties although in a very rudimentary way for the current standards; mobile devices are very recent, the possibilities of eLearning or mobile learning are almost unlimited. The current economic circumstances have only catalyzed this movement towards change and improvement.

But I do not think that change is necessary because health circumstances demand it. Change is necessary because the nature of the learning outcomes we need are different than in the past. It is no longer enough to know or memorize certain contents no matter how complex they are. Now, more than ever, it is necessary to know how to think deeply and creatively, to develop the critical capacity and the ability to solve problems, to know how to work in a team, to communicate effectively, to be technologically literate, etc., without diminishing the importance of knowing that one must embrace as a priority the know-how. This "new nature" of learning is not possible with an expository model, centered on the teacher, because one only learns by doing. It is the classic learning by doing, which reminds that maxim of Aristotle (free translation): "To know what we want to do, we must do what we want to know."

Digital technologies are new, we could say, and are growing exponentially, with trends that point to adaptive learning, artificial intelligence, learning analytics, virtual environments (immersive or not),

holistic, the development of open educational resources increasingly interactive, multimedia and sophisticated, among many others (Cf. Horizon Report, 2020).

Educational technology is not so technological; we can mention some approaches such as Mastery Learning, proposed by Bloom in 1968 (Cf. Bloom, 1968; López, López, 2006); learning based on projects, problems or challenges (Cf. Schmidt, 2012; Cator & Nichols, 2008; Duch, Groh & Allen, 2001), Just in Time Teaching [JITT] (Mazur, 1997) and many others that have decades of study and research behind them, with proven effectiveness in many cases. Sometimes they have been proposed from the perspective of pedagogical reflection, other times from the perspective of educational practice. All of them have, as the reader will recognize, a common denominator: To activate the student and make him/her go from being a patient subject of a task carried out primarily by the teacher, to being an agent subject, the protagonist of his/her own learning. Therefore, they are often referred to generically under the label "active methodologies", and are placed under an inductive conception of learning (Cf. Tourón and Martín, 2018)

But what has changed over the years? In my opinion, the development of digital technology now makes it possible to implement methodologies that, until now, were difficult to apply and scale by merely analogical procedures. Thus, pedagogy (or educational technology, as you wish) and digital technology: The noun and the adjective in this process of learning and teaching, are interwoven to make possible the apparent utopia of education and learning centered on the student and not on the teacher. Personalized learning, in short.

This is the case of the monograph that I now present, centered on an approach, a model or meta-strategy, as you wish, that has been called in different ways in Spanish; in two ways, mainly, in English: flipped learning or flipped classroom (see https://flglobal.org/ and https://flippedlearning.org/).

Flipped learning, which "is a pedagogical approach in which direct instruction moves from the group learning space to the individual learning space. As a result, the group space is transformed into a dynamic, interactive learning environment in which the educator guides students as they apply concepts and engage creatively in the subject matter" (Cf. https://flippedlearning.org/).

Thus, the roles of both change; as the Saxons say, the teacher stops being "the sage on the stage" to become "the guide on the side".

This approach, which is reviewed here and in some detail in the various works included, has been applied in different contexts, environments and educational levels: face-to-face, online, in non-immersive 3D virtual spaces, etc. In all of them a common denominator can be perceived: A greater involvement of the students in their learning, more satisfaction, better motivation... in short, a preference for action over exhibition.

However, it would be naive, even puerile, in my opinion, to think that these so-called active approaches should replace the masterly and erudite exposition of an expert, or the deep learning that comes from study as "the occupation of the understanding with the concepts, the presence of these in the consciousness" (Cf. Tourón, 2017). I understand that the question to be asked, for example, is: Masterly lesson, what for? That is to say, that each objective, each learning result, requires a certain approach and none of them can claim the capacity to serve to effectively promote any type of achievement. What I want to point out is that we must seek complementarity of approaches, appropriate to the diversity of results we seek. It is not a question of confronting methodologies, but of using each one in what it is most effective for.

The reader can find in these works that are gathered here a panorama of actions and results that we hope will inspire them to improve the learning and teaching process wherever they work, and to seek the best evidences that will consolidate educational practices appropriate to the needs of each moment.

I want to thank you all the authors for their effort and contribution to this issue. And to the Editor-in-Chief of Revista de Educación for providing us with this space for the dissemination and improvement of research in the field of education.

References

Cator, K. & Nichols, M. (2008). Challenge Based Learning, A White Paper. Cupertino, CA: Apple, Inc. (PDF).

Duch, B. J., Groh, S. E, & Allen, D. E. (Eds.). (2001). *The power of problem-based learning*. Sterling, VA: Stylus.

Educause (2020). Horizon Report. Teaching and Learning Edition. Accesible en: https://library.educause.edu/-/media/files/library/2020/3/2020_horizon_report_pdf.pdf?la=en&hash=08A92C17998E8113BCB15DCA7BA1F467F303BA80.

López, López, E. (2006). El Mastery Learning a la luz de la investigación educativa. Revista de Educación, 340, 625-666.

Mazur, E. (1997). *Peer instruction: a user's manual*. Upper Saddle River: Prentice Hall.

Schmidt H.G. (2012) A Brief History of Problem-based Learning. In: O'Grady G., Yew E., Goh K., Schmidt H. (eds) *One-Day, One-Problem*. Springer, Singapore. https://doi.org/10.1007/978-981-4021-75-3_2.

Tourón, J. (2017). El anti-intelectualismo en educación. ¿tiene consecuencias? Entrada de blog: https://www.javiertouron.es/el-antiintelectualismo-en/.

Tourón, J. y Martín, D. (2018). Aprender y enseñar en la Universidad hoy. UNIR Editorial, Madrid.

Tourón, J.; Altarejos, F. y Repáraz, Ch. (1990). Los roles del profesor y del alumno en la enseñanza universitaria. Coloquio Internacional la Pedagogía Universitaria: un reto a la enseñanza superior. Barcelona, 17-19. Octubre.

Synchronous Flipped Classroom in STEM subjects

Clase Invertida Síncrona en asignaturas STEM

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Abstract

A variant of flipped classroom based on synchronous sessions, aimed at solving intrinsic difficulties of STEM subjects, is presented. Synchronous Flipped Classroom provides initial tutoring, so as to fix students' weaknesses that prevent autonomous, homework progress. Thereafter, group work, problem–based learning, integration questionnaires, along with formative peer–evaluation, have been assembled to yield remarkable increases in students' performance, as well as personal satisfaction. Application to three Chemistry subjects, at the University of Sevilla, as well as one Chemistry subject, at the University of Barcelona, is thoroughly discussed.

Keywords: Synchronous Flipped Classroom, Group Work, Problem-Based Learning, Integration Questionnaires, Formative Evaluation, Peer Evaluation, University Education, Chemistry Teaching.

Resumen

Se presenta una metodología de clase invertida, con modificaciones sincrónicas para adaptarse a la dificultad propia de las materias STEM. La Clase Invertida Síncrona refuerza la tutoría inicial, para resolver las dudas de los alumnos que les impiden progresar a través del material que trabajan fuera del aula. A continuación, una dinámica de trabajo en grupo, aprendizaje basado

en problemas, cuestionarios de integración, y evaluación formativa por pares, dan lugar a una destacable mejora de los resultados académicos, junto a una reducción del tiempo de trabajo y un incremento significativo en el grado de satisfacción del alumnado. Se discute su aplicación a tres asignaturas del Grado en Química de la Universidad de Sevilla, así como una asignatura del Grado de Química de la Universidad de Barcelona.

Palabras clave: Clase Invertida Síncrona, Trabajo en Grupo, Aprendizaje Basado en Problemas, Cuestionarios de Integración, Evaluación Formativa por pares, Enseñanza Universitaria, Enseñanza de la Química.

Introduction

New students come to classrooms immersed in a digital and technological world, where device interactivity opens up new avenues for teaching action. For instance, the information that a teacher can provide in class may be downloaded by students, nowadays, instantly. This case, and of course many others, enhances the use of more sophisticated pedagogical resources to increase the efficiency of learning (Fletcher, 2013).

The basic paradigm, staged in Europe through the so–called Bologna process (Bologna Process, 2020), is that improvement in learning performance should not be solved by the student alone, but should be based on greater academic support by the teacher (Biggs and Tang, 2011).

Therefore, university professor's main role is no longer knowledge transmission. Its main mission is now to accompany and guide the student, through their personal learning process, using better pedagogical resources and all the resources that digitization puts at their disposal (Seery, 2012).

Students, for their part, must acquire more complex skills that allow them to use the appropriate knowledge to solve complex situations. This requires a more experiential and, above all, active learning and teaching, which strongly contrasts with the traditional expository methodology, commonly identified as "dissertation" or "lecturing", where the student adopts an essentially passive role (Freeman, 2014).

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For these reasons, university teachers have been immersed, for more than two decades (Mazur, 1997), but with special intensity since the beginning of this decade, in a change in their way of teaching. The so–called active learning, a set of methodologies in which activity in the classroom focuses on the student, is increasing its presence in a multitude of university centers, mainly in Europe, the United States, Australia and New Zealand (Biggs and Tang, 2011; Christersson, 2019; Mintzes and Walter, 2020). General methodologies based on "flipping the classroom (FC)" stand out powerfully. They are based in letting the student acquire a first basis of information, through personal effort, and then work on the application and acquisition of skills and abilities in the classroom (Medina, 2016; Prieto, 2017).

This general scheme of active learning then admits many particular teaching methodologies, which frame the specific way of working contents: project–, problem–, competences–, or thinking–based learning, cooperative learning, gamification, or design thinking are already part of the day-to-day life of many universities in wide, varied areas (de Alba, 2020).

In STEM degrees (Science, Technology, Engineering and Mathematics), and therefore in Chemistry, the use of these methodologies is less frequent (Freeman, 2014). Even so, numerous (and successful) cases have been described, highlighting the original FC, applied by Sams and Bergmann for the first time in 2007, in Secondary Chemistry (Sams, 2013; Bergmann, 2014), the profound reform of contents , based on constructivism, carried out through Concept Development Studies, by Hutchinson at Rice University, since 1998 (Hutchinson, 2000), or the proposal called Project Based Guided Inquiry, by Wheeler and others, at the University of Virginia (Wheeler, 2017). Other proposals would be the POGIL method (Straumanis, 2012) or the application of PBL, Problem-Based Learning, which has grown in the field of analytical chemistry, and is also used in industrial, pharmaceutical, environmental or forensic chemistry (Belt, 2002; Summerfield, 2003; Belt, 2005; Belt and Overton, 2007; McDonnell, 2007; Williams and Parker, 2012; Clarke, 2012; Dicks and Batey, 2013).

However, less applied areas of knowledge are more resistant to the development of active learning. The complexity of concepts, sometimes too abstract or with complicated mathematical foundations, pose a fundamental obstacle. Leaving that part of the learning to student's

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autonomous work is therefore a contradiction from the point of view of the teacher's tutorial role (Lespiau, 2019). It is of no surprise, then, that teaching staff perceives that students simply switch off during their explanations, which entails less motivation and insufficient academic results.

Therefore, any active learning methodology demands, in these cases, additional reinforcements to ensure that students maintain constant effort throughout the course (Arévalo, 2018).

What can be done, then, when students have great difficulty understanding materials that should be worked out autonomously? How can we solve the delay of those who quickly lose the pace? Incidentally, these are some of the recurring questions that change–resistant teachers use in order not to change, as if traditional methodologies give a satisfactory answer (Cooper, 2015). When it is precisely the situation generated by traditional classes that has caused the previous questions and whose answers led, at least in part, to the development of active learning methodologies (Mazur, 2009).

The strategy followed in the methodology developed in this article, to solve the previous problem, is based, from a general point of view, on the contribution of David C. Geary, summarized in his important publication "The origin of the mind" (Geary, 2006), as well as by John Sweller's works on "Cognitive Load Theory (CLT)" (Kirchsner, 2010). These authors propose, when necessary, greater guidance by the teacher, from the beginning of the work until the students are more capable of functioning with greater autonomy.

CLT allows discerning which part of learning requires close monitoring, and which part allows greater autonomy. Basically, those subjects whose content can be taught resourcing on individual life experiences, linguistic knowledge, as well as the use of senses, allow a high degree of self–learning. It is what, in more and more contexts, is known as "primary knowledge". On the other hand, subjects that require a cultural background and increasing levels of abstraction, especially mathematics, need more guidance from the teacher, from the beginning. This type of content adduces to "secondary knowledge" (Geary, 2016).

For this reason, and without prejudice to other, successful versions of flipped classroom (Francl, 2014; Blau, 2017; Prieto, 2018), a variant of it is exposed in the present work. It starts activity on a certain topic always in the classroom, under teacher tutoring, from the first moment.

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This variant, called "Synchronous Flipped Classroom (SFC)", has been gradually developed since 2009, by one of the authors (Giménez, 2016a; 2016b; Medina, 2016), until reaching its current format, which is described in detail in this Article.

Comparison of overall academic results, during years 2009 to 2020, against control groups that have followed the traditional exposition methodology, has allowed to verify how academic performance is clearly higher, in line with other successful active learning practices, in a STEM environment (Freeman, 2014).

The present work also shows the practical application of the SFC methodology, to various subjects of the Chemistry degree, of the Universities of Sevilla and Barcelona, Spain, for which SFC has established itself as a mature, highly appreciated methodology.

The SFC methodology

As we have just mentioned, the implementation of the SFC work scheme in the classroom has been developed since 2009, in various stages, at the University of Barcelona, and since 2017 at the University of Sevilla. As it happens in the rest of the flipped classroom modalities, the SFC scheme eliminates most of the lectures and replaces them with work by students in the classroom, under the supervision of the teacher.

A broader view of what differences mean, between FC and SFC methods, may be obtained by placing FC and SFC in opposing extremes of a class of methods, in which synchronicity might be implemented variably. This means understanding synchronicity as a "parameter", whose "value" depends on the course, maturity of the specific group of students, and of course content. Greater maturity, or less abstract content, allows replacing the initial guide provided by the teacher, by readings or viewings of material, always in quantities that involve moderate efforts by students. One should not forget that excessive workload is one of the factors that lead to abandonment of continuous work by students (Medina, 2016).

The content of the SFC method is outlined in Figure 1. During the development of the classes, new concepts of theory are worked on, which are followed by practical activities. The former consists mainly of text readings, selected or prepared by the teacher, as well as video viewings,

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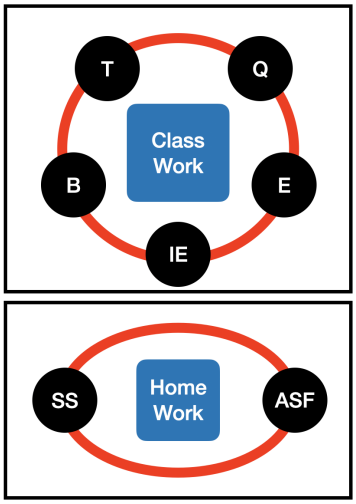
either also prepared by the teacher, or available on the Internet. These activities are carried out previously, in the FC method, and carried out synchronously in the classroom, in the SFC variant, instead. The practical activities are based on answering questions related to theoretical concepts and their application to practical cases.

FIGURE 1. Diagram of classroom and home activities involved in the Synchronous Flipped Classroom, SFC. The weight of each activity depends mainly on a) content; and b) degree of maturity of students. Greater conceptual content difficulty and lower degree of maturity imply greater guidance from the teacher and, therefore, an increase in activities with direct interaction between the teacher and the student. T: Theory; Q: Questions; B: "Blackboard" teaching; E: Exercises; IE: Integration Exercises; SS: Self–Study; ASF: Activity Script Finishing.



The main elements that make up the class dynamics, under the SFC scheme, are exposed below:

On course material and calendar

- The so-called Activity Scripts (AS) are worked out in the classroom.
- AS have been developed by the teacher and contain the detailed script of activities that students must carry out, with the teacher's help, in classroom, in–person sessions.

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- The calendar of all ASs that make up the course (typically, between 10 and 15 for a 6–credit semester course) is available and known from the beginning.
- The dossier with answers to AS is delivered through the Virtual Campus, before scheduled date and time.
- Given that planning competencies of students are not fully developed, especially in the first courses, it is very convenient to send frequent reminders on AS deadlines. This point becomes critical in distance learning environments.

On class work and teacher–student interaction

- Classroom work is done in groups of 3 to 5 students.
- The students write down a report. Although they work in groups, report writing is individual. It contains the answers to the AS questions.
- Working groups are set up freely. Moreover, its composition may change throughout the class sessions. As relevant authors (Hutchinson, 2020) point out, it is not a critical parameter, so it can be used to create greater comfort for the student, when deemed relevant.
- The role of different group members (driver, receiver ...) has to rotate throughout the same session, or across different sessions in shorter time settings, always following teacher's advice.
- Answers to AS questions must be based on bibliography, notes, previous practices, textbooks and, highly advisable, the web. Therefore, responses cannot contain hypotheses not supported by the literature.
- Consequently, any response must include the source from which the information was obtained.
- ASs suggest readings, mainly from the textbook or teacher's notes, as an initial activity. These readings, as well as the questions that will be raised later, should be discussed by working groups.
- The necessary arguments are discussed among group members, as well as between different groups. Students may freely consult between groups or do so following teacher's instructions.

- Any topic that, after being discussed within the group, or among several groups, does not yield consensus for the answer, might be asked to the teacher. This includes readings, questions as well as external sources of information.
- Questioning is central to learning; in no case will student's questions serve as evaluation criteria. Therefore, students should be encouraged to translate any issue into the question format.
- It is not appropriate, or operational, to assume that the student has the competence to correctly formulate questions that properly cast his doubt or confusion. The teacher will help in this questioning phase, especially initially. Explicit awareness on these difficulties is of great pedagogical value for the student.

On correcting Activity Sheets

- Correction of questions raised in the AS is not done during class time. It should be insisted on this point and that students ask the teacher everything related to the questions. In addition, they will usually have information that serves as a reference, such as the numerical values of the solution, where appropriate.
- However, a peer correction will be made during the last sessions of the course (Karpicke and Blunt, 2011).
- Each student must correct one or two AS of any other student, depending on the length of the subject and their position within the Bachelor or Master that is being studied. This correction is made in class, under teacher tutoring.
- The correction is not limited to question marking. Students must identify the sources of error or success. This analysis is a very important source of learning and provides a very relevant sense of progress.
- This analysis of the causes of error and / or success can be carried out in groups, but the corrections must be submitted individually.
- Both the AS, as well as fixes, error–success analyses, must be completed outside class hours, if necessary. That is, students are helped from start of the work, but they are required to know how to plan its completion. Difficulties are fixed at the beginning, whereas

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autonomous work is encouraged only when students become sufficiently acquainted with the task.

On continuous and formative evaluation

- The teacher will score the corrections, both for corrected and correcting students. The rating represents 30% of the total. In addition, class work will also be evaluated (basically, constancy in work) weighting another 30% in the final grade.
- Before starting ASs, students answer a short questionnaire of about 10 multiple–choice questions. The same questionnaire will be taken at the end of the AS, providing the student with an internal measure of their progress.
- One week after the delivery of each AS, the students will once again take the initial questionnaire associated with that AS. As mentioned, comparing before / after results will allow you to measure your progress.
- These questionnaires are answered outside of class hours, for time efficiency. However, it is advisable, to acquire adequate fluency with the questionnaires, that at least the first one is done in class.
- However, those students with problems following the course, or those who miss a certain number of in–person sessions, will take the questionnaires in person in the classroom. This improves monitoring students with difficulties, while discouraging them from attempting unauthorized actions.
- Depending on the course length, between two and four integration questionnaires will be carried out on an evenly distributed calendar. The grade obtained weighs 40% in the final grade for the course.
- These questionnaires contain questions that force us to relate different ASs, or to raise a certain concept in different application contexts. These questionnaires are carried out when enough time has passed since the AS. As Professor Bjork's research group (Storm, 2008) has shown, learning requires a certain level of forgetting first.
- All questionnaires, except the last one, are done outside class sessions, and therefore do not require being in–person. The last questionnaire, however, must be done during class time. The reason is that it serves as a deterrent to unethical attitudes. In fact, students

are informed that, in the event of flagrant differences in scores between on–line and in–person questionnaires, only in–person results will be taken into account. It is not outrageous, since the last questionnaire contains material corresponding to the entire course.

- Students may request individual tutoring sessions. They are useful for those students who do not take full advantage of the group work dynamics. In addition, students who are late, or those who miss face-to-face sessions, are obliged to request these sessions.

Following the above points allows a complete course to be developed under the Synchronous Inverted Class, SFC scheme, as long as the corresponding activity scripts have been adequately developed. The latter is not an easy task, and actually involves at least three courses (Porlán, 2017), not to mention issues related to content selection, a fundamental problem that might be addressed once active methodologies become common practice (Wood, 2009a, 2009b; Hutchinson, 2014; Mazur, 2015; Porlán, 2017; Arévalo, 2018).

As can be seen, the practical implementation aspects of the methodology go beyond a simple synchronous flip of the classroom. For example, the need to incorporate formative evaluation has led to the questionnaires before and after AS, as well as correction by peers with error–success analysis. Since peer correction is carried out without having the reference answers, it is a form of Autonomous Peer Correction, APC. The combination SFC plus APC has been called SABER (Giménez 2016a; 2016b), acronym for Supervision of Basic Learning through Exercises and self-Reflection.

As we will see below, the extensive use of the SABER methodology gives good results, in all the cases in which it has been applied. In fact, such results confirm trends shown by other FCs. Therefore, one may conclude that methodologies based on active learning, applied with a sufficient level of teacher supervision, based on pedagogically sound materials, are better than the best implementations of the traditional methodology, for STEM subjects (Freeman, 2014).

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Validation of sfc methodology and its application to different subjects

The methodology proposed in this study has been thoroughly used in the subject Introduction to Programming, taught during the second semester, 1st year of the Chemistry Degree at the University of Barcelona, whose academic results between the 2009-2020 period have served as a general validation. Results obtained in three subjects of the Chemistry Degree, at the University of Sevilla, namely General Chemistry (taught during the 1st year), Inorganic Chemistry I (2nd year) and Inorganic Chemistry II (3rd), have been instrumental for further validation and extension to other subject typologies. The latter include academic performance and subjective assessment by students. In all cases, the academic results have been compared with control groups, which have followed the traditional dissertation methodology, either from the same academic year or from previous courses.

Introduction to Programming at the University of Barcelona

Figure 2 shows the results of the comparative study between traditional teaching and the SFC method, which was carried out between 2009 and 2020, at the University of Barcelona. This comparison has been made with a first–year subject, Introduction to Programming.

Time elapsed shows two different stages, significant from the point of view of pedagogical methodology:

- Initially (period 2008–2014) programming learning is carried out using the FORTRAN language, and the course gradually introduces the different elements, combining theoretical sessions with lists of exercises. The theoretical part is explained in a classical, dissertation format, backed with slide presentations.
- As of 2014–2015 academic year, a move to high–level Python language is undertaken, maintaining the course structure. In addition, Activity Scripts are developed, which combine theory and exercises in a single, self–executable document.

Classes are organized in 11 groups containing between 20 and 30 students each, and consist of 14 sessions of 2 hours each, at a rate of

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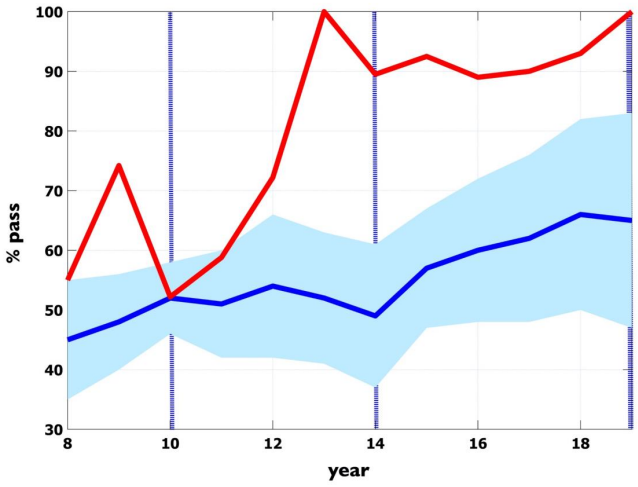
6 hours per week. It is therefore a compact course, since it involves only 6 weeks, with the particularity that the workload is high, since in 6 weeks students to learn to program, through the subprograms of the available libraries, problems of some complexity, such as iterative cycles, numerical integration or linear function fit.

The evaluation tests are the same, with the same scoring criteria, between SFC and control groups. Therefore, the only difference is the methodology of classroom work, with the exceptions mentioned above, referring to the two stages of the subject.

FIGURE 2. Percentage of pass students, for academic years 2008–2009 to 2019–2020, Introduction to Programming, taught during the first year of the Chemistry Degree at the University of Barcelona. Red line shows results for SFC group, while the blue line shows results, with one standard deviation in light blue, for the remaining 10 dissertation, control groups. The 2010 dashed vertical line indicates ending period of a first version of the SFC methodology. In previous years, a primitive version of the SFC method had been used, based on reducing the number of lectures and interacting more intensely with the students during programmed exercises. The 2014 dashed blue vertical line indicates a change from Fortran programming language to Python, as well as the introduction of Activity Scripts as course material. The 2019 dashed blue vertical line indicates the course taught in blended format, due to the Covid-19 pandemic.



The comparison between the two groups of results, and the analysis of their temporal evolution, provide a good amount of relevant data. This analysis requires distinguishing three situations:

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a) Results prior to 2010: The ten control groups use classical methodology, using slides as support for dissertations (12 class hours) and working on exercises in class for 16 hours. The SFC (primitive) group is based on reducing the theory class hours to 8 and increasing exercise hours to 20. It results in a slight improvement, although not significant.
b) Results between 2010 and 2014: The control groups use classical methodology (slides plus exercises), while the SFC group discards theory dissertation, tutoring students' exercises more intensively. The SFC results are clearly ascending, while the control results remain at their usual values.
c) Results from 2014: The control groups are divided into those that use the classic methodology, and the others that use the Activity Scripts, in classic format, that is, teacher's dissertation is kept. The SFC group applies the methodology fully, including group work and peer review. SFC results keep student's pass level at maximum, whereas in control groups an improvement trend is detected.

It should also be mentioned that the last academic year, 2019–2020, was affected by the Covid–19 pandemic, which required blending the course format and, in particular, switching to on–line sessions for the last two weeks. Even so, the trend shown in previous years still holds, concerning the difference between SFC and control group results.

General and Inorganic Chemistry I and II, University of Sevilla

The subjects are taught in two–semester courses, having 18, 13.5 and 10.5 ECTS credits, at a rate of 4 1–hour sessions per week, in the case of General Chemistry, as well as 2 1–hour classes in Inorganic Chemistry I and II. In addition to the time assigned to theory classes (see Table 1), in which the entire group of students participate, seminars are given in small groups, each lasting 2 hours. Table 1 shows the distribution of activities by subject, as well as their enrollment.

TABLE 1. Relevant data for the subjects where the SFC methodology has been applied in the present study. The abbreviation "rep" stands for students who take the subject for the second time or more.

Subject, Year	Dissertation sessions / hours	Exercise Seminars / hours	Enrollment (year)
General Chemistry, 1	***112***	***24***	***68*** *(2018–2019)*, ***24*** *rep* ***51*** *(2019–2020)*, ***13*** *rep*
Inorganic Chemistry I, 2	***60***	***16***	***53*** *(2016–2017)* ***52*** *(2017–2018)*
Inorganic Chemistry II, 3	***43***	***14***	***38*** *(2018–2019)*, ***22*** *rep*

Two types of variables have been examined:

I) **Objective indicators**:
   a) pass percentage among *attending* students,
   b) pass percentage among *enrollment*,
   c) *attending* vs *enrollment* rate.

II) **Student's subjective assessment indicators**:
   a) ***satisfaction*** with different subject aspects: material provided, applied methodology, work done by the teacher, evaluation system, and learning self-evaluation.
   b) ***balance*** between academic results and student effort.
   c) ***time*** devoted to self–study.

Type II indicators were evaluated, only for 2018–2019 academic year, by means of a quasi-experimental design with natural groups, where the experimental group is made up of SFC General Chemistry and Inorganic Chemistry II students, and the control group is, in the case of Inorganic Chemistry II, the remaining groups that follow a methodology based solely on dissertation classes, while in General Chemistry, the group itself changes its methodology when moving from first to second semester. The difference analysis has been carried out using "t of Student" test, for the contrast of means, as well as an Analysis of Variance for the analysis of interactions between the experimental condition and students taking the subject for the first time or not.

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Class attendance in General Chemistry (GC) and Inorganic Chemistry II (IC–II), for 2018/19 and 2019/2020 academic years, was imposed as mandatory, in order to participate in the continuous assessment system. 60 (GC, 2018/19), 47 (GC, 2019/2020) and 32 (IC–II, 2018/2020) students attended regularly class sessions and did assigned work. It should be noted that no distinction is made on activities carried out in theory classes or exercise seminars, except that small student groups were used for the latter.

SFC was fully applied in 2018/2019 academic year, Inorganic Chemistry II course. In the case of General Chemistry, it has been used in 2018/2019 and 2019/2020 academic years, although only during the first semester; the traditional dissertation methodology was used in the corresponding second semesters.

TABLE 2a. Comparison in pass percentage, between groups that followed the SFC methodology (SFC), and groups that followed the traditional dissertation (Dis) methodology, General Chemistry subject. Red: SFC results. See text for an explanation of Year 18/19. Year 19/20 shows SFC results for the first semester only.

General Chemistry

Year	2015–2016		2016–2017		2017–2018		2018–2019		2019–2020	
	Dis	*SFC*	*Dis*	*SFC*	*Dis*	*SFC*	*Dis*	*SFC*	*Dis*	*SFC*
Attending (Enrollment) pass / %	*72 (56)*		*61 (54)*		*42 (48)*		*66 (42)* *69 (55)* *21 (13)* *55 (35)*	*48 (44)* *88 (56)*		*59 (57)*
Attending vs Enrollment / %	*78*		*88*		*87*		*92*	*62* *64*		*96*

Tables 2a–c show results obtained in type I indicators, for the groups in which the SFC methodology has been applied in the 2016/17–2019/20 academic years. Values in red are results achieved when applying the SFC teaching methodology. Table 2b SFC results correspond to courses in which work began using Activity Scripts, but the remaining aspects of SFC were not deployed. Values in black refer, unless indicated, to overall

percentages, *i.e.* considering jointly results for all teaching groups that include, if applicable, SFC groups.

TABLE 2b. Red: results for the SFC methodology. Black: average of all groups. Inorganic Chemistry I subject. It should be noted, however, that students followed an incomplete version of SFC: the AS were not sent to the teacher at the end of the topic, they did not compare their answers with those of the teacher, the classes were not mandatory, they did not have a prior scheduling of autonomous work activities, nor did they perform any evaluation other than official exams.

Inorganic Chemistry I

Year	2015–2016		2016–2017		2017–2018	
	Dis	***SFC***	***Dis***	***SFC***	***Dis***	***SFC***
Attending (Enrollment) pass / %	***81 (66)***		***83 (62)***	***80 (53)***	***91 (71)***	***100 (77)***
Attending vs Enrollment / %	***81***		***74***	***66***	***78***	***77***

TABLE 2C. Inorganic Chemistry II subject. Red: results for the SFC methodology. Black: all–group average.

Inorganic Chemistry II

Year	2015–2016		2016–2017		2017–2018		2018–2019	
	Dis	***SFC***	***Dis***	***SFC***	***Dis***	***SFC***	***Dis***	***SFC***
Attending (Enrollment) pass / %	***61 (41)***		***70 (50)***		***69 (49)***		***77 (60)***	***100 (98)***
Attending vs Enrollment / %	***68***		***72***		***73***		***78***	***98***

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It should be noted that the GC 2019/2020 academic year shows data for the first semester only. The proper comparison with 2018/19 year is made possible after splitting dissertation group results in 4 cases: the first two show pass percentages, overall (what is known as July and September calls). The third includes the results of the first and second semester exams. The fourth indicates the percentage of students who passed the part of the exam corresponding to the first semester, on the one hand, and the part corresponding to the second, on the other. Course clearance required passing both parts independently.

Results compiled in Tables 2a–c reveal significant trends. First, it is observed that the application of the SFC methodology to IC–II led to a 100% pass rate of attending students, which represented a substantial increase compared to the results of previous courses. In addition, it is found that the percentage of students attending exams increased.

General Chemistry was taught under SFC methodology during the first semesters of 2018/19 and 2019/20. Comparing first and second semester exam data shows, in both years, very notable differences in pass percentage and attendance rate. SFC, 2018–2019 1st semester values are higher than traditional, 2nd semester results for the same year. Consideration of 2018–2019 July and September exams, shows 88% pass for first semester, this percentage dropping to 55% for the second semester. Actually, a passing percentage of 88% was a result much higher than the average for that subject in previous years, as the top performance was 72% in 2015/2016. This subject evaluation is complex, in any case, since passing requires independent pass of 1st and 2nd semester exams. For this reason, the overall pass percentage drops to 66% of attendants, but it is still a number higher than average of previous years' control groups.

It is also interesting to highlight an observed decrease, between first and second semesters of the 2018/19 academic year, regarding student attendance to General Chemistry exams. Second semester attendance was 64%, much lower than 92% recorded in the first semester exam. It is even a lower percentage than the average of those attending this subject in previous, dissertation courses. No further information is available on this issue, even though informal chats with students attributed this decrease to student's lack of motivation as they had to change the methodology in the second semester.

The partial application of the SFC methodology to Inorganic Chemistry I, academic year 2017/18, resulted in 100% pass rate. However, the rate of attending students versus those enrolled still continued within the overall ranges of the subject.

Subjective assessment was provided by questionnaires circulated to 2018–2019 General Chemistry and Inorganic Chemistry II students. Mean comparison between SFC and control group show significant differences in the *satisfaction* variable, for the complete set of surveyed aspects, showing the SFC group higher levels of satisfaction (M = 4.78) than the control group (M = 2.78), with t, 87, = 14.53, $p < 0.001$.

There are also differences in the positive evaluation of the *balance* variable, so that the SFC groups consider the evaluation as fairer (M = 4.09) than the control group (M = 3.17), with t, 87, = 4.44, $p < 0.001$. However, the differences observed in *time* devoted to the subject in both groups were not significant (t, 31, = -1.55, ns). It is observed that time in the control group is greater than that used in SFC, however, as there is a great dispersion in such values, mean value differences are not statistically significant.

Finally, ruling out the influence of taking the subject for the first time or not, required performing the same analysis, but segmenting between first– and second–time takers of both subjects. Data suggests, for both first–time and second–time takers, greater satisfaction ($F(1,85) = 8.66$, $p < 0.001$). The relationship with perceived balance is marginally significant ($F(1,85) = 2.66$, $p < 0.10$). Finally, no differences arise, between those under SFC methodology and the control group, concerning time devoted to the subject (t, 87, = 0.23, ns).

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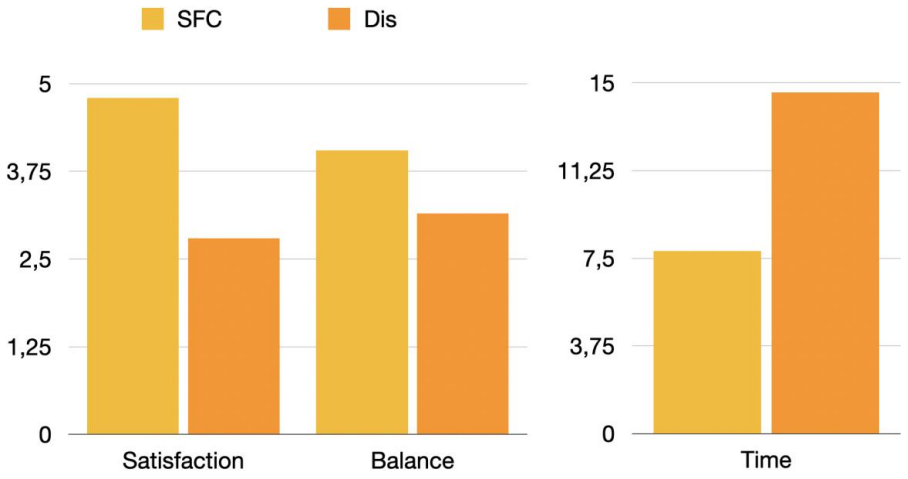
FIGURE 3. Analysis of *Satisfaction, Balance* and *Time* variables, for SFC and Dissertation groups. A scale from 1 to 5 has been used for Satisfaction and Balance, in which 1 corresponds to 'very little satisfied' and 5 to 'very satisfied'. Time is given in hours.



As a final conclusion, students were asked directly to write down sentences describing aspects valued the most, for SFC and Dissertation methodologies. Table 3 shows some of the most frequent responses, which confirm observations widely collected in the bibliography:

TABLE 3. Most relevant comments, for SFC and Dissertation groups, from the personal evaluation section of satisfaction surveys, completed by students at the end of the course.

Synchronous Flipped Classroom
'Ease of understanding and learning', 'the possibility of students to participate in class', 'feeling obliged to work daily', 'feeling that you are learning', 'teacher involvement', 'closeness to the student'
Dissertation
'Too much dissertation classes', 'very monotonous classes' 'lack of commitment from the teacher', 'forces you to study just to pass the exam'

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Conclusions

The application of the SFC methodology, between 2009 and 2020, to a subject of the Chemistry Degree of the University of Barcelona, along with three different subjects of the Chemistry Degree of the University of Seville, between 2017 and 2020, has been presented.

Use of SFC in class sessions of Introduction to Programming, at the University of Barcelona, has made it possible to improve, from pass levels of 60% or lower, characteristic of traditional dissertation teaching, to pass levels higher than 90%, which are solidly, effortlessly maintained over time. It should be noted that implementing the active methodology is quickly understood, and well appreciated, by students, although its foundations must be explained in detail. In this regard, it is highly advisable to explain the available scientific evidence to the students, as it improves confidence in the methodology and increases the level of involvement in this type of work in the classroom.

On the other hand, the application of SFC to the teaching of General Chemistry, Inorganic Chemistry I and Inorganic Chemistry II, of the Chemistry Degree at the University of Sevilla, has led in all cases to an increase in pass percentage. Specifically, 88% pass in first semester of 2018/2019 General Chemistry, and 100% in the two–semester Inorganic Chemistry II subject, was obtained. In addition, 92% of first–semester General Chemistry enrollment and 98% of Inorganic Chemistry II enrollment were able to follow the subject regularly, attending class and carrying out the tasks assigned by the teacher.

Teaching Inorganic Chemistry I under SFC led also to 100% pass rates of attending students, for the second year of SFC application, with attendance rate of 77%. Comparing this result with reference results in Inorganic Chemistry II and first–semester General Chemistry, it seems that offering the possibility of continuous evaluation, under the requirement of compulsory class attendance, makes students being able to experience this new methodology and feel attracted and engaged by the subject, in such a way that they manage to keep up constant work until the end of the course.

But as remarkable as improved academic results and increased class attendance, is the degree of satisfaction evidenced by students, with nearly unanimous top–level markings in SFC groups. Students declared being extremely satisfied with the work that has been done in class, as

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well as with the work that they have done themselves. They consider that, unlike other subjects' perceptions, they achieve true levels of learning, with no relevant increase in time devoted to personal work, as compared to their peers in the control group. Students feel also more satisfied with their grades.

Thus, excellent results from student satisfaction surveys have been obtained, becoming perhaps one of the best arguments for assessing the usefulness of this type of teaching methodology. Students engage in the transition from passive subjects, to being directly responsible for their own learning.

The pedagogical setting presented in this work appears as a real possibility of changing the traditional teaching of chemistry. An opportunity to skip dissertation classes in which very complex, difficult to understand concepts are tackled passively. Active learning provides students, therefore, the opportunity to reflect on such difficult concepts, devoting sufficient, active work, under teacher's direct, explicit advice. In addition, group work and peer correction stimulate and motivate students to seek the required solutions, forcing them to maintain critical reasoning. Overall speaking, SFC has revealed as a very useful, powerful and effective tool that enhances learning, raises student motivation and leads to successful academic results.

Acknowledgments

We wish to dedicate this work to our students as an acknowledgment for their effort and involvement in our classes, and for all the smiles that served as encouragement. On the other hand, we thank the Institutes of Education Science, or Professional Development Institutes, of the different universities, for their permanent and silent work in favor of active learning development. The combination of technological advances, and the great work done by these centers, are the real causes of the unstoppable progression of these important pedagogical changes.

References

de Alba, N., Porlán, R. (eds.), 2020: "*Docentes universitarios. Una formación centrada en la práctica*". Ed. Morata, Sevilla.

Arévalo, L., Gamallo, P., Giménez, X., 2018, "*SABER 2.0 in STEM: Rewarded Correction and Subject Content – Active Learning Practical Matching Strategies*", REIRE Journal, ***11*** (2), 83–95.

Belt S.T., Evans E.H., McCreedy T., Overton T.L., Summerfield S., 2002, "*A problem–based learning approach to analytical and applied Chemistry*", Univ. Chem. Educ., 6(2), 65–72.

Belt S.T., Leisvik M.J., Hyde A.J., Overton T.L., 2005, "*Using a context-based approach to undergraduate chemistry teaching – a case study for introductory physical chemistry*", Chem. Educ. Res. Pract., 6, 166–179.

Belt S.T., Overton T.L., 2007, "*Context-based Case Studies in Analytical Chemistry*", in Marbrouk P. A. (ed.), *Active Learning: Models from the Analytical Sciences*. American Chemical Society, Washington.

Bergmann, J., Sams, A., 2014, "*Flipped Learning: Maximizing face time*". Training and Development, New York.

Biggs, J., Tang, C., 2011, "*Teaching for Quality Learning at University*" (4a Ed.). McGraw–Hill, England.

Blau, I., Shamir–Imbal, T., 2017: "*Redesigned flipped learning model in an academic course: the role of co–creation and co–regulation*". Computers and Education 115, 69–81.

Bologna Process, official site, 2020: http://www.ehea.info/index.php

Christersson C., Staaf P., Corti P., Giménez X., McCarthy M., 2019, "*Promoting active learning in Universities*". Thematic Peer Group Report, Learning and Teaching Paper #5. European University Association.

Cooper, M.M.; Caballero, M.D.; Ebert–May, D.; Fata–Hartley, C.L.; Jardeleza, S.E.; Krajcik, J.S.; Laverty, J.T.; Matz, R.L.; Posey, L.A.; Underwood, S.M., 2015: "*Challenge faculty to transform STEM learning*". Science 350, 281.

Fletcher, S., 2013: "*Enseñanza Adaptativa*" in "*Informe especial: la educación en la era digital*". Investigación y Ciencia, September 2013, 40–46.

Francl, T.J., 2014: "*Is flipped learning appropriate?*". Journal of Research in Innovative Teaching 71,

Freeman, S. y cols., 2014: "*Active learning increases student performance in Science, Engineering, and Mathematics*". Proc. Natl. Acad. Sci. USA. 111(23), 8410–8415.

Geary, D.C., 2006, "*The Origin of Mind*". American Psychological Association, Washington.

Geary, D.C.; Berch, D. 2016: "*Evolution and children's cognitive and academic development*", in Geary, D.C. and Berch, D. (eds) "Evolution and children's cognitive and academic development". Springer International Publishing, Switzerland, 217–249.

Giménez X., 2016a, "*S.A.B.E.R.: Enseñar (casi) sin clases magistrales (I) ¡Atrevámonos!*" SciLogs–Blogs de Ciencia, Investigación y Ciencia: https://www.investigacionyciencia.es/blogs/fisica-y-quimica/39/posts/s-a-b-e-r-ensear-casi-sin-clases-magistrales-i-atrevmonos-14163

Giménez X., 2016b, "*S.A.B.E.R.: Enseñar (casi) sin clases magistrales (II). ¡Hagámoslo!*" SciLogs–Blogs de Ciencia, Investigación y Ciencia: https://www.investigacionyciencia.es/blogs/fisica-y-quimica/39/posts/s-a-b-e-r-ensear-casi-sin-clases-magistrales-ii-hagmoslo-14170

Hills P.J., 2018, "*The Self–Teaching Process in Higher Education*". Routledge Revivals, London.

Hutchison J.S., 2000, "*Teaching Introductory chemistry using concept development case studies: Interactive and Inductive learning*". Univ. Chem. Education 4, 3–7.

Karpicke, J.D.; Blunt, J.R., 2011: "*Retrieval practice produces more learning than elaborative studying with concept mapping*". Science 331, 772; Mintzes, J.J. et al. (Comment). Science 334, 453c; Karpicke, J.D.; Blunt, J.R. (Response to comment). *Science* 334, 453d.

Kirschner, P.A.; Sweller, J; Clark, R.E., 2010: "*Why minimal guidance during instruction does not work: an analysis of the failure of constructivist, discovery, problem–based, experiential and inquiry–based teaching*". Educational Psychologist 41, 75.

Lespiau, F.; Tricot, A. 2019: "*Using primary knowledge: an efficient way to motivate students and promote the learning of formal reasoning*". Educational Psychology Review 31, 915–938.

Mazur, E., 1997, "*Peer–Instruction: A users' Manual*". Prentice–Hall.

Mazur, E., 2009: "*Farewell, Lecture?*". Science 323, 50–51.

Mazur, E., 2015, "*Principles and Practice of Physics*". Pearson Education, Boston.

McDonnell C., O'Connor C., Seery M.K., 2007, "*Developing practical chemistry skills by means of student-driven problem-based learning mini-projects*", Chem. Educ. Res. Pract., 8, 130–139.

Medina, J.L. (coord..), 2016, "*La docencia universitaria mediante el enfoque del aula invertida*". Octaedro–ICE–UB.

Mintzes, J.J.,Walter, E.M. (eds.), 2020, "*Active Learning in College Science. The case for evidence–based practice*". Springer Nature, Switzerland.

Nichol, C.A., Szymczyk, A.J., Hutchinson, J.S., 2013: "*Data First: Building scientific reasoning in AP Chemistry via the Concept Development Study Approach*". J. Chem. Educ. 91, 1318–1325.

Prieto, A., 2017, "*Flipped Learning. Aplicar el Modelo de Aprendizaje Inverso*". Narcea Ediciones.

Prieto, A. et al., 2018: "*Nuevas combinaciones de aula inversa con just–in–time teaching y análisis de respuestas de los alumnos*". Revista Iberoamericana de educación a distancia 21, 175–194.

Prieto, A., Giménez, X., 2020, "*La enseñanza universitaria basada en la actividad del estudiante: evidencias de su validez*", en "Docentes universitarios. Una formación Centrada en la Práctica". Nicolás de Alba, Rafael Porlán (coords). Ed. Morata, Sevilla.

Porlán, R. 2017: "*Enseñanza Universitaria. Como mejorarla*". Ed. Morata, Sevilla.

Sams, A., Bergmann, J., 2013, "*Flip your student's learning*". Technology–Rich Learning, 70, 16–20.

Seery, M.K.; Donnelly, R., 2012: "*The implementation of pre–lecture resources to reduce in–class cognitive load: a case study for higher eduction chemistry*". British Journal of Educational Technology 43, 667–677.

Storm, B.C.; Bjork, E.L.; Bjork, R.A., 2008: "*Accelerated relearning after retrieval–induced forgetting: the benefit of being forgotten*". Journal of Experimental Psychology: Learning, Memory and Cognition 34, 230.

Straumanis A., 2012, "*Organic Chemistry. A guided inquiry for recitation*." Brooks–Cole Cengage Learning, Belmont, USA.

Summerfield S., Overton T.L., Belt S.T., 2003, "*Problem-solving case studies*." Anal. Chem., 75(7), 181–182.

Wheeler, L.B., Clark, C.P., Grisham, C.M., 2017, "*Transforming a traditional laboratory to an inquiry–based course: Importance of training TAs when redesigning a curriculum*". J. Chem. Educ. 94, 1019–1026.

Received: 02-09-2020 Accepted: 04-11-2020

Wood, W.B., 2009a: "*Innovations in teaching undergraduate biology, and why we need them*". Annual Review of Cell and Developmental Biology 25, 93.

Wood, W.B., 2009b: "*Revising the AP biology curriculum*". Science 325, 1627.

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Learning about the economic analysis of inequality through team-based learning

Aprendizaje del análisis económico de la desigualdad a través del "Team-based learning"

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Abstract

Introduction: We seek to describe how students' conceptual knowledge about the economic analysis of inequality and their ability to apply it changed through a contextualized team-based learning (TBL) process carried out in the Bachelor's of Business Administration and Management program at the University of Barcelona.

Method: Data was collected in 2018-2019 from a sample of 318 students distributed in five groups. Data was collected three times, using an initial individual test (Ci), a test carried out in teams during class time (Cg), and a final individual exam (Pfa). Percentages of students who passed and mean scores were analyzed quantitatively, and we compared changes overall, within groups and between groups.

Results: We observed a clear positive change for the whole sample and for each group between Ci and Cg, for both conceptual knowledge and its application. The mean scores improved by 49.8%, while passing percentages grew by 30%. In contrast, this positive trend was reversed between Cg and Pfa in the application of knowledge, although we found substantial intergroup differences, attributable to differences in the Pfa.

Conclusion: The TBL process contributed to students' conceptual knowledge of the economic analysis of inequality, suggesting that teamwork favors the learning

of elementary cognitive processes such as remembering and understanding. In contrast, while a certain degree of reversal between Cg and Pfa was expected, intergroup differences in knowledge application suggest that, despite what the literature has sometimes suggested, group tests for knowledge application in TBL should be identical, rather than merely comparable.

Key words: team-based learning, flipped classroom, higher education, quantitative analysis, business administration education, economic analysis, economic inequality, learning.

Resumen

Introducción: Esta investigación persigue describir y comparar cómo, a través de una propuesta contextualizada de "Team-based learning" (TBL), varió el conocimiento del análisis económico de la desigualdad (a nivel conceptual y de aplicación de dicho conocimiento) entre estudiantes del Grado de Administración y Dirección de Empresas en la Universidad de Barcelona.

Metodología: El estudio, desarrollado durante 2018-2019, contó con una muestra de 318 estudiantes distribuidos en cinco grupos. Los datos fueron recogidos en tres momentos utilizando una prueba inicial individual (Ci), una prueba en clase en equipos (Cg) y una prueba final individual (Pfa). Estos datos fueron analizados cuantitativamente –atendiendo a porcentaje de aprobados y calificaciones promedio– y comparando su evolución global, intragrupal e intergrupal.

Resultados: Se dio una clara evolución positiva para el total de la muestra e intragrupalmente entre Ci y Cg, tanto a nivel conceptual como de aplicación del conocimiento. En este sentido, la variación porcentual en la calificación promedio para el total de la muestra fue de un 49,8%, mientras que el porcentaje de aprobados creció cerca de un 30%. En cambio, en términos de aplicación del conocimiento, dicha evolución positiva se revirtió completamente entre Cg y Pfa para el total de la muestra, si bien con sustanciales diferencias intergrupales debido a matices en las actividades planteadas.

Conclusión: La propuesta analizada, fruto del trabajo en equipos, contribuyó positivamente al conocimiento conceptual del análisis económico de la desigualdad, evidenciando cómo este favorece el aprendizaje en procesos cognitivos elementales como recordar y comprender. Por otro lado, pese a cierta reversión esperable en los resultados entre Cg y Pfa, las diferencias intergrupales en la aplicación del conocimiento sugieren que, en contraste con lo que en ocasiones apunta la literatura, las actividades de aplicación que realizan los grupos durante el TBL habrían de ser idénticas, no solo comparables.

Palabras clave: aprendizaje basado en equipos, aula invertida, educación superior, análisis cuantitativo, enseñanza de administración y dirección de empresas, análisis económico, desigualdad económica, aprendizaje.

Introduction

We describe the outcomes of a process of team-based learning (TBL)–a tool of the flipped classroom–in economics higher education. We tried to understand how a TBL activity–which we modified to adjust it to the context and content–altered the knowledge of the economic analysis of inequality of 318 students from five groups from the Bachelor's of Business Administration and Management (ADE) of the University of Barcelona. This objective is divided into two sub-objectives:

- Describe how–in terms of the percentage of passing students and the average scores–knowledge about the economic analysis and inequality (both in conception and application) changed overall, within groups and between groups from the initial individual test (Ci) and the same test taken later in groups (Cg).
- Describe how this knowledge and its application changed–in terms of the percentage of passing students–overall, within groups and between groups from the Ci to the final individual course exam (Pfa).

The flipped classroom

The flipped classroom is a model of teaching and learning (Prieto, 2017) that consists of altering the sequence of "teach-study-evaluate," traditional in higher education (Medina, 2016), to "study-evaluate-teach-evaluate." The first references to the flipped classroom (or similar techniques) appeared in the United States in 2000 when, in the context of higher education, Lage, Platt and Treglia (2000) wrote of the "inverted classroom" and Baker (2000) of the "flipped classroom." These seminal studies point to the flipped classroom as a way of serving different learning styles and contributing to a more active type of learning. The popularization of the flipped classroom occurred largely thanks to the visibility of the work of Bergmann and Sams (2012) in secondary school. These authors have sometimes been identified as the founders of the flipped classroom movement (Prieto, 2017), even though they themselves referenced the work of Lage et al. (2000), which had been developed in economics education at the University of Miami (Ohio).

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Through the flipped classroom, the instructor selects course material for the students to work through on their own outside of class before it is taught in the classroom. In this way, class time is intentionally freed up for learning activities for which the presence of the instructor is essential. In this sense, the flipped classroom is marked by a constructivist approach (Bergmann, Overmyer, & Willie, 2011), in that classroom teaching comes after prior (guided) study by the student and the (formative) evaluation of the outcome of this prior study. Through a process of aligning classroom teaching with the understanding that the students have developed through prior study activities (Medina & Jarauta, 2013), the flipped classroom makes it possible for the content delivered in the classroom (related to the development of competencies and the achievement of learning results) to become more meaningful for each student. In this way, the flipped classroom shuns mechanical and reproductive instruction (Bergmann & Sams, 2012) and facilitates alternative uses for course content–problematizing it, practicing it, reflecting on it, discussing it, working on it in groups, etc.–through activities that allow students to formulate informed judgments and analyze and reformulate their knowledge in light of its practical derivations and theoretical coherence. In short, the flipped classroom seeks to help students develop higher-order cognitive processes (O'Flaherty & Phillips, 2015), thus maximizing their learning opportunities.

Over the past two decades, the flipped classroom has gained international popularity, as the research reports positive outcomes. Recent literature reviews of the flipped classroom in higher education have shown how the approach contributes to improving students' learning outcomes, attitudes, motivation and satisfaction with the teaching and learning process (Akçayır & Akçayır, 2018; O'Flaherty & Phillips, 2015; Thai, De Wever, & Valcke, 2017). Given these impressive results, for the past 20 years we have seen the flipped classroom emerge in various disciplines, including economics, both outside (Butt, 2014; Lage et al., 2000; Roach, 2014) and inside the Spanish university context (Abío et al., 2019; Hernández & Pérez, 2016).

In parallel with the popularization of the flipped classroom, related approaches have also emerged, including "first exposure" (Walvoord & Anderson, 1998), "peer instruction" (Mazur, 1997), "just-in-time teaching" (Novak et al., 1999) and TBL (Michaelsen et al., 2002). We analyze a

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process of TBL–adjusted for reasons related to time and content–carried out within a flipped classroom.

Team-based learning

The idea of TBL emerged in the late 1970s (Michaelsen et al., 2002; Sweet & Michaelsen, 2012) and was developed as a strategy during the 1990s. L.K. Michaelsen developed it in response to his experience teaching in business schools. He felt dissatisfied that he did not know what his students were thinking during his lessons (because the number of students in his classrooms had grown). Moreover, he wanted to create more opportunities for his students to address in class problems that they would have to handle in their future work (Parmelee et al., 2012). Michaelsen's proposed solution was TBL, a useful strategy for working with large classes, helping students develop conceptual and procedural knowledge (Michaelsen & Sweet, 2008) and critical thinking skills, and building high-performance learning teams (Sweet & Michaelsen, 2012).

In its most standardized form, the TBL sequence consists of three main phases that combine face-to-face and distance learning (through targeted study) (Michaelsen & Sweet, 2008; Michaelsen & Sweet, 2011; Parmelee et al., 2012):

- Preparation: pre-classroom learning activities that students perform individually based on study materials.
- Readiness assurance process: class work–generally in a face-to-face session–to diagnose the students' learning stage and provide feedback to prepare them for subsequent work with more complex problems. This phase includes:
  - Initial individual test about key ideas, usually in the form of a multiple-choice test.
  - Conducting the same test in teams that must reach consensus before responding.
  - Immediate feedback from the instructor that makes it possible for the team to discuss and defend their responses.
  - Brief explanation by the instructor to clarify points related to incorrect responses.

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- Application activities: performing, in one or more sessions, teamwork activities oriented to the practical application of previously addressed content. At this stage, the various teams seek to respond to significant problems and also receive feedback as quickly as possible so that, if necessary, they can again defend their responses (Parmelee et al., 2012).

Properly (and successfully) implementing this TBL sequence requires several elements. First, permanent work teams must be created strategically (Michaelsen & Sweet, 2008; Michaelsen & Sweet, 2011). Second, students must take responsibility for their individual and group work (Michaelsen & Sweet, 2008). And finally, students need to receive early feedback (Michaelsen & Sweet, 2008; Sweet & Michaelsen, 2012), which can sometimes draw on peer evaluation (Michaelsen & Sweet, 2011; Parmelee et al., 2012; Sweet & Michaelsen, 2012).

Positive learning outcomes (Gast, Schildkamp, & van der Veen, 2017; Fatmi et al., 2013; Sisk, 2011) have led to TBL being extended to a range of disciplines (especially health sciences). However, its origin within the framework of business schools continues to be reflected in current studies that, like ours, demonstrate its use for teaching and learning in economics and business (see, for example, Abío et al., 2019; Espey, 2012).

Method

Context and proposal of the TBL process

The study was carried out during the 2018-19 academic year in five groups of students from the Bachelor's of ADE of the Faculty of Economics and Business of the University of Barcelona, in the second-year compulsory course World Economic Environment. The course objective was for students to increase their knowledge of how the world economy operates and improve their analytical and critical capacity.

The disciplinary content addressed by the TBL was the economic analysis of inequality from 1980 to the present. This topic is one of the first on the syllabus and is a central issue in the course, reappearing when students learn about the growth model during the years of neoliberal capitalism and the causes of the global financial crisis of 2007/08. As

such, students' learning of this topic at its first introduction conditions the remainder of the course. We adjusted the standard TBL structure according to the characteristics of the material at hand to include two phases: preparation (including conceptual and applied work) and learning assessment (also including conceptual and applied work).

During the preparation phase, the students conducted the pre-study guided by two texts by the Serbian-American economist Branko Milanovic (2011; 2014), a renowned specialist in issues of global inequality. The first text met the requirements of both accessibility and rigor, conditions not always easy to meet in economics. This text was complemented by a second text by the same author that addressed more specifically one of the topics of the first text: how globalization has affected the unfolding of inequality internationally. Each student had to devise a summary outline that would be the only material he or she could use during the next phase; the aim was to encourage prior preparation in order to enhance understanding and reflection.

The second phase, which took place face-to-face in the classroom (at exception of the initial test), had four steps:

- Individual response to the initial test (Ci) that addressed both conceptual knowledge and its application (thus advancing the application stage of the TBL). The conceptual questions allowed us to detect whether the students had comprehended key ideas and analytical tools for the economic analysis of inequality. The application questions allowed students to demonstrate their competence by interpreting the economic indicators that measure inequality, as well as its causes and economic and socio-political impacts, in order to verify their reflexivity and critical perspective.
- Team response to the same test (Cg). To this end, teams of four students were randomly selected, and they agreed on their answers to the conceptual and application questions. At this time, the students could only make use of the summary outlines they had drawn up individually before class. During this stage, the instructor interacted with the groups, seeking to maintain a balance between their autonomy and their need for assistance.
- Immediate feedback on Cg and the opportunity to defend responses in the large group. Students remained seated with their work teams and group participation was encouraged.

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- Brief explanation in which the instructor answered questions and offered the main conclusions to ensure that students had understood the material.

Sample

The TBL process was carried out with a total of 318 students distributed across five second-year class groups of the Bachelor's of ADE: G1 (n=84), G2 (n=81), G3 (n=53), G4 (n=59) and G5 (n=41) selected through intentional convenience sampling. The five groups were taught by the same teaching team. Their personal information was anonymized according to ethics protocols. The groups had been formed following an enrolment process according which the student with the best academic record has first choice and the groups are gradually filled until they reach the enrolment maximum. The groups with a more attractive timetable end up with a greater number of students. Given this enrolment process, the order of enrolment and the order in which the groups filled serves as a rough proxy for the average academic record of the students in each group. G1 and G2 had the strongest academic records, while G3, G4 and G5 had average academic records that were similar to each other and weaker than those of G1 and G2.

Data collection and analysis

We collected data at three different times and through two tests (Ci and Cg) and the final course exam (Pfa). Ci and Cg were identical and consisted of 17 questions about the economic analysis of inequality. Five of these questions were related to conceptual knowledge and 12 were related to the application of that knowledge. Ci and Cg were conducted following the TBL process: individually before class and then in class in teams that had to reach consensus on their answers.

The Pfa, carried out at the end of the course, incorporated an application activity related to the notion of inequality. The application activity in the Pfa was identical for three of the groups (G1, G4 and G5) and incorporated a slight change in the other two (G2 and G3). We included this difference to reduce the possibility that students taking

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the exam earlier would inform other groups of the questions. This protocol is acceptable in TBL, according to which questions should focus on the same type of problem and generate the same type of decisions (Michaelsen & Sweet, 2008).

We conducted a quantitative statistical analysis separately for conceptual knowledge and its application, comparing average scores and passing rates overall (across the five groups as a whole), within groups and between groups. The minimum passing score 5 out of 10.

According to the statistical significance of the Moodle questionnaires, the basic statistics for each sample confirm their validity, with a low standard deviation for both Ci and Cg. This low standard deviation indicates the narrow dispersion of the data around the average, as well as a value of around -1 for the asymmetry coefficient, which meets the discrimination requirement between scores (Table 1).

TABLE I. Sample statistics

	G1		G2		G3		G4		G5	
	Ci	**Cg**	**Ci**	**Cg**	**Ci**	**Cg**	**Ci**	**Cg**	**Ci**	**Cg**
Average	6.83	9.60	5.70	8.70	6.30	8.50	5.00	8.50	5.10	8.30
Standard deviation	14.43	4.24	16.64	8.21	15.75	9.25	15.71	13.94	16.05	7.94
Median	6.8	9.4	6.0	8.7	5.9	8.5	5.2	9.3	5.3	8.3
Asymmetry coefficient	-0.3	-0.6	-0.6	-0.2	0.5	-0.2	-0.2	-0.2	-1.3	-0.6
Number of cases	84	84	81	81	53	53	59	59	41	41

Source: Authors

Results

The first objective of this research was to describe how–in terms of the percentage of students passing and their average scores–knowledge about the economic analysis and inequality (both in conception and application) changed overall, within groups and between groups from the initial individual test (Ci) and the same test taken later in groups (Cg).

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With regard to overall change for the total sample, the data presented in Table II show clear growth between Ci and Cg, whether we differentiate conceptual knowledge and its application or analyze them together. This fact is reflected in the average score and its increase by nearly three points (out of a total of 10).

TABLE II. Percentage of passing students and average score

	Average five groups		
	Ci	**Cg**	**Pfa**
% passing, conceptual knowledge	39.1	80.0	n/a
% passing, application	67.1	90.4	66.6
% passing overall	58.9	87.3	n/a
average score	5.89	8.82	n/a
% change in average score (Ci to Cg)	+49.8		n/a

Source: Authors

This positive development is also reflected if we analyze the intragroup data from the five groups, an important step considering the intergroup differences in the academic record of the enrolled students. As Table III shows, and as was the case overall, all groups show clear growth between Ci and Cg, for both conceptual knowledge and application (taken separately or together) when we examine average scores and their percentage change.

TABLE III. Percentage of students passing and average score per group

	G1			G2			G3			G4			G5		
	Ci	**Cg**	**Pfa**	**Ci**	**Cg**	**Pfa**	**Ci**	**Cg**	**Pfa**	**Ci**	**Cg**	**Pfa**	**Ci**	**Cg**	**Pfa**
% passing, conceptual knowledge	53.4	90.7	n/a	36.4	82.6	n/a	35.4	62.9	n/a	30.9	85.9	n/a	31.8	66.4	n/a
% passing, application	74.3	97.8	83.5	67.2	88.8	57.8	71.8	85.8	58.9	57.7	86.6	60.7	59.5	90.0	67.4
% passing overall	68.2	95.7	n/a	58.1	87.0	n/a	61.1	79.1	n/a	49.8	86.4	n/a	51.4	83.1	n/a
average score	6.83	9.60	n/a	5.70	8.70	n/a	6.30	8.50	n/a	5.00	8.50	n/a	5.10	8.30	n/a
% change in average score (Ci to Cg)	+40.6			+52.6			+34.9			+70.0			+62.8		

Source: Authors

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These positive results demonstrate the influence of group work on the learning outcomes of students for both conceptual knowledge and its application. However, as reflected in Table III, the starting point in the percentage of students receiving a passing score for conceptual questions was always lower than that of students receiving a passing score for the applications. This pattern generated, in turn, a greater change in the percentage of passing scores for this type of questions in Cg (with the exception of G5 and, especially, G3).

The extreme cases illustrating this trend in the results between Ci and Cg are represented by groups G3 and G4. G3 is the group showing least growth group between Ci and Cg, with 27.5% more passing in conceptual issues, 14% in application, and 18% in the combination of both. It is also the group in which the score between Ci and Cg improves the least, although this smaller improvement is enough to place the average score at 8.50. A deeper analysis of how this group solved the questions shows that this smaller increase has to do with the fact that a particular question, both in Ci and Cg, had few correct answers (it was answered correctly by 10% of students in Ci and by 7% in Cg).

At the other extreme, we find the case of G4, which showed the greatest increase between Ci and Cg. The score in this group increased by 70% and the percentage of passing scores combining conceptual and application issues increased by 36.6%, an increase that is also seen in the percentage of students passing in conceptual knowledge (55% more) and its application (28.9% more, behind only G5).

Our second objective was to describe how this knowledge and its application changed–in terms of the percentage of passing students–overall, within groups and between groups from the Ci to the final individual course exam (Pfa). With regard to the overall change for the total sample (Table IV), we find no improvement between Ci and Pfa for application (in fact, overall, there is a slight decline in the percentage of passing scores related to application). However, analyzing the intra- and intergroup level (see Table III and Table IV) serves to highlight how this lack of overall positive changes does not occur in all groups.

TABLE IV. Percent change in application of knowledge between Ci, Cg and Pfa

	G1	G2	G3	G4	G5	Overall
Change in passing scores, application between Ci and Cg	+23.5	+21.6	+14.0	+28.9	+30.5	+23.3
Change in passing scores, application between Cg and Pfa	-14.3	-31.0	-26.9	-25.9	-22.6	+23.8
Total change in passing scores, application Between Ci and Pfa	+9.2	-9.4	-12.9	+3.0	+7.9	-0.5

Source: Authors

As can be seen in Table IV, the percentage change of passing scores for application issues between Cg and Pfa is negative for all groups. However, while this decline does not reverse the growth experienced between Ci and Cg in the case of groups G1, G4 and G5, for G2 and G3 the decrease between Cg and Pfa completely reverses their previous growth and, moreover, reverses the overall increase for the total sample (although by only 0.5%).

Discussion

The data gathered in relation to our first objective suggest that the TBL process enabled an overall improvement for the five groups in terms of percentage of passing scores and average score. As noted in the results, the immediate impact of the teamwork was better test results; this happens whether we look at the total sample (see Table II) or within groups. Thus, the results of this research are consistent with previous literature about the effect of peer discussion and teamwork on student learning (Allen et al., 2013; Willett, Rosevear, & Kim, 2011; Zgheib, Simaan, & Sabra, 2010; Zingone et al., 2010).

The data also show that the impact of teamwork is present for both conceptual knowledge and its application. The impact was especially strong for conceptual knowledge, which started from a lower percentage of passing scores, thus showing that teamwork also serves to improve basic cognitive processes such as remembering and understanding (Anderson & Krathwohl, 2001). Interestingly, students passed at a higher

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rate on application questions than conceptual ones, both on Ci and Cg, in all groups (see Table III). This finding–a subject for further study–suggests that even with superficial or incipient conceptual knowledge, the student may already be able to successfully answer questions related to its application.

Continuing with this first objective, intra- and intergroup analysis showed that the two extreme cases in terms of the change between Ci and Cg were G3 and G4. For G4, the positive change is explained by the fact that the group started with the lowest scores and passing rates on Ci. This low starting point made it possible for its scores and passing rates to increase more than those of the other groups, although, in absolute terms, the rating of this group is the second lowest (equal to G3 and ahead only of G5). This type of significant growth in students with lower scores has been found in previous studies on TBL (Koles et al., 2005). In contrast, the same argument, inverted, is not applicable for the case of G3. In this case, this is not the group that started with the lowest scores and passing percentages (in all cases, G1 is higher), which could explain its lower relative growth. A more detailed analysis of how this group answered the questions, as noted in the results, shows that the smaller increase in this group was due to a misconception that remained unresolved in Cg. This finding underscores the importance of the brief post-group explanation for resolving doubts and ensuring learning (Parmelee et al., 2012; Sweet & Michaelsen, 2012).

We had a second objective related to the change in scores for knowledge application between Ci and Pfa. Overall, we observe that the positive development observed between Ci and Cg, the result of teamwork, is reversed–partially or totally–when students later had to respond to an application question on their own on the Pfa. Unlike what we observed for conceptual knowledge, the TBL does not appear to have had a positive impact on more complex cognitive processes, unlike what other authors have previously suggested (Allen et al., 2013; Imazeki, 2015).

The fact that, some time later and in the context of a final individual exam, the percentage of passing scores is lower than what we found within a team-based test conducted in the classroom is not surprising, and this outcome has also emerged in previous studies about TBL (Espey, 2018). However, our intergroup comparison allowed us to observe that

the change between Ci and Pfa differs between, on the one hand, G1, G4 and G5, and, on the other hand, G2 and G3.

For G1, G4 and G5, we observed a positive change between Ci and Pfa. For G4 and G5 the percentage increase may be attributed to the fact that these groups started from a lower percentage of passing scores on application issues (see Table III). However, this reasoning cannot apply to G1, the group that started with the highest percentage in Ci and which nevertheless showed the most improvement. This change highlights the characteristic of this group that we noted when describing the sample: G1 (along with G2) was made up of students with the strongest academic record, a feature that also manifests itself in the higher average scores and percentage of passing scores that this group obtained (see Table III). In this sense, the results are consistent with Espey's (2018) observation about the impact of the average scores of the participating student on learning results during the TBL.

However, while we have pointed out for G1 should also apply to G2, the results reflect that this group experienced a remarkable setback in the percentage of passing scores, something we also observed in G3. We attribute this outcome to the fact that G2 and G3 received a slightly different Pfa (to prevent students from sharing the questions across groups). TBL theory permits slightly different application activities. Michaelsen and Sweet (2008) suggest that all students should resolve comparable problems so that they have to make decisions of a similar nature and therefore their results can be compared. In later work, these authors (Michaelsen & Sweet, 2011) specify that the problems addressed must be the same. Our results show that comparable but not identical problems can result in different learning outcomes and scores, suggesting that knowledge application work should be carried out with questions that are identical and not merely similar.

Conclusion

We sought to uncover how a group of students from the Bachelor's of ADE progressed in relation to their knowledge (both in concept and application) of the economic analysis of inequality through TBL. On the one hand, we observed that TBL enabled positive developments in relation to conceptual knowledge of the economic analysis of inequality

in all groups, mainly as a result of teamwork. We have pointed out the importance of the teacher offering a brief explanation at the end of the TBL to clarify doubts that may have remained even after teamwork.

On the other hand, we have shown that for the application of knowledge about inequality, there is a reversal in the percentage of passing scores between the results obtained through working as a group and the results subsequently obtained individually. What set apart the groups that maintained an overall positive change from those did not was the activities carried out for the Pfa. Our analysis suggests that comparable–but different–application activities might have impacted learning outcomes. This leads us to suggest that applied work in TBL be carried out with identical activities and that the practical matter of how to prevent cheating be resolved in a different way.

Finally, this research has some limitations that future work could address. First, the context in which the students take Ci, Cg and Pfa is different, and future research should address how different aspects of the context (related, for example, to emotions or time) affect the data collected. Second, this research offers a quantitative analysis that would be enriched by a qualitative analysis of, for example, how group work proceeds or what students perceive about their own learning during TBL and the instruments used. Finally, we have pointed only tangentially to a new dimension of study regarding whether and how students with superficial conceptual knowledge can accurately respond to questions related to the application of this knowledge.

References

Abío, G., Alcañiz, M., Gómez-Puig, M., Rubert, G., Serrano, M., Stoyanova, A., & Vilalta-Bufí, M. (2019). Retaking a course in economics: Innovative teaching strategies to improve academic performance in groups of low-performing students. *Innovations in Education and Teaching International, 56(*2), 206-216. http://dx.doi.org/10.1080/14703297.2017.1389289

Akçayır, G., & Akçayır, M. (2018). The flipped classroom: A review of its advantages and challenges. *Computers & Education, 126*, 334–345. https://doi.org/10.1016/j.compedu.2018.07.021

Allen, R. E., Copeland, J., Franks, A. S., Karimi, R., McCollum, M., Riese, D. J., y Lin, A. Y. F. (2013). Team-Based Learning in US Colleges and Schools of Pharmacy. *American Journal of Pharmaceutical Education, 77*(6). http://dx.doi.org/10.5688/ajpe776115

Anderson, L. W., y Krathwohl, D. R. (Eds.) (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives*. Longman.

Baker, J. W. (2000). The 'Classroom Flip': Using Web Course Management Tools to Become the Guide by the Side. En J. A. Chambers (Ed.), *Selected Papers from the 11th International Conference on College Teaching and Learning* (pp. 9-17). Jacksonville, FL: Florida Community College at Jacksonville.

Bergmann, J., Overmyer, J., y Willie, B. (2011). The Flipped Class: What it is and What it is Not. *The Daily Riff*. http://www.thedailyriff.com/articles/the-flipped-class-conversation-689.php

Bergmann, J., y Sams, A. (2012). *Flip Your Classroom: Reach Every Student in Every Class Every Day*. International Society for Technology in Education.

Butt, A. (2014). Student views on the use of a flipped classroom approach: Evidence from Australia. *Business Education & Accreditation, 6*(1), 33-43. https://www.theibfr.com/download/BEA/2014-bea/bea-v6n1-2014/BEA-V6N1-2014.pdf#page=35

Espey, M. (2012). Team-based learning in economics. En M. Sweet y L. K. Michaelsen (Eds.), *Team-based learning in the Social Sciences and Humanities* (pp. 99-112). Sterling, Virginia: Stylus.

Espey, M. (2018). Diversity, effort, and cooperation in team-based learning. The Journal of Economic Education, 49(1), 8–21. https://doi.org/10.1080/00220485.2017.1397571

Fatmi, M., Hartling, L., Hillier, T., Campbell, S., 7 Oswald, A. E. (2013). The effectiveness of team-based learning on learning outcomes in health professions education: BEME Guide No. 30. *Medical Teacher, 35*(12), 608–624. https://doi.org/10.3109/0142159X.2013.849802

Gast, I., Schildkamp, K., y van der Veen, J. T. (2017). Team-Based Professional Development Interventions in Higher Education: A Systematic Review. *Review of Educational Research, 87*(4), 736–767. https://doi.org/10.3102/0034654317704306

Hernández, N. y Pérez, M. (2015). Students' Satisfaction with a Blended Instructional Design: The Potential of "Flipped Classroom" in Higher

Education. *Journal of Interactive Media in Education, 1*(4), 1–12. http://dx.doi.org/10.5334/jime.397

Imazeki, J. (2015). Getting Students to Do Economics: An Introduction to Team-Based Learning. *International Advances in Economic Research, 21*, 399-412. https://doi.org/10.1007/s11294-015-9541-0

Koles P, Nelson S, Stolfi A, Parmelee D, y DeStephen D. (2005). Active learning in a Year 2 pathology curriculum. *Medical Education, 39*, 1045–1055. https://doi.org/10.1111/j.1365-2929.2005.02248.x

Lage, M. J., Platt, G. J., y Treglia, M. (2000). Inverting the Classroom: A Gateway to Creating an Inclusive Learning Environment. *The Journal of Economic Education, 31*(1), 30-43. https://doi.org/10.1080/00220480009596759

Mazur, E. (1997a). Peer instruction: Getting students to think in class. En E.F. Redish y J.S. Rigden (Eds), *The changing role of physics departments in modern universities: Proceedings of the ICUPE* (pp. 981-988). Melville, NY: American Institute of Physics

Medina, J. L. (Coord.) (2016). *La docencia universitaria mediante el enfoque del aula invertida*. Barcelona: Octaedro.

Medina, J., y Jarauta, B. (2013). *Enseñanza y aprendizaje en la educación superior*. Madrid: Síntesis

Michaelsen, L. K., Knight, A. B., y Fink, L. D. (Eds.) (2002). *Team-based learning: a transformative use of small groups*. Westport, CT: Praeger.

Michaelsen, L. K., y Sweet, M. (2008). The essential elements of team-based learning. *New directions for teaching and learning, 116*, 7-27. https://doi.org/10.1002/tl.330

Michaelsen, L. K., y Sweet, M. (2011). Team-based learning. *New directions for teaching and learning, 128*, 41-51. https://doi.org/10.1002/tl.467

Milanovic, B. (2011). Más o menos. *Finanzas y Desarrollo*, *septiembre*, 6-11. https://www.imf.org/external/pubs/ft/fandd/spa/2011/09/pdf/milanovic.pdf

Milanovic, B. (2014). La historia de dos clases medias. *Sin Permiso*. https://www.sinpermiso.info/textos/la-historia-de-dos-clases-medias

Novak, G, Patterson, E. T., Gavrin, A. D., y Christian, W. (1999). *Just-In-Time Teaching: Blending Active Learning with Web Technology*. Upper Saddle River, NJ: Prentice Hall.

O'Flaherty, J., y Phillips, C. (2015). The use of flipped classrooms in higher education: A scoping review. *Internet and Higher Education, 25*, 85-95. http://dx.doi.org/10.1016/j.iheduc.2015.02.002

Parmelee, D., Michaelsen, L. K., Cook, S., y Hudes, P. D. (2012). Team-based learning: A practical guide: AMEE Guide No. 65. *Medical Teacher, 34*(5), 275-287. https://doi.org/10.3109/0142159X.2012.651179

Prieto, A. (2017). *Flipped learning. Aplicar el modelo de Aprendizaje Inverso*. Madrid: Narcea.

Roach, T. (2014). Student perceptions toward flipped learning: New methods to increase interaction and active learning in economics. *International review of economics education, 17*, 74-84. https://doi.org/10.1016/j.iree.2014.08.003

Sisk, R. J. (2011). Team-Based Learning: Systematic Research Review. *Journal of Nursing Education, 50*(12), 665–669. https://doi.org/10.3928/01484834-20111017-01

Sweet, M., y Michaelsen, L. K. (2012). Critical thinking and engagement. Creating cognitive apprenticeships with team-based learning. En M. Sweet y L. K. Michaelsen (Eds.), *Team-based learning in the Social Sciences and Humanities* (pp. 5-32). Sterling, Virginia: Stylus.

Thai, N. T. T., De Wever, B., y Valcke, M. (2017). The impact of a flipped classroom design on learning performance in higher education: Looking for the best "blend" of lectures and guiding questions with feedback. *Computers & Education, 107*, 113–126. https://doi.org/10.1016/j.compedu.2017.01.003

Walvoord, B. E., y Anderson, V. J. (1998). *Effective Grading: A Tool for Learning and Assessment*. San Francisco, CA: Jossey-Bass.

Willett, L. R., Rosevear, G. C., y Kim, S. (2011). A Trial of Team-Based Versus Small-Group Learning for Second-Year Medical Students: Does the Size of the Small Group Make a Difference? *Teaching and Learning in Medicine, 23*(1), 28–30. https://doi.org/10.1080/10401334.2011.536756

Zgheib, N. K., Simaan, J. A., y Sabra, R. (2010). Using team-based learning to teach pharmacology to second year medical students improves student performance. *Medical Teacher, 32*(2), 130–135. https://doi.org/10.3109/01421590903548521

Zingone, M. M., Franks, A. S., Guirguis, A. B., George, C. M., Howard-Thompson, A., y Heidel, R. E. (2010). Comparing Team-Based and Mixed Active-Learning Methods in an Ambulatory Care Elective Course. *American Journal of Pharmaceutical Education, 74*(9). https://doi.org/10.5688/aj7409160

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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.

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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
	EXPERIMENTAL	0.070	115	0.200	0.982	115	0.116
Posttest_Total	CONTROL	0.117	16	0.200	0.949	16	0.478
	EXPERIMENTAL	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	Asymptotic sig. (2-sided)	Effect Size
Pretest_Total	CONTROL	21	79.05	1660.00	-1.339	0.181	
	EXPERIMENTAL	115	66.57	7656.00			
Posttest_Total	CONTROL	16	14.25	228.00	-4.662	0.000	0.66
	EXPERIMENTAL	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 $z = -6.528$ ($p = 0.000$).

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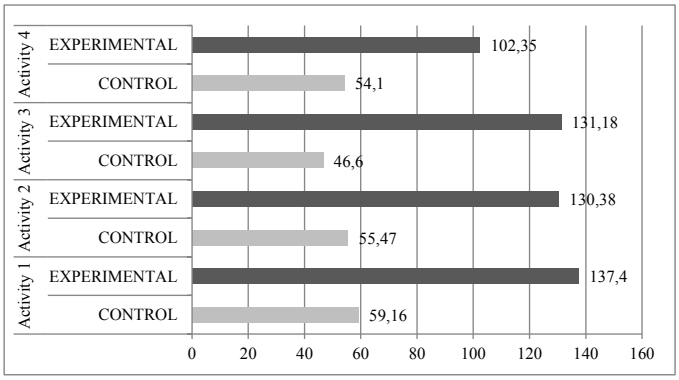
TABLE VI. Mid-ranges for the four activities performed

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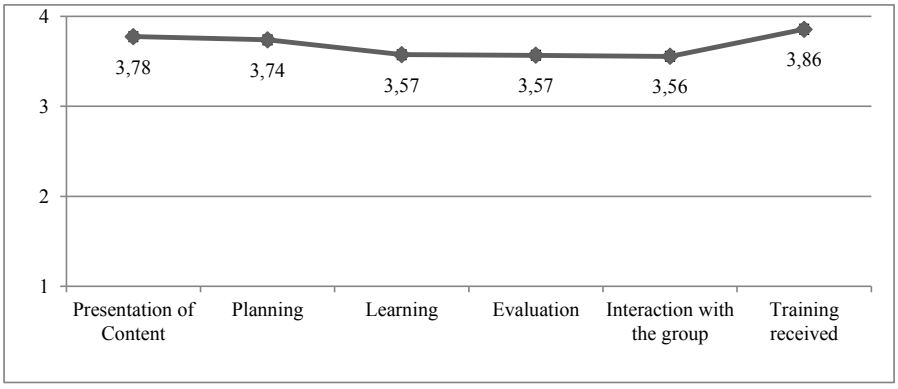
In relation to the experimental group's level of satisfaction with the experience, we analysed six dimensions: content presentation, planning, learning, evaluation, interaction with the group, and training received.

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).

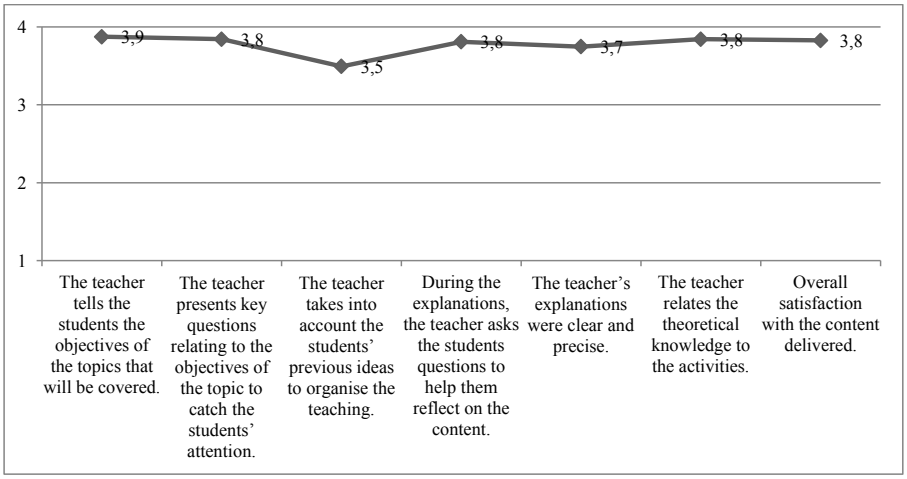
FIGURE II. Means of all dimensions analysed



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).

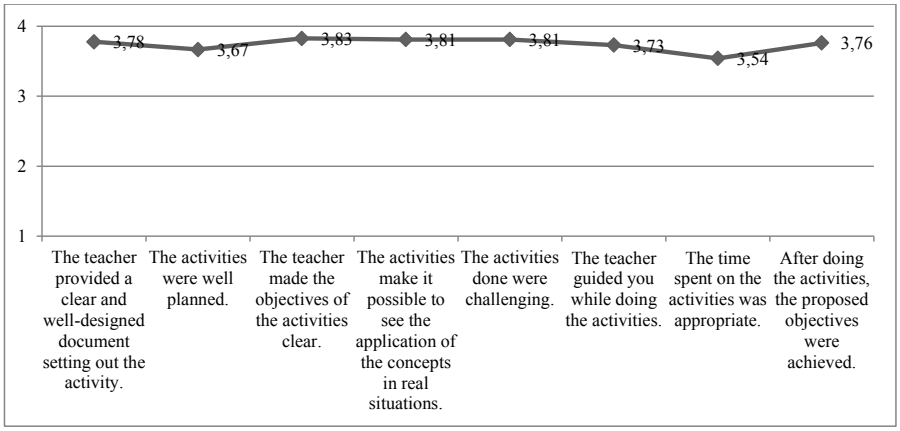
FIGURE III. Means of items from the content presentation dimension



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).

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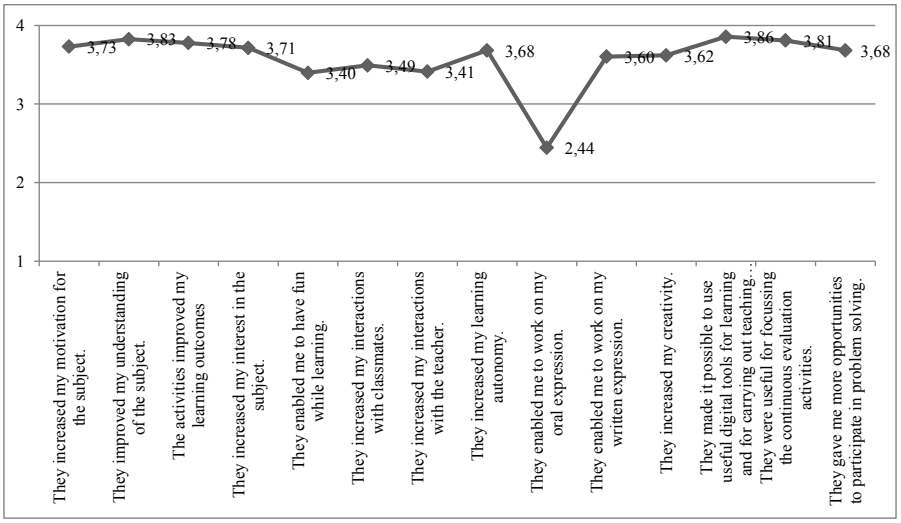
FIGURE V. Means of items from the activities dimension



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).

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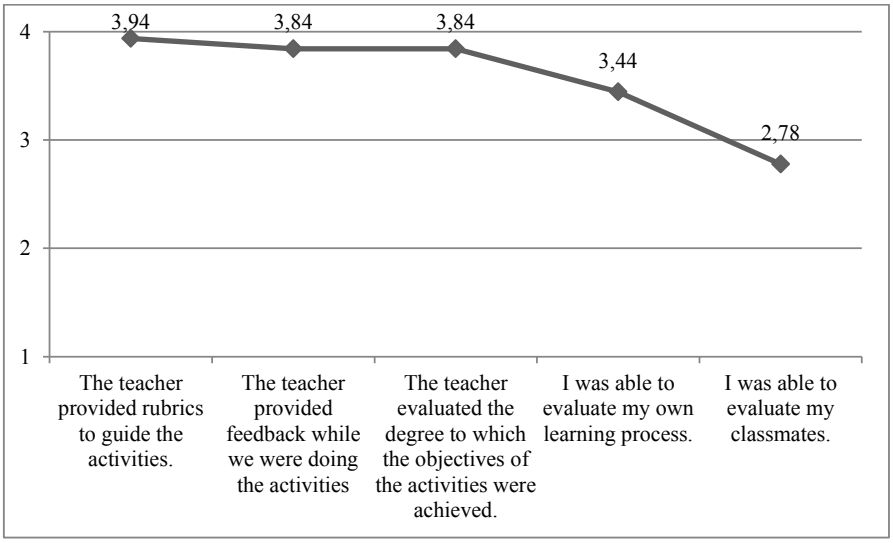
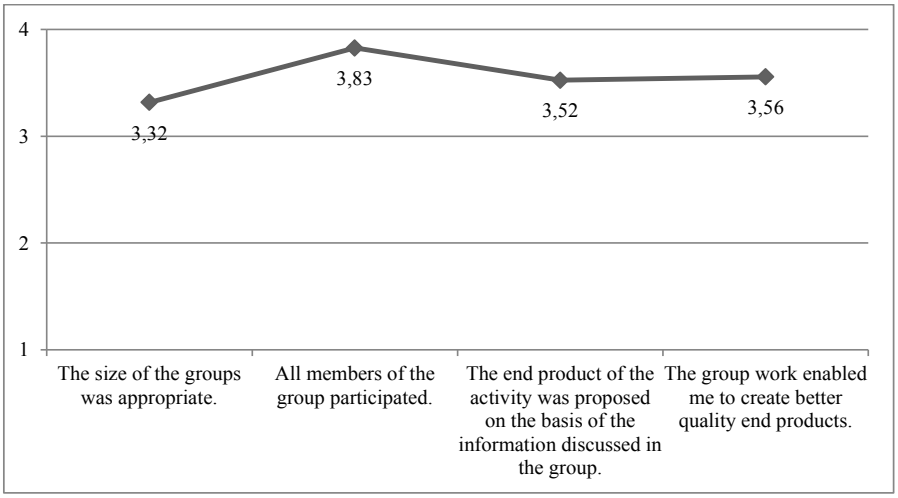
FIGURE VI. Means of items from the evaluation dimension



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).

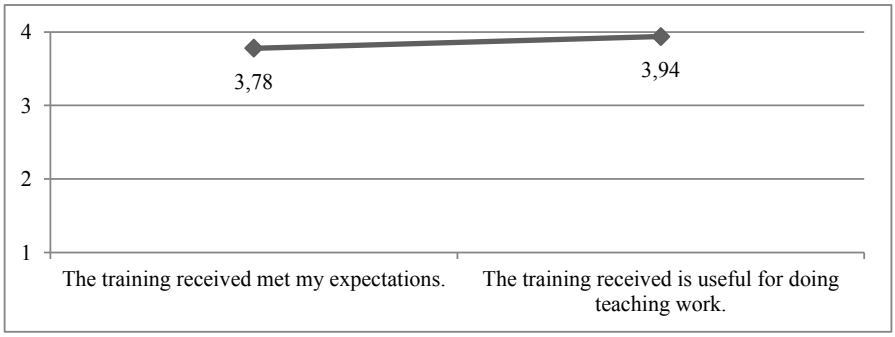
FIGURE VII. Means of items from the interaction with the group dimension



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.

References

Abeysekera, L. & Dawson, P. (2015). Motivation and cognitive load in the Flipped Classroom: Definition, rationale and a call for research. *Higher Education Research and Development, 34*, 1–14. https://doi.org/10.1080/07294360.2014.934336

Adams, W. & Wieman, C. (2010). Development and Validation of Instruments to Measure Learning of ExpertLike Thinking. *International Journal of Science Education, 33*(9), 1289-1312. doi:10.1080/09500693.2010.512369.

Adams, W., Perkins, K., Podolefsky, N., Dubson, M., Finkelstein, N. & Wieman, C. (2006). New instrument for measuring student beliefs about physics and learning physics: The Colorado Learning Attitudes about Science Survey. *Physical Review Special Topics - Physics Education Research, 2*(1), 1-14. doi:10.1103/physrevstper.2.010101.

Aguilera, C., Manzano, A., Martínez, I., Lozano, M. C. & Casiano, C. (2017). El modelo Flipped Classroom. *International Journal of Developmental*

and Educational Psychology, 4(1), 261–266. https://doi.org/10.17060/ijodaep.2017.n1.v4.1055

Anderson, L. W. & Krathwohl, D. R. (Eds.) (2001). *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives.* Allyn & Bacon. Boston, MA.

Arráez, G., Lorenzo, A., Gómez, M. & Lorenzo, G. (2018). La clase invertida en la educación superior: percepciones del alumnado. *International Journal of Developmental and Educational Psychology. INFAD Revista de Psicología,* 1(Monogr. 1), 155–162. https://doi.org/10.17060/ijodaep.2018.n1.v2.1197

Awidi, I. T. & Paynter, M. (2019). The impact of a Flipped Classroom approach on student learning experience. *Computers and Education, 128*, 269–283. https://doi.org/10.1016/j.compedu.2018.09.013

Bergmann, J. & Sams, A. (2012). *Flip your classroom: Reach every student in every class every day*. Eugene, OR: International Society for Technology in Education.

Castellanos Sánchez, A., Sánchez Romero, C. & Calderero Hernández, J. F. (2017). Nuevos modelos tecnopedagógicos. Competencia digital de los alumnos universitarios. *Revista Electrónica de Investigación Educativa, 19*, 53–60. https://doi.org/10.24320/redie.2017.19.1.1148

Chen, J. S., Wu, W.-C. V. & Marek, M. W. (2017). Using the Flipped Classroom to enhance EFL learning. Computer Assisted Language Learning. *Computer Assisted Language Learning, 30*, 1–21. https://doi.org/10.1080/09588221.2015.1111910

Cheng, L., Ritzhaupt, A. D. & Antonenko, P. (2018). Effects of the Flipped Classroom instructional strategy on students' learning outcomes: A meta-analysis. *Educational Technology Research and Development, 66*(6), 1–32. https://doi.org/10.1007/s11423-018-9633-7

Consejo de la Unión Europea. (2014). Conclusiones del Consejo, de 20 de mayo de 2014, sobre la *formación eficaz de los docentes.* Diario Oficial de la Unión Europea, serie C, núm. 183/05, de 14 de junio de 2014. Retrieved from https://eur-lex.europa.eu/legal-content/ES/TXT/PDF/?uri=CELEX:52014XG0614%2805%29&qid=1413806898567&from=ES

Dehghanzadeh, S. & Jafaraghaee, F. (2018). Comparing the effects of traditional lecture and Flipped Classroom on nursing students' critical thinking disposition: A quasi-experimental study. *Nurse Education Today, 71*, 151–156. https://doi.org/10.1016/j.nedt.2018.09.027

Espada, M., Rocu, P., Navia, J. A. & Gómez-López, M. (2020). Rendimiento académico y satisfacción de los estudiantes universitarios hacia el método Flipped Classroom. *Profesorado. Revista de Currículum y Formación del Profesorado, 24*(1), 116–135. 10.30827/profesorado.v24i1.8710

Flipped Learning Network (FLN). (2014). *The Four Pillars of F-L-I-P™*. Retrieved from https://flippedlearning.org/definition-of-flipped-learning/

Fuentes, A., Parra-González, M. E., López, J. & Segura-Robles, A. (2020). Educational Potentials of Flipped Learning in Intercultural Education as a Transversal Resource in Adolescents. *Religions, 11,* 53. https://doi.org/10.3390/rel11010053

Galindo, H. (2018). Un meta-análisis de la metodología Flipped Classroom en el aula de educación primaria. *EDUTEC. Revista Electrónica de Tecnología Educativa, 63*, 73–85. https://doi.org/10.21556/edutec.2018.63.983

Gillette, C., Rudolph, M., Kimble, C., Rockich-Winston, N., Smith, L. & Broedel-Zaugg, K. (2018). A meta-analysis of outcomes comparing Flipped Classroom and lecture. *American Journal of Pharmaceutical Education, 82*(5), 433–440. https://doi.org/10.5688/ajpe6898

Hew, K. F. & Lo, C. K. (2018). Flipped Classroom improves student learning in health professions education: A meta-analysis. *BMC Medical Education, 18*(38), 1–12. https://doi.org/10.1186/s12909-018-1144-z

Hinojo, F. J., Mingorance, A. C., Trujillo, J. M., Aznar, I. & Cáceres, M. P. (2018). Incidence of the Flipped Classroom in the physical education students' academic performance in university contexts. *Sustainability, 10*(5), 1334. https://doi.org/10.3390/su10051334

Hu, R., Gao, H., Ye, Y., Ni, Z., Jiang, N. & Jiang, X. (2018). Effectiveness of flipped classrooms in Chinese baccalaureate nursing education: A meta-analysis of randomized controlled trials. *International Journal of Nursing Studies, 79*, 94–103. https://doi.org/10.1016/j.ijnurstu.2017.11.012

Jong, M. S. Y., Chen, G., Tam, V. & Cahi, C. S. (2019). Adoption of flipped learning in social humanities education: the FIEBER experience in secondary schools. *Interactive Learning Environments, 27,* 1222–1238. https://doi.org/10.1080/10494820.2018.1561473

Kwon, J. E. & Woo, H. R. (2018). The Impact of Flipped Learning on Cooperative and Competitive Mindsets. *Sustainability*, *10*(1), 79. https://doi.org/10.3390/su10010079

Lee, J., Park, T. & Davis, R. O. (2018). What affects learner engagement in flipped learning and what predicts its outcomes? FL engagement and outcomes. *British Journal of Educational Technology*, *0*, 1–18. https://doi.org/10.1111/bjet.12717

Lo, C. K., Lie, C. W. & Hew, K. F. (2018). Applying "First principles of instruction" as a design theory of the flipped classroom: Findings from a collective study of four secondary school subjects. *Computers and Education, 118,* 150–165. https://doi.org/10.1016/j.compedu.2017.12.003

Long, T., Cummins, J. & Waugh, M. (2017). Use of the flipped classroom instructional model in higher education: instructors' perspectives. *Journal of Computing in Higher Education, 29,* 179–200. https://doi.org/10.1007/s12528-016-9119-8

López Belmonte, J., Pozo Sánchez, S. & Del Pino Espejo, M. J. (2019). Projection of the Flipped Learning Methodology in the Teaching Staff of Cross-Border Contexts. *Journal of New Approaches in Educational Research, 8,* 184–200. https://doi.org/10.7821/naer.2019.7.431

Martín, D. & Santiago, R. (2016). "Flipped Learning" en la formación del profesorado de secundaria y bachillerato. Formación para el cambio. *Contextos Educativos*, *1*, 117–134. https://doi.org/10.18172/con.2854

Matzumura, J. P., Gutiérrez, H., Zamudio, L. A. & Zavala, J. C. (2018). Aprendizaje invertido para la mejora y logro de metas de aprendizaje en el curso de metodología de la investigación en estudiantes de universidad. *Revista Electrónica Educare, 22*(3), 1–21. https://doi.org/10.15359/ree.22-3.9

Mengual-Andrés, S., López Belmonte, J., Fuentes Cabrera, A. & Pozo Sánchez, S. (2020). Modelo estructural de factores extrínsecos influyentes en el Flipped Learning. *Educación XX1, 23*, 75–101. https://doi.org/10.5944/educxx1.23840

Ministerio de Educación, Cultura y Deporte. (2014). *TALIS 2013. Informe español.* Madrid: Secretaría General Técnica. Retrieved from https://www.oecd.org/education/school/Spain-talis-publicaciones-sep2014_es.pdf

Murray, E., Durkin, K., Chao, T., Star, J. R. & Vig, R. (2018). Exploring Connections between Content Knowledge, Pedagogical Content

Knowledge, and the Opportunities to Learn Mathematics: Findings from the TEDS-M Dataset. *Mathematics Teacher Education and Development, 20*(1), 4–22. Retrieved from https://mted.merga.net.au/index.php/mted/article/view/310

Nunnally, J. C. (1978). *Psychometric Theory*, 2nd ed., New York: McGraw-Hill.

Pérez, A., Collado, J., García de los Salmones, M. M., Herrero, A. & San Martín, H. (2019). An empirical exploration of the perceived effectiveness of a 'flipped classroom' in a business communication course. *Journal of the Scholarship of Teaching and Learning*, *19*(2), 47–65. https://doi.org/10.14434/josotl.v19i1.22842

Prieto, A. & Giménez, X. (2020). La enseñanza universitaria basada en la actividad del estudiante: evidencias de su validez. In N. de Alba & R. Porlan (Coords.), *Docentes universitarios. Una formación centrada en la práctica*. Madrid: Ed Morata

Reyes, A. E. (2015). Educación y formación en la Unión Europea: análisis del proceso de Bolonia, el Espacio Europeo de Educación Superior, la Estrategia Europa 2020 y el Programa Erasmus+. *Derecho y Cambio Social, 12*(42), 1–23. Retrieved from https://www.derechoycambiosocial.com/revista042/EDUCACION_Y_FORMACION_EN_LA_UNION_EUROPEA.pdf

Romero-García, M., Buzón-García, O. & Tourón, J. (2019). The Flipped Learning model in online based education for secondary teachers. *Journal of Technology and Science Education*, *9*(2), 109–121. https://doi.org/10.3926/jotse.435

Sacristán, M., Martín, D., Navarro, E. & Tourón, J. (2017). Flipped Classroom y Didáctica de las Matemáticas en la Formación online de Maestros de Educación Infantil. *Revista Electrónica Interuniversitaria de Formación de Profesorado, 20*(3), 1–14. https://doi.org/10.6018/reifop.20.3.292551

Santiago, R. (2019). Conectando el modelo *Flipped Learning* y la teoría de las Inteligencias Múltiples a la luz de la taxonomía de Bloom. *Magister: Revista Miscelánea de Investigación, 31*(2), 45–54. https://doi.org/10.17811/msg.31.2.2019.45-54

Sola, T., Aznar, I., Romero, J. M., & Rodríguez-García, A. M. (2019). Eficacia del Método Flipped Classroom en la Universidad: Meta-Análisis de la Producción Científica de Impacto. *REICE. Revista Iberoamericana*

sobre Calidad, Eficacia y Cambio en Educación, 17(1), 25–38. http://dx.doi.org/10.15366/reice2019.17.1.002

Tomczak, M. & Tomczak, E. (2014). The need to report effect size estimates revisited. An overview of some recommended measures of effect size. *Trends Sport Sciences*, *1*(21), 19-25

Tourón, J. & Santiago, R. (2015). El modelo Flipped Learning y el desarrollo del talento en la escuela. R*evista de Educación, 368,* 196–231. DOI: 10.4438/1988-592X-RE-2015-368-288

Tse, W. S., Choi, L. Y. A. & Tang, W. S. (2019). Effects of Video-Based Flipped Class Instruction on Subject Reading Motivation: Flipped Class Instruction. *British Journal of Educational Technology, 50,* 385–398. https://doi.org/10.1111/bjet.12569

Van Alten, D. C., Phielix, C., Janssen, J. & Kester, L. (2019). Effects of Flipping the Classroom on Learning Outcomes and Satisfaction: A Meta-Analysis. *Educational Research Review, 28,* e.100281. https://doi.org/10.1016/j.edurev.2019.05.003

Weir, J. P. (2005). Quantifying test-retest reliability using the intraclass correlation coefficient and the SEM. *Journal of Strength and Conditioning Research / National Strength & Conditioning Association*, *19*(1), 231-40.

Zainuddin, Z. & Halili, S. H. (2016). Flipped Classroom Research and Trends from Different Fields of Study. *The International Review of Research in Open and Distributed Learning, 17*, 1–23. https://doi.org/10.19173/irrodl.v17i3.2274

Zheng, L., Bhagat, K.K., Zhen, Y., Zhang, X. (2020). The Effectiveness of the Flipped Classroom on Students' Learning Achievement and Learning Motivation: A Meta-Analysis. *Educational Technology and Society, 23*(1), 1-15

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Flipped training in a virtual 3D environment to foster teaching competences

Formación Flipped en un entorno virtual 3D para el desarrollo de las competencias docentes

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Abstract

The main objective of this study is the results' evaluation of a training program on active methodologies, aimed at teachers, developed in a virtual 3D environment under a Flipped model. Two criteria are assessed, the first one is the level of acquisition of the program contents (teaching skills) using a one group pre-experimental design carrying out measurements before and after the educational intervention. The second is the opinion of the participants on the role that different aspects of the teaching process had in the acquisition of skills. Pretest-posttest changes of competencies are studied with the Student's T-test for related groups, item-to-item changes are also checked using the Wilcoxon signed rank test, and Cohen's D effect sizes are calculated. For the second criterion, the deviation of the participants' opinion from what was expected in global terms was analysed, the chi-square statistic for a sample the chi-square statistic was used to compare the observed and expected frequency distribution. The results show that students perceive an improvement in their teaching competence, the greatest change occurs in the digital area with a high effect size (d=0.84), followed by the social, didactic, and innovation and improvement areas. The learning process aspects that contribute most to achieving this goal are frequent

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teacher feedback, interaction with the teacher and Flipped experiences, all with more than 60% of cases indicating the highest level of assessment.

Key words: Training teacher, 3D virtual environment, teaching skills, flipped learning, e-learning

Resumen

El objetivo principal de este estudio es la evaluación de los resultados de un programa formativo sobre metodologías activas, dirigido a profesores y desarrollado en un entorno virtual 3D bajo un modelo *Flipped*. Para la valoración se evalúan dos criterios, el primero, el nivel de adquisición de los contenidos del programa (competencias docentes) empleando un diseño preexperimental con un único grupo y medidas antes y después de la intervención educativa. El segundo, la opinión de los participantes sobre el proceso de enseñanza utilizado para la adquisición de las competencias docentes. El análisis de los cambios pretest-posttest en las competencias se hizo con la prueba T de Student para grupos relacionados, también se comprobaron los cambios ítem a ítem utilizando la prueba de rangos de Wilcoxon y se calcularon los tamaños del efecto D de Cohen. Para el segundo criterio, se analizó si la opinión de los participantes era más alta o más baja de los esperado en términos globales, mediante el estadístico chi² para una muestra que comparar la distribución de frecuencias observada y esperada. Los resultados muestran que los participantes perciben una mejora de su competencia docente, el mayor cambio se produce en el área digital, con un tamaño del efecto alto (d=0,84) siguiéndole la social, didáctica e innovación y mejora. Y los aspectos del proceso de enseñanza que más contribuyeron a conseguir ese cambio son el *feedback* frecuente del profesor, la interacción con el profesor y las experiencias *Flipped*, todas con más del 60% de los casos indicando el máximo nivel de valoración.

Palabras clave: Formación docente, entorno virtual 3D, competencia docente, flipped learning, formación online

Introduction

The general educational context, characterised by rapid change, both in content, digital resources and the inclusion of active educational techniques, demands a role and a series of actions from teachers that contribute to fostering the real importance of students, and the

development of competencies that enable them to move ahead in today's constantly changing world. In the light of this evolution, teachers need to keep up to speed so they can bring new teaching and learning processes into the classroom that facilitate this development, which involves thinking of the need for ongoing training to help them deal successfully with these new roles.

Teaching competencies

Professional knowledge is not inate, it is developed through a training process that runs throughout our lives. This teaching knowledge can be understood as *a set of knowledge, skills and competencies that society deems sufficiently useful and important for teacher training* (Cardona, 2008, p.103).

A professional competency has an integrating quality. Its definition emerges from the detailed analysis of the position's functions and tasks, of specific demands that are made to those who officially accredit this formation and, finally, of the specific purposes envisaged by the training programme.

For Le Boterf (2000, p.87), a competency *is the sequence of actions that combine several pieces of knowledge, a operative scheme that is transferable to a family of situations.* Perrenoud, (2004, p.11) defines it as *the ability to mobilise several cognitive resources in order to addrss a type of situations*, and González (2004) points out that the competency is only revealed if it is possessed when, in practice, resources and knowledge are mobilised against a problematic situation in a context.

Perrenoud (2004) emphasises the applied, contextualised sense of the whole set of skills and knowledge possessed (González, 2004). So, exercising competency requires complex operations, (Altet,1994, in Perrenoud, 2004b), that enable an action adapted to reality to be carried out.

Studies have been compiled on the teaching profession in Europe since the year 2000. Their profiles are conditioned by students' learning needs and strategies in a globalised and heavily digitised society. This entails living with plural cultures, integrating stimuli, Access to information, different formats, means of communication, guiding critical thought, incorporating technology into daily and professional life, adapting to

sudden changes and self-learning (NGA & CCSSO, 2010; Partnership for 21st Century Skills, 2016) and leading to a wider vision such as autonomy, assuming responsibilities, teamwork and the ability to learn to learn (Galvis, 2007).

Tardif (2004), Regan (2002) Tejada (1998), Tardif, Llessar and Lahaye (1991), Shulman (1987), Grossman (1990), Zabalza (1990, 2006) or del Moral (1998), Perrenoud (2004), Galvis (2007), Bernal y Teixido (2012) have carried out research into teaching competency proposing different dimensions: pedagogy, social, curricular, knowledge of the subject to teach, adaptation to change, tolerance to uncertainty, interpersonal, reflexion on teaching practices and ethical-professional capacity. The OCDE (2005) incorporates, in addition: languages, multiculturalism, matters of gender and co-living, student diversity and new technologies. Of all these, we have selected the following, as part of this study:

- Didactics. Considering conditions for the teaching-learning process.
- Innovation and improvement. Applying new educational ideas, proposals and practices with the aim of improving.
- Teamwork. Sharing work with other colleagues in order to achieve goals.
- Communicative. Using language for the exchange of knowledge, ideas, thoughts and emotions.
- Digital. Using technology to facilitate learning, processing and using information and sources.
- Social. Relating and interacting properly with families, students and colleagues;

Ongoing teacher training

In teaching, there is an underlying idea of *lifelong learning*, which implies the need to keep moving forward in order to respond to the demands of professional activity. The UNESCO (2010) states that teachers' professional development is of great importance, while on the other hand, the TALIS study (2009) came up with a diagnosis regarding teacher training processes and how it is linked with competency development, so this training should be designed with utmost care.

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The design of a training course based on competencies involves travelling along a path that starts with the identification of competencies that will make up the profile, to the design of the programme in order to achieve this, and requiring training aimed at the practical development of theoretically founded processes (Galvis, 2007).

The study carried out by Urbani, Roshandel, Michaels and Truesdell (2017) shows that primary school teachers indicated that the most powerful learning occurred through integrated learning experiences. This fusion enabled the development of these skills while they were applied simultaneously in their educational environments. This clearly highlights that *in order to know what we want to do, we have to do what we want to know.*

So, how can everything that has been covered in an ongoing online training programme be put into practice? How can learning outcomes be created where the learner can perform them? How can defined competencies be integrated, in such a way that teachers can take what has been practiced simultaneously to their classroom, where to foster communication, the sense of community, and their digital skills?

In order to combine all these, the proposal was made to follow the flipped learning model, whose face-to-face (virtual synchronised) sessions were carried out in a virtual 3D environment, that would enable us to experience techniques and methods, facilitate communication, engage in teamwork and use different digital tools.

For more information on flipped learning the following literature is available: (see Bergmann and Sams, 2004; Roach, 2014; Calvillo Castro, 2014; Sams and Bergmann, 2015; Tourón and Santiago, 2015; Martín R. and Santiago, 2015, 2016; Berenguer-Albaladejo, 2016; Prieto, 2017; Martín R. and Tourón, 2017; Serrano and Casanova, 2018). In addition, there are other articles dealing with this monographic section, in particular Prieto et. al. specifically reviews the best evidence of this focus. Therefore, we shall focus our attention on the use of virtual 3D environments.

Virtual 3D environment (VLE 3D)

Virtual environments are being applied more and more to distance learning. A virtual environment can be defined as *a parallel, immersive world, inhabited simultaneously by thousands of people who communicate,*

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play and work, on different levels and variants on role plays with their avatars (Carr and Pond, 2007, p.22).

Youngblut (1998) discovered that unique capacities exist in virtual reality, the majority of uses included constructive learning aspects, the teachers' role changed to that of facilitator and proved to be effective with special needs students. Mas and Marín (2008) conclude that open environments foster innovation and boost creativity, offering opportunities to both teachers and students (Dickey, 2005a). However, its use is determined by the teacher. They should be proposed as spaces sheltered by a constructivist paradigm, boosting the student's active role (Huang, Rauch and Liaw, 2010; Livingstone and Kemp, 2006, Bronack, Riedl and Tashner, 2006; Dede, brown-l'Bahy and Whitehouse, 2002; Eschenbrenner et al., 2008), where experiential and inclusive situations are designed, dealing with different learning strategies, and which promote cooperative and collaborative learning (Siau, 2003). Rutherfoord and Rutherfoord (2007) propose seven principles from the Universal Learning Design for its use, and Chen (2006) and Pantelidis (2009) suggest an instruction model based on Gagné and Biggs (1979).

The 3D environment provides a feeling of being present (each student has an avatar offering their own identity), interactivity, abstraction and experience of situations that enable the students to generate new knowledge (Selvarian, 2003; Bronack, Sanders, Cheney, Riedl, Tashner and Matzen, 2008; Warburton, 2009). It can *stimulate learning and understanding because it provides a close attachment between symbolic and experiential information* (Bowman, Hodges, Allison and Wineman, 1998).

However, there a number of disadvantages to be considered, such as the economic cost of its implementation, the learning time required to become comfortable in the environment, possible technical problems, the precepts that users may have regarding the use of technology for their training, and the integration with other internal and external tools (Pantedilis, 2009, Díaz Fernández, 2014).

There are few studies that analyse the use of VLE 3D for teacher training and development (Tuncer and Simsek, 2015). These projects include AVALON (2009/2011), ASSIS (2011), AVATAR (2009/2011), EUROVERSITY (2011/2014) or CAMELOT by the European Union (2013/2015), although the majority of these studies have been carried out through experiences on the *second life* platform, in our study we have used *The Education*

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District by *Virtway*, a 3D environment that can be used on a computer, Tablet or smartphone.

Accordingly, the aim of this study is the evaluation of a training programme aimed at teachers, on active methodologies, developed in a virtual 3D environment, the duration of which was three months. To this end two specific objectives have been formulated:

- Compare the results of the programme with the participants' perceived attainment level of teaching competencies.
- Analyse participant ratings on the contribution of different aspects of the training process on the attainment of these competencies and their overall appraisal of the programme.

Method

The educational teaching model followed for was the flipped model, including materials for the development of the training programme on a virtual platform. In the model's "pre" phase participants accessed readings or videos, and content related to active methodologies with different formats (videos, texts, graphics or interactive content), self-assessment surveys, etc. The "during" phase was carried out in a virtual 3D environment two hours a week. In these, the teacher guided participants as they put into practice what they had worked on in the previous phase, offering permanent feedback. Different didactic techniques were used, such as collaborative work in small groups, the Aronson puzzle, the completion of Webquest, the discovery of objects and images to determine their association, small matching games or the completion of definitions to build on what has been learned, peer instruction and the use of surveys in the form of quizzes. The "after" phase is dedicated to forum participation, the social media site *Twitter* for sharing at any time, the use of the Remind tool for quicker contact with the teacher, and the holding of round table debates with other professionals.

This research consisted of carrying out the evaluation of results of the training programmed described above. Two criteria were followed for the evaluation of this linked to specific goals. The first was the attainment level of teaching competencies was rated by using a pre-experimental design with a single group, measured before and after the educational

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intervention. The second involved the study of the participants' opinion once the training process was completed, comparing observed answers with expected answers expressed as an average.

Sample

The total number of participants in the training programme was 100, and collaboration was requested to all of them. 68.4% were women and the average age was 40.42 years old, with the age range varying from 23 to 59 years. The average age of the women was 39.31 years (D.T. 8,139) and that of men was 42.81 years (D.T. 8,848).

The sample that finally responded to the professional competency instrument in the pretest was 89 cases, and in posttest it was 61. The total amount of subjects with answers in the two applications was 52. In the rating instrument of the training process, answers were collated from 66 cases in most of the items.

Instruments

Two instruments were used for the gathering of information linked to the above mentioned evaluation criteria: professional competencies and the appraisal of the training process. Both are Likert scales with five levels of response grading.

The instrument was made taking into account the established dimension according to authors such as Zabalza (1990, 2006) or del Moral (1998), Perrenoud (2004), Galvis (2007), Bernal and Teixido (2012) and the OCDE (2015). From there the dimension chart was established to measure the attainment of competencies and the 39 items related to the application of procedures during the teaching process. It was organised in the following way:

- Didactics (8 items)
- Teamwork (6 items)
- Innovation and Improvement (8 items)
- Communicative (4 items)
- Digital (9 items)
- Social (4 items)

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Teachers had to rate the use before and after completing the training programme in five possible categories (From 1-never to 5-always). An analysis was made of the reliability and the construct validity. Firstly, ordinal reliability coefficients, calculated using the matrix of polychoric correlations, are shown in table 1, which also include correlations between these dimensions. Different analyses have been carried out separately for the pretest and posttest items, and a joint study considering a single variable with the information of the two applications. The data from this joint study are shown below:

TABLE 1. Ordinal reliability coefficients for the total sample (pretest and posttest) and correlations between groups of evaluated competencies.

	Didactics (S1)	**Teamwork (S2)**	**Innovation and improvement (S3)**	**Communicative (S4)**	**Digital (S5)**	**Social (S6)**
Alpha Ordinal	0.932	0.890	0.900	0.863	0.924	0.794
	S 1	S 2	S 3	S 4	S 5	S 6
S 1	1.000	0.681	0.823	0.758	0.814	0.835
S 2		1.000	0.831	0.640	0.630	0.639
S 3			1.000	0.811	0.759	0.781
S 4				1.000	0.842	0.766
S 5					1.000	0.814
S 6						1.000

All the dimensions have an approximate reliability of 0.8 or above, which indicates the high accuracy of scores. In addition, the correlations between dimensions suggest a general dimension of professional teaching competency. Secondly, considering these results, a confirmatory factorial analysis was carried out for ordinal items (using the matrix of polychoric correlations and the unweighted least square mean and variance adjusted method (ULSMV)) with the purpose of showing evidence in this respect.

The model of a dimension showed acceptable comparative adjustment indexes, with CFI and TLI values of 0.902 and 0.895, respectively (values of 0.90 are considered acceptable) and RMSEA and SRMR global adjustment indexes with values of 0.08 and 0.082, respectively (values of

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0.08 are considered acceptable). In reduced sample sizes, an acceptable adjustment in the combination of these indexes is sufficient to confirm the model (Hu and Bentler, 1999). In addition, factorial weights are superior to 0.5 and significant, as shown in table 2.

TABLE 2. Factorial weights (one factor) listed in descending order by magnitude, standard error and associated probability

Item	Factorial weight	S. E.	P	Item	Factorial weight	S. E.	P
I20	0.833	0.032	0.000	I25	0.722	0.042	0.000
I23	0.819	0.031	0.000	I18	0.721	0.044	0.000
I11	0.809	0.033	0.000	I3	0.719	0.042	0.000
I27	0.807	0.031	0.000	I8	0.714	0.044	0.000
I31	0.807	0.032	0.000	I35	0.714	0.053	0.000
I19	0.784	0.037	0.000	I5	0.707	0.044	0.000
I36	0.781	0.037	0.000	I4	0.706	0.043	0.000
I17	0.773	0.039	0.000	I30	0.694	0.048	0.000
I12	0.772	0.038	0.000	I10	0.660	0.048	0.000
I22	0.772	0.038	0.000	I29	0.644	0.052	0.000
I14	0.768	0.039	0.000	I24	0.643	0.050	0.000
I15	0.766	0.042	0.000	I33	0.643	0.050	0.000
I37	0.748	0.039	0.000	I13	0.626	0.054	0.000
I26	0.740	0.041	0.000	I38	0.607	0.057	0.000
I16	0.738	0.041	0.000	I1	0.591	0.061	0.000
I21	0.734	0.043	0.000	I7	0.573	0.056	0.000
I28	0.734	0.041	0.000	I6	0.523	0.060	0.000
I32	0.734	0.041	0.000	I39	0.520	0.064	0.000
I9	0.732	0.042	0.000	I34	0.503	0.059	0.000
I2	0.727	0.043	0.000				
Ordinal alpha coefficient:					0.977		

The explained variance (square of the loads) exceeds 25% in all items and in 26 out of the 39 it is over 50%. As a mean, the variance explained by the model is 51%. In addition, the reliability of the scores of this

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general dimension of professional competency stands at 0.98. Therefore, this information of the confirmatory factorial study indicates that a global teacher competency score can be considered valid and reliable.

The second instrument rates, according to the participant, how different elements of the programme have contributed to competency improvement, on a scale from 1(nothing) to 5 (a lot). Table 3 shows the rated elements.

TABLE 3. Items rated in the training process survey

General structure of the platform (LMS)
Ease of access to content
Didactic material
Tasks performed
Flipped experiences
Round table debates
Teacher feedback
Virtual 3D environment
Interaction among students
Interaction with the teacher
Flipped methodology
Activities carried out during face-to-face sessions
Digital tools used (outside of the 3D space)
Forums
Twitter social media site
Frequent feedback
Remind

Data analysis plan

The competency attainment survey is applied before starting the training process. It is applied again when the programme is completed, together with the process' aspect rating survey. The application of the instruments was carried out on *Google form*.

In order to provide an answer to the first objective, a calculation was made of the mean values of each of the above mentioned teaching competencies as well as of the total number of items. The means were used due to the different number of items in each dimension. Next, Kolgomorov-Smirnov normality tests were carried out with negligible values reported, therefore a normal distribution of the different scores was assumed. Accordingly, for pretest and posttest comparisons the Student T test was used for related groups and a calculation was made of the Cohen' D effect size for repeated measurements (Morris & DeShon, 2002). Regarding this first objective, changes were checked item by item be means of the Wilcoxon range test due to the fact the distribution of scores, in this case, cannot be considered normal. A calculation was made of Cohen' D effect sizes in its version for non-parametric statistics (Fritz, Morris & Richler, 2012).

In order to achieve the second objective, a calculation was made of means, averages, typical deviations of each items and response percentages in each of the rating scale categories. And to identify elements in the process that stand out, both positively and negatively, a comparison was made of the frequency distribution of responses with respect to the expected distribution with the chi-square statistic for a sample. As an expected distribution the mean of relative frequencies of response categories was used in the instrument's set of items.

Data were analysed with the IBM SPSS 26 statistical package and for the interpretation of effect sizes the Cohen categorisation (1992) was used, which considers effects superior to 0.5 as medium and superior to 0.8 as large effects.

Results

Figure 1 shows the averages of the different teaching competencies, as well as the overall rating, in the pretest and the posttest, reliability intervals of 95%. The averages of the different environments rated are notably high in the pretest, which is good to consider when it comes to rating the differences. In the pretest all the dimensions are more than half way above the rating scale (1-5). In the posttest, all dimensions exceeded 4 points.

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FIGURE 1. Different competency averages in the pretest and the posttest and confidence interval at 95%

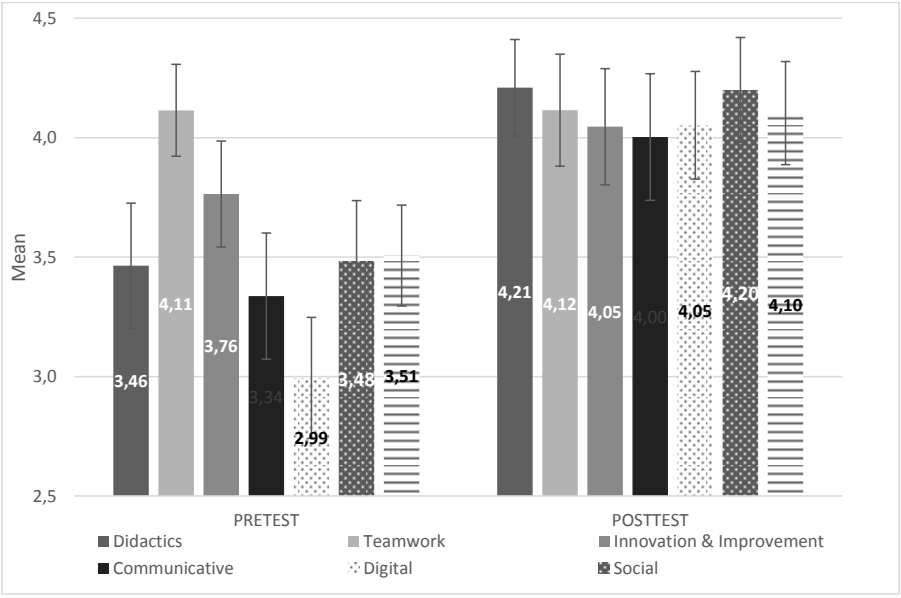

Table 4 contains the significance by dimensions of each set of competencies calculated on participants' pretest and posttest ratings (N=52). All differences are significant, except in "teamwork". The largest difference occurs in "digital competency", with an effect size (hereafter, ES) of 0.84, meaning that 80% of the posttest group's scores are above the average of the pretest group; followed in ES by "social competency" with a Cohen' d of 0.66 and "didactic competency" with an ES of 0.64. These values imply that 74.5% and 73.9% of the posttest group's scores are superior to the pretest group's scores. The lowest differences, but no less significant, refer to "innovation and improvement" items; even so, 65.2% of the posttest scores are above the pretest scores.

TABLE 4. Significance of pretest and posttest comparisons for the diverse range of evaluated competency and ES groups (Cohen' D)

Competency	Av. diff	S. D	S. E.	Lower Lim.	Upper Lim.	t	df	p	Cohen' D
Didactics	-0.745	1,052	0.146	-1.038	-0.452	**-5.110**	51	0.000	0.645
Teamwork	-0.001	0.905	0.125	-0.253	0.251	-0.005	51	0.996	0.086
Innovation and improvement	-0.281	0.969	0.134	-0.551	-0.012	**-2.095**	51	0.041	0.392
Communicative	-0.667	1.128	0.156	-0.981	-0.353	**-4.262**	51	0.000	0.612
Digital	-1.058	1.059	0.147	-1.353	-0.763	**-7.200**	51	0.000	0.840
Social	-0.716	1.106	0.153	-1.024	-0.408	**-4.670**	51	0.000	0.656
Teachers (Total)	-0.597	0.888	0.123	-0,.844	-0.350	**-4.847**	51	0.000	0.687

Considering the competencies as a single dimension, and with all the items taken as a whole, the ES is 0.69, meaning that 75.5% of the posttest group's scores are above pretest. All these effects are considered to be between medium (>0.50) and large (>0.80) according to Cohen himself (1992).

In table 6 we can see the significance of the ordinal differences in each of the items and the size of these differences estimated with the Cohen D statistic for each group of competencies.

All items that rate "didactic competency" show significant differences in favour of the posttest, with an ES of between 0.92 for the progressive management of the students with customised itineraries as they progress through the curriculum (item 36), and 0.48 in the design of the didactic programme by using key competencies. No significant differences are found in the item referring to the use of key competencies in classroom activities. All the effects in this set are between medium and high.

The "teamwork" dimension does not report any significant differences, but there are two items that do (13 and 24). The ES in item 13 is large (0.92) and refers to the creation of activities in the classroom that involve student teamwork. Item 24 is somewhat lower than an EM considered medium (0.40).

Six of the eight items in the "innovation and improvement" group report significant differences and with ES that range from 0.89 for item 15: "Seeking the opinion of my students on how the teaching-learning

process has been developed", followed by item 3, "Using cooperative learning, projects or collaborative work in the classroom", with an ES of 0.82. This is followed by ES in the item referring to "Analysing whether digital resources used in class have been effective" (D= 0.74). All of these are considered large ES and, as can be observed, with an emphasis in student centrality in their learning process. Items 5 and 25 have medium effects, on the analysis of the efficiency of class activities and the use of a diverse range of evaluation methods.

Of the four items that make up "communicative competency", two do not report any significant differences, while item 8 on the production of videos adapted to students (ES= 1.17) and item 20 on the presentation of tasks in diverse formats by students, with and ES of 0.82, have large effects, as can be observed, and are responsible for the differences in the set (see table 5).

In "digital competency" (global ES 0.84) several items with large ES stand out. So, those that are linked to the use of educational digital resources, the carrying out of gamification activities and mobile learning and the utilising of digital tools for evaluation, have EM values of 1.11; 1.14 and 1.16 respectively. They are followed by others that are also related to the use of digital tools for a wide range of uses, such as the creation of graphs or comics, or to foster interaction among teachers, students and parents (0.88 and 0.85).

Finally, social competency reports two significant items with ES of 1.02 and 0.87, referred respectively to provide physical or virtual participation spaces and the use of techniques to record students' academic advancements.

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TABLE. 5. Significance of pretest and posttest ordinal comparisons (Wilcoxon T) of items within each evaluated competency and effect size (Cohen' D).

		% Negative ranges	% Positive ranges	% ties	Z	P value	Cohen' D*
	Didactic Competency						
1	Designing the didactic programme taking into account key competencies	17.647	45.098	37.255	**-2.350**	0.019	0.479
2	Taking into account key competencies in different activities I propose in the classroom	21.277	37.255	35.294	-1.946	0.052	0.410
11	Creating different activities for my students' needs	13.462	51.923	34.615	**-3.296**	0.001	0.683
12	Selecting techniques and activities in accordance with learning standards	23.077	51.923	25.000	**-2.604**	0.009	0.528
23	Proposing different methods or materials according to students' learning strategies	11.538	61.538	26.923	**-3.672**	0.000	0.772
28	Using diverse evaluation means and instruments (rubrics, surveys, control lists, expositions, portfolio, exams, etc.)	10.000	60.000	30.000	**-4.003**	0.000	0.874
32	Evaluating students' learning as the achievement or not of learning standards	9.615	59.615	30.769	**-3.422**	0.001	0.712
36	Managing students' progress, offering them new differentiated learning itineraries as they progress through the curriculum	11.765	66.667	21.569	**-4.216**	0.000	0.919
	Teamwork Competency						
6	Learning from my school colleagues	30.769	28.846	40.385	-0.224	0.823	0.044
13	Creating activities in the classroom that involve students' teamwork	13.462	48.077	38.462	**-3.348**	0.001	0.695
14	Generating a team-working environment with my school colleagues	40.385	26.923	32.692	-0.742	0.458	0.146
24	Contributing ideas I have learned or resources to my teacher colleagues	38.462	17.308	44.231	**-1.981**	0.048	0.396
29	Paying attention to what my teacher colleagues are contributing	26.923	13.462	59.615	-1.578	0.115	0.313
33	Interpreting student errors as part of the learning process	21.569	31.373	47.059	-0.749	0.454	0.149

TABLE. 5 (cont.). Significance of pretest and posttest ordinal comparisons (Wilcoxon T) of items within each evaluated competency and effect size (Cohen' D).

		% Negative ranges	% Positive ranges	% ties	Z	P value	Cohen' D*
	Innovation and Improvement Competency						
3	Using cooperative learning, collaborative projects or work in the classroom	9.804	52.941	37.255	**-3.839**	0.000	0.822
7	Researching which of the educational activities or proposals has worked well or badly in class.	46.154	17.308	36.538	**-2.845**	0.004	0.581
15	Recording my students' opinions about how successful the teaching-learning process has been.	7.843	56.863	35.294	**-4.098**	0.000	0.888
19	Modifying the planned training plan if I see that my students are not learning	19.231	36.538	44.231	-1.562	0.118	0.310
25	Using different types of evaluation (self-assessment, co-assessment, continuous assessment)	13.462	53.846	32.692	**-2.843**	0.004	0.581
30	Adapting to changes in society	32.692	19.231	48.077	-0.674	0.500	0.132
34	Reviewing and analyzing my teaching activities in terms of my students' learning	45.098	21.569	33.333	**-2.124**	0.034	0.430
37	Analyzing whether the digital resources used in classes were effective or not	12.000	50.000	38.000	**-3.449**	0.001	0.735
	Communicative Competency						
8	Producing videos adapted to the group of students	1.923	73.077	25.000	**-5.139**	0.000	1.167
16	Providing varied teaching material (images, written texts, listening exercises, etc.)	19.608	31.373	49.020	-1.240	0.215	0.247
20	Enabling students to express what they have learned in different ways (text, video, dance, posters, graphics, etc.)	11.765	64.706	23.529	**-3.812**	0.000	0.815
26	Providing spaces and activities for reflection, debating and discussing solutions to classroom problems	34.615	34.615	30.769	-0.512	0.609	0.120

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TABLE 5 (cont.). Significance of pretest and posttest ordinal comparisons (Wilcoxon T) of items within each evaluated competency and effect size (Cohen' D).

		% Negative ranges	% Positive ranges	% ties	Z	P value	Cohen' D
	Digital Competency						
4	Creating teaching content and material on different media (audio-visual, paper, etc.) and languages (text, video, images, etc.)	21.154	44.231	34.615	-1.908	0.056	0.381
9	Using open educative resources (OER)	8.163	71.429	20.408	**-4.815**	0.000	1.113
17	Doing activities in class that require the use of devices (Tablet, laptop, Smartphone, interactive whiteboard)	17.647	54.902	27.451	**-2.504**	0.012	0.512
21	Using digital tools to make images, comics, conceptual maps, graphics or similar items	9.804	66.667	23.529	**-4.056**	0.000	0.877
27	Using digital tools to enable interaction and communication with students and parents (platforms, networks, blogs, etc.)	13.725	58.824	27.451	**-3.961**	0.000	0.853
31	Proposing that students do activities that require the use of digital tools	11.765	49.020	39.216	**-3.012**	0.003	0.625
35	Using gamified activities and mobile learning	5.882	74.510	19.608	**-5.014**	0.000	1.144
38	Using digital assessment tools (Rubrics, Flubaroo, Google forms, Socrative, Quizalize, etc.)	5.882	78.431	15.686	**-5.073**	0.000	1.162
39	Learning about the use of online copyright content to use in class	19.231	55.769	25.000	**-3.509**	0.000	0.733
	Social Competency						
5	Using techniques to register my students' progress to make my relationship with them more impartial and objective	11.538	57.692	30.769	**-4.077**	0.000	0.872
10	Interacting with my colleagues, students and parents	17.647	39.216	43.137	-1.461	0.144	0.292
18	Providing spaces (physical and virtual) for student and parent participation	9.804	76.471	13.725	**-4.587**	0.000	1.020
22	Supporting the creation of a participative atmosphere and active learning in my classroom	23.529	27.451	49.020	-0.225	0.822	0.045

As a synthesis, 13 of the items show a large ES, above 0.80. Another 11 are between 0.50 and 0.80, seven are between 0.30 and 0.50 while another seven show minor effects. All these differences should be considered in the context of the starting values, as mentioned above.

These data show the effect of the intervention (the training programme) discussed in the following section.

Table 6 and Figure 2 show the descriptive statistics of the items linked to elements of the training process rated by the participants (second objective). The last line of this table shows the global evaluation of the course.

In general, 50% or more of those surveyed gave a score of 4 or 5 to all items, except the item referring to the contribution of the Twitter social network for the acquisition of competences, whose average is in category 3. This item, however, is also the one to show the greatest percentage of variation in the answers.

In terms of averages, the elements of the training process that contributed the most to the acquisition of the different competencies were teacher feedback, interaction with the teacher and the Flipped experiences.

TABLE 6. Descriptive statistics of the items on the questionnaire to assess the training process. Number of answers, Mean, Average, standard deviation and variation coefficient percentage. And the chi-square test for a sample and associated probability

	N	Median	Mean	D.T.	% variation	Chi^2	p
General platform structure (LMS)	66	4	3.970	0.877	22.080	**18.77**	**0.001**
Ease of access to content	66	4	4.167	0.756	18.148	**14.01**	**0.007**
Teaching material	66	5	4.348	0.813	18.701	5.731	0.220
Tasks completed	65	5	4.415	0.788	17.857	6.402	0.171
Flipped experiences	59	5	4.576	0.724	15.822	**10.21**	**0.037**
Round table debates	58	4	4.207	0.913	21.703	2.557	0.634
Teacher feedback	64	5	4.594	0.706	15.378	**11.86**	**0.018**
Virtual 3D environment	66	5	4.182	1.094	26.165	4.094	0.393
Student interaction	65	5	4.323	0.903	20.894	3.798	0.434
Interaction with the teacher	64	5	4.578	0.730	15.954	**10.84**	**0.028**
Flipped methodology	66	5	4.455	0.845	18.960	5.342	0.254
Activities carried out during face-to-face classes	64	5	4.422	0.832	18.815	4.181	0.382
Digital tools used (outside of the 3D space)	66	5	4.485	0.789	17.597	7.21	0.125
Forums	64	4	3.406	1.342	39.394	**36.63**	**0.000**
Twitter social media site	64	3	2.672	1.437	53.786	**204.9**	**0.000**
Frequent feedback	64	5	4.328	1.040	24.023	5.477	0.242
Remind	37	4	3.919	1.064	27.151	3.876	0.423
Global Score (out of 10)	66		8.773	1.634	18.625		

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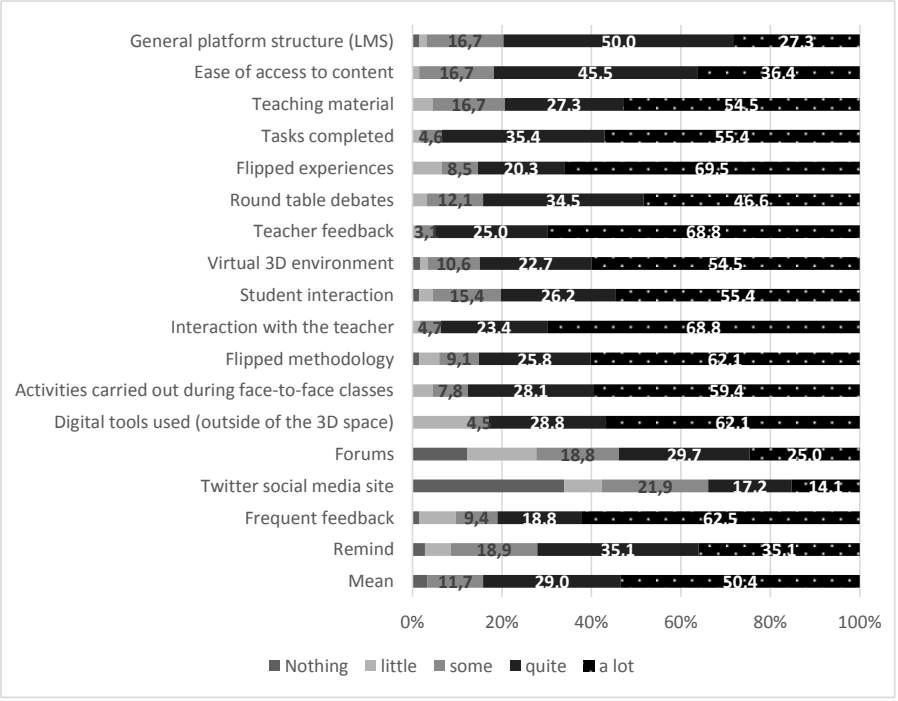
FIGURE 2. Percentage of answers with different scores



Overall, the percentages of cases in rating categories are 3.2% for level 1, 5.6% for level 2, 11.7% for level 3, 29% for level 4 and 50.4% in the top level of the scale. Considering this distribution as the expected values, the elements of the process were identified that deviate from this pattern with the chi-square test for a sample.

The results indicate that the feedback and interaction with the teacher, along with the flipped experiences, stand out in terms of the percentage of cases awarded the highest score, approximately 20% more than expected. The opposite can be said for the Forums and the Twitter social media site, which show a percentage of cases in lower categories than expected (9% and 28% respectively)

Discussion

Having completed this training programme based on the flipped learning model, using a virtual 3D environment for synchronous sessions, the participants (working teachers) noticed an improvement in their teaching competency.

The posttest scores were higher than the pretest scores when the competency was considered as the only factor. All the differences were significant, except for those referring to "teamwork" which, even though there was an improvement, was already high in the pretest.

The largest difference was in digital competency, followed by the social, didactic, innovation and improvement and communicative areas. Even so, while their differences varied independently, what is noticeable is the fact that each area was rated as a level 4, pointing to a standard quality among them. This highlights the idea that competencies develop through the persistent application and experience of the learner, from one work experience to another (Pavié, 2011) and by including integrated learning experiences (Urbani, Roshandel, Michaels and Truesdell (2017) in the programme, as they have been in this programme.

The ES (0.84) in the whole digital area is notable. Besides this, notable features include the use of educational digital resources, gamification activities and mobile learning and the use of digital tools for assessment. In other words, acquisition occurs by taking part in appropriate training programmes that include integrated experiences of these competencies, passing on the use of techniques and resources that will then be applied to their students (Rust & Bergey, 2014; White & Chant, 2014). Specifically, when the training programme integrates technology in order to improve teaching (and not as a subject) - in this case helping to model the technique for their students (Hora and Holden, 2013, Nicholson and Galguera, 2013) - it supports a clear view of the use of technology and suitable infrastructure (Resta and Patru, 2010) in a contextualised form.

The didactic aspect reveals significant differences in favour of the posttest, with the sizes of its items' effects between 0.92 for managing student progress through customised itineraries, 0.77 for proposing different methods and materials to match the students' learning strategies, 0.87 for using different means and instruments for evaluations, 0.69 for creating different activities for the students' needs, to 0.48 for using key competences to design the teaching programme. All this suggests

that professional competency develops when the didactic aspects are intrinsically linked to each other when designing the learning outcomes (Urbani, Roshandel, Michaels and Truesdell, 2017), when it is oriented towards applying knowledge to their students' learning activities and supported in this endeavour by various educational contexts (Darling-Hammond, 2006). It is worth noting that the programme applies a constructivist paradigm designed and executed in VLE3D, placing emphasis on the interaction between the learner and the environment, encouraging identification of students' prior knowledge and how to apply knowledge and skill in the classroom context (Huang, Rauch and Liaw, 2010; Livingstone and Kemp, 2006, Bronack, Riedl and Tashner, 2006; Dede, brown-l'Bahy and Whitehouse, 2002; Eschenbrenner et al., 2008).

Curiously, the "teamwork" aspect shows no significant change (it was already high in the pretest) even though the interaction of small groups was part of the programme and a degree of group cohesion was noted. Even so, there is change in the items related with creation of classroom activities that involve students working together in teams. This may be in accordance with the emphasis of the practice of putting the student at the centre and with the experiments with active methodologies that the 3D environment itself makes possible, in which they can interact and collaborate, creating small and motivating working teams (Bronack, Sanders, Cheney, Riedl, Tashner and Matzen, 2008; Leask and Younie, 2001 and Ríos and Ruiz, 2011, Dalgarno, Hedberg and Harper, 2002; Pantelidis, 2009). Interaction in VLE spaces occur naturally and student participation is quite high (Tuncer and Simsek, 2015).

Something similar happens with EM (0.82), with the "innovation and improvement" items, using, in the context of their cooperative learning classroom, collaborative work and projects, and gathering student opinions on how successful the teaching-learning process has been. This happens when suitable tasks are designed, based on pedagogical principles for the purpose of transference (Dalgarno, Hedberg and Harper, 2002; Pantelidis, 2009).

As regards participants' rating of the elements with the most influence on their acquisition, the most prominent of these were teacher feedback and interaction and flipped experiences. They don't point to the virtual 3D environment as such, rather the elements and functions that it provides when there is an instruction design focused on the student.

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For all the above, it is worth pointing out that teaching competencies can be improved and developed when a training programme that focuses on the student is used, and that the 3D VLE is an excellent resource for e-learning, considering all that has been said. In other words, mastery of the content is necessary for teacher training, but is not enough in itself. It is necessary to use teaching methods that include models, learning outcomes, training, a community of learners, scaffolding, articulation, reflection and exploration (Collins 2006).

One of the strengths of this study has been the planned and systematic intervention carried out, and the specific design for each session which was held in a 3D environment. On the other hand, as is common in applied research, there is limited control over the experiment and the sample size is small. Nevertheless, the clarity of the results will inspire replicas of the study with other student groups and subjects in the future.

References

Access to Virtual and Action Learning live Online (www.avalonlearning.eu)

Added Value of Teaching in a Virtual World (www.avatarproject.eu)

Altet, M. (1994). La formation profesionnelle des enseignatns. en Perrenoud, P. (2004b). *Desarrollar la práctica reflexiva en el oficio de enseñar*. Graó.

Berenguer-Albaladejo, C. (2016). Acerca de la utilidad del aula invertida o flipped classroom. In *Jornadas de Redes de Investigación en Docencia Universitaria*. Universidad de Caldas.

Bergmann, J., & Sams, A. (2014). *Flipped learning: Gateway to student engagement*. International Society for Technology in Education.

Bernal, J. L. & Teixidó, J. (2012). *Las competencias docentes en la formación del profesorado*. Síntesis.

Bowman, D. A., Hodges, L. F., Allison, D., & Wineman, J. (1998). *The educational value of an information virtual environment* (GVU Technical Report; GIT-GVU-98-05). Georgia Institute of Technology.

Bronack, S., Sanders, R., Cheney, A., Riedl, R., Tashner, J., & Matzen, N. (2008). Presence pedagogy: Teaching and learning in a 3D virtual

immersive world. *International journal of teaching and learning in higher education*, 20(1), 59-69.

Calvillo Castro, A. J. (2014). *El modelo Flipped Learning aplicado a la materia de música en el cuarto curso de Educación Secundaria Obligatoria: una investigación-acción para la mejora de la práctica docente y del rendimiento académico del alumnado*. Unpublished doctoral thesis Universidad de Valladolid.

Cohen, J. (1992). A power primer. *Psychological Bulletin*, 112, 155-159. https://doi.org/10.1037/0033-2909.112.1.155

Collins, A. (2006). Cognitive apprenticeship. En R. K. Sawyer (Ed.), *The Cambridge handbook of the learning science*s (p. 47–60). Cambridge University Press.

Combined OIT/UNESCO expert committee on the application of *Recomendaciones relativas al personal docente* (28 September – 2 October 2009). Report. Tenth meeting, Paris.

Creating Machinima Empowers Live Online Language Teaching and Learning (http://camelotproject.eu)

Dalgarno, B., Hedberg, J., & Harper, B. (2002). The contribution of 3D environments to conceptual understanding. In *Proceedings of the 19th Annual Conference of the Australian Society for Computers in Tertiary Education* (ASCILITE). Auckland, New Zealand: UNITEC Institute of Technology.

Darling-Hammond, L. (2006). *Constructing 21st-century teacher education. Journal of Teacher Education*, 57, 300–314. https://doi.org/10.1177/0022487105285962

Dede, C., Whitehouse, P., & Brown-L'Bahy, T. (2002). Designing and studying learning experiences that use multiple interactive media to bridge distance and time. *Current perspectives on applied information technologies*, 1, 1-30.

Díaz Fernández, S. M. (2014). Desarrollo de una ficha de observación para el análisis y evaluación de experiencias educativas en mundos virtuales. IJERI: International *Journal of Educational Research and Innovation*, (2), 69-82.

Dickey, M. D. (2005). Three dimensional virtual worlds and distance learning: two case studies of Active Worlds as a medium for distance education. *British Journal of Educational Technology,* 36(3), 439-451.

Received: 30-04-2020 Accepted: 06-11-2020

Eurydice European Unit (2002). *La profesión docente en Europa: Perfil, tendencias y problemática. Informe II. Oferta y demanda. Educación secundaria inferior general.* Eurydice.

Eurydice European Unit (2003). *La profesión docente en Europa: Perfil, tendencias e intereses. Informe I. Formación inicial y transición a la vida laboral. Educación Secundaria inferior general*. Eurydice.

Fritz, C. O., Morris, P. E., & Richler, J. J. (2012). Effect size estimates: Current use, calculations, and interpretation. *Journal of Experimental Psychology: General*, 141(1), 2-18. https://doi.org/10.1037/a0024338

Galvis, R. V. (2007). De un perfil docente tradicional a un perfil docente basado en competencias. *Acción pedagógica*, 16(1), 48-57.

González, L. (2004) Formación universitaria por competencias. In *Seminario internacional CINDA. Currículo universitario basado en competencias*. www.ugcarmen.edu.co/documentos/cinda/gonzalez

Hora, M., & Holden, J. (2013). Exploring the role of instructional technology in course planning and classroom teaching: Implications for pedagogical reform. *Journal of Computing in Higher Education*, 25(2), 68–92.

Hu, L. and Bentler, P. M. (1999) Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, 6:1, 1-55, https://doi.org/10.1080/10705519909540118

Le Boterf, G. (2000). *Ingeniería de las competencias*. Barcelona: Gestión 2000

Leask M. and Younie S. (2001). Communal constructivist theory: information and communications technology pedagogy and internationalisation of the curriculum. *Journal of Information Technology for Teacher Education*, 10, 117-134.

Livingstone, D. and Kemp, J. (2006). Massively Multi-Learner: Recent Advances in 3D Social Environments. *Computing and Information Systems Journal*, 10(2), 1-5.

Martín R., D., & Santiago, R. (2016). Flipped Learning en la formación del profesorado de secundaria y bachillerato. Formación para el cambio. *Contextos educativos: Revista de educación*, (1), 117-134.

Martín R., D., & Tourón, J. (2017). El enfoque flipped learning en estudios de magisterio: percepción de los alumnos. RIED. *Revista Iberoamericana de Educación a Distancia*, 20(2), 187-211.

Received: 30-04-2020 Accepted: 06-11-2020

MEC (2006). *Propuestas para la renovación de las metodologías educativas en la Universidad*. Consejo de Coordinación Universitaria, Ministerio de Educación y Ciencia, Secretaría General Técnica, Madrid.

Michaels, R., Roshandel, S., Truesdell, E., & Urbani, J. M. (2015, June). *Developing and assessing 21st-century skills across teacher education programs.* California Council

Ministry of Education. Secretaría de Estado de Educación y Formación profesional. Dirección General de Evaluación y Cooperación Territorial. Instituto de Evaluación (2009). TALIS *Estudio internacional sobre la Enseñanza y Aprendizaje. Informe español.*

Moral Santaella, C. (1998). Training for the teaching profession. Grupo Editorial Universitario

Morris, S. B., and DeShon, R. P. (2002). Combining effect size estimates in meta-analysis with repeated measures and independent-group designs. *Psychological methods*, 7(1), 105. https://doi.org/10.1037//1082-989X.7.1.105

Nicholson, J., & Galguera, T. (2013). Integrating new literacies in higher education: A self-study of the use of Twitter in an education course. *Teacher Education Quarterly*, 40(3), 7–26.

OECD. (2005). *Teachers matter: Attracting, developing and retaining effective teachers*. Education and Training Policy.

OECD. (2006). *Attracting, Developing and Retaining Effective Teachers - Final Report: Teachers Matter*.

Officers. (2010). Common Core State Standards. Washington, DC: Authors. on Teacher Education Newsletter, pp. 36–37

Pantelidis, V. S. (1991-2009). *Virtual reality and education: Information sources; a bibliography.* Retrieved from http://vr.coe.ecu.edu/vpbib.html

Partnership for 21st Century Skills. (2016). *Framework for 21st century learning*. National Governors Association Center for Best Practices & Council of Chief State School. http://www.p21.org/about-us/p21-framework

Pavié, A. (2011). Formación docente: hacia una definición del concepto de competencia profesional docente. *Revista electrónica interuniversitaria de formación del profesorado,* 14(1), 67-80.

Perrenoud, P. (2004b). *Desarrollar la práctica reflexiva en el oficio de enseñar.* Graó.

Received: 30-04-2020 Accepted: 06-11-2020

Perrenoud, P. (2008). Construir las competencias, ¿es darle la espalda a los saberes? *Revista de Docencia Universitaria, número monográfico I1"Formación centrada en competencias*. http://www.redu.m.es/Red_U/m2

Prieto Martín, A. (2017). *Flipped Learning: aplicar el modelo de aprendizaje inverso*. Narcea Ediciones.

Resta, P. and Patru, eds. (2010). *Desarrollo del maestro in a E-learning Age: A Policy and Planning Guide*. UNESCO.

Riedl, R., Bronack, S., & Tashner, J. (2005). Innovation in learning assumptions about teaching in a 3-D virtual world. In *International College Teaching Methods and Styles Conference,* Reno, NV.

Ríos, J. and Ruíz, J. (2011). Competencias, TIC e innovación: Nuevos escenarios para nuevos retos. *Revista de docencia universitaria*, 10 (2), 467-470.

Roach, T. (2014). Student perceptions toward flipped learning: New methods to increase interaction and active learning in economics. *International review of economics education*, 17, 74-84.

Rust, F., & Bergey, N. (2014). Developing action-oriented knowledge among preservice teachers. *Teacher Education Quarterly*, 41(1), 63–83.

Rutherfoord, R. H. and Rutherfoord, J. K. (2007). *Universal instructional design for learning how to apply in a virtual world.* Document presented at the VIII Conferencia ACM SIGITE de Tecnología de la Información en Educación (pp. 141-146), Minneapolis, EE.UU.

Sams, A., & Bergmann, J. (2013). Flip your students' learning. *Educational leadership*, 70(6), 16-20.

Selverian, M. M., & Hwang, H. S. (2003). A systematic evaluation of evolving VLEs. In *Teleoperators & Virtual Environments*, 12(5), 512-522.

Serrano Pastor, R. M., & Casanova López, O. (2018). Recursos tecnológicos y educativos destinados al enfoque pedagógico Flipped Learning. *Revista de Docencia Universitaria* Vol. 16(1), 155-173.

Siau, K. (2004). Evaluating the usability of a group support system using co-discovery. *Journal of Computer Information Systems*, 44(2), 17-28.

Tejada, J. (1998) *Los agentes de la innovación en los centros educativos. Profesores, directivos y asesores*. Aljibe

Received: 30-04-2020 Accepted: 06-11-2020

Tourón, J., & Santiago, R. (2015). El modelo Flipped Learning y el desarrollo del talento en la escuela. *Revista de Educación*, (368), 174-195.

Tuncer, C. A. N., & Simsek, I. (2015). The use of 3d virtual learning environments in training foreign language pre-service teachers. *Turkish Online Journal of Distance Education*, 16(4), 114-124.

UNESCO. (2010). *Educación para la transformación de las TIC*. Una guía regional. Http://unesdoc.unesco.org/images/0018/001892/189216e.pdf.

Urbani, J. M., Roshandel, S., Michaels, R., & Truesdell, E. (2017). Developing and modeling 21st-century skills with preservice teachers. *Teacher Education Quarterly*, 44(4), 27-50.

Varela, G. A. (2010). *Mundos virtuales educativos: una estrategia de aprendizaje para nativos digitales*. http://148.202.167.76/igcaav/sites/default/files/capitulo%20MV%20gavn.pdf

Warburton, S. (2009). Second Life in higher education: Assessing the potential for and the barriers to deploying virtual worlds in learning and teaching. *British journal of educational technology*, 40(3), 414-426.

White, J. W., & Chant, R. H. (2014). Challenging idealism: Pre-service teachers' core beliefs before, during, and after an extended field-based experience. *Teacher Education Quarterly*, 41(2), 73–92.

Zabalza, M. (2006). *Competencias docentes del profesorado universitario. Calidad y desarrollo profesional*. Narcea.

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Blended teaching through flipped classroom in higher education

La enseñanza híbrida mediante *flipped classroom* en la educación superior

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Abstract

Dramatic changes are expected in higher education with the emergence of the so-called Industry 4.0, which demands soft-skilled, autonomous practitioners with lifelong active learning capacity. Higher Education Institutions (HEIs) try to respond to this demand by redesigning and optimising learning experiences. Blended teaching will help to achieve these objectives when the methodologies required to deploy its full potential become available. The objective of this study is to assess effectiveness of blended teaching based on flipped classroom, in terms of student satisfaction and performance, as compared to fully online teaching. For that, the following questions regarding hybrid subjects are analysed: i) preference for hybrid subjects over fully online teaching; ii) satisfaction with flipped classroom as compared to traditional methodology; and iii) academic performance as a function of the learning environment. Research relied on quantitative and qualitative information obtained from closed surveys and focus groups directed to students from different HEIs, where differences among the means were contrasted to identify statistically significant differences regarding academic performance. Results indicate that the students are highly satisfied with the hybrid environment and the *flipped classroom* methodology. Moreover, the studies taught in this type of classrooms yield better success rates and improved retention as compared to fully online teaching. These indicators can assist HEIs

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in the choice of teaching modalities and methodologies for use in the different subjects of their programs.

Keywords: Information and communication technologies, pedagogical innovation, learning process, satisfaction and undergraduate drop-out rate.

Resumen

La educación superior se dirige a un profundo cambio con la irrupción de la denominada Industria 4.0 que requiere profesionales con competencias *soft*, autónomos y con capacidad para el aprendizaje activo a lo largo de toda la vida. Las Instituciones de Educación Superior (IES) tratan de responder a esta demanda mediante el rediseño y optimización de las experiencias de aprendizaje. La enseñanza híbrida o *blended* puede contribuir a alcanzar estos objetivos si dispone de las metodologías necesarias para desplegar todo su potencial. El objetivo de este estudio es evaluar la efectividad de la enseñanza híbrida con *flipped classroom*, en términos de satisfacción y *performance* del alumno, en comparación con la enseñanza 100% *online*. Para ello, se analizan las siguientes cuestiones respecto de las asignaturas híbridas: i) preferencia de éstas frente a las cursadas 100% online, ii) satisfacción con la *flipped classroom* frente a la metodología tradicional y iii) resultados académicos en función del entorno de aprendizaje. La investigación se ha basado en información cuantitativa y cualitativa obtenida de encuestas cerradas y *focus group* dirigidos a estudiantes de diferentes IES, donde el contraste de medias permite identificar diferencias estadísticamente significativas en relación al rendimiento académico. Los resultados indican que los estudiantes están muy satisfechos con el entorno híbrido y la metodología *flipped classroom*. Además, los estudios que se imparten en este tipo de aulas ofrecen mejores tasas de éxito y una mejor retención en comparación con la enseñanza totalmente *online*. Estos indicadores pueden guiar a las IES en la elección de las modalidades y metodologías de enseñanza para las diferentes asignaturas de sus programas.

Palabras Clave: Tecnologías de la información y comunicación, innovación pedagógica, proceso de aprendizaje, satisfacción y abandono de estudios.

Introduction

The 21st century student needs to acquire the skills and knowledge that enable him/her to face the future challenges of organisations. Higher education is now facing the task of training professionals who can

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occupy and perform in jobs that have yet to be created in the labour market. Higher Education Institutions (HEIs) are attempting to respond to this by turning teaching environments into hybrid models and applying active and collaborative methodologies based on information and communication technologies (ICT). Hybrid or blended teaching can be defined as an approach that combines face-to-face and online learning with ICT (Graham, 2006). The effective integration of both components in the learning experience is the distinguishing feature of hybrid teaching and what makes it more complex (Garrison & Kanuka, 2004). It involves a reappraisal of the teaching-learning process and of spaces, times and resources for active learning. In this context, a methodology that could be considered is the flipped classroom, which focuses on reorganising teaching time and students' active participation in their learning. Theoretical content is transmitted via online support, with practical application, problem solving, group interaction and debates taking place in face-to-face classes. This focus contrasts with traditional methodology, which may be described as the transmission of knowledge to students who play a passive role and where learning is rarely experiential (Wise, 1996). In the hybrid context, applying this methodology means time in the classroom is dedicated to conducting master classes, while practical development takes place outside.

To improve education, it is necessary to consider the many methodologies that currently exist (Bisquerra, 2012). To this end, the aim of this article is to investigate the suitability in higher education of the flipped classroom approach in hybrid teaching, contrasting it with the relevant indicators for HEI decision making, such as satisfaction, performance and student dropout. Firstly, the students' perceptions have been used as a basis to analyse student satisfaction, given that they are the main stakeholders in this approach. In fact, student satisfaction is a basic element in achieving effective learning (Lizzio, Wilson & Simons, 2002). A twofold focus was used to study this factor: hybrid teaching vs. online teaching and the flipped classroom method vs. a traditional approach.

Secondly, the impact of this methodology on academic performance is analysed, examining the differences between students' scores in the hybrid subjects taught in flipped classroom sessions and those obtained in the 100% online subjects. Finally, the impact of the flipped classroom on levels of student dropout from the subject is estimated. Our study

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demonstrates the effectiveness of this methodology in hybrid settings at HEIs, which is a subject that has not been properly addressed in the scientific literature (Pérez-Sanagustín, Hilliger, Alario-Hoyos, Kloos & Rayyan, 2017; Pérez-Sanagustín et al., 2020).

The article uses a methodological triangulation combining quantitative and qualitative research methods to ensure that the results are valid and robust (Aguilar & Barroso, 2015). Closed-ended surveys and focus groups were carried out, contrasting the data from both methods. The sample was made up of degree students in Spain and the United States in hybrid classrooms where the flipped classroom methodology was used.

The results show a high level of student satisfaction with the hybrid setting and the flipped classroom methodology, better marks and lower dropouts in the courses that use this type of classroom when compared to 100% online groups. The contributions of this study to teaching research are as follows: (i) to show the effectiveness of the flipped classroom methodology in hybrid learning as compared to online teaching in terms of satisfaction and performance, (ii) to provide students' perceptions that should be taken into consideration when designing hybrid settings with flipped classroom methodologies and (iii) to provide HEIs with important indicators for decision making about the selection of teaching modalities and methodologies in the subjects that shape their syllabuses.

The article is structured as follows: firstly, the previous literature is reviewed and the research questions are proposed and explained. Then the methodology that was implemented is then described and the results are discussed. Finally, the conclusions and future lines of research are presented.

Hybrid learning and the flipped classroom in higher education

Hybrid teaching is the integration of two forms of learning that develop independently: face-to-face teaching, which has mainly used ICT as a documental repository, and online teaching, which does not have the benefits of a face-to-face class. This necessarily involves redesigning teaching programmes for student-centered learning to further their active participation and increase interaction with the educator, classmates and content (Dziuban, Hartman & Moskal, 2004).

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The integration of the face-to-face and online learning experiences in different contexts, programmes, subjects, etc. brings about different blended models, which means that no two blended designs are alike (Garrison & Kanuka, 2004). New research on the validity of hybrid and online teaching is therefore needed to better understand what might be the ideal hybrid approach, the combination of activities in and out of class that best improve students' learning (Arbaugh, 2014; Nortvig, Petersen & Balle, 2018). The aim in this case is to go deeper into the selection and sequencing of content and the structuring of activities to be done by students. Estrada, Zaldívar, Mendoza, Nava and García (2013) identified areas requiring improvement in hybrid programmes such as quality and interactivity of educational materials and highlighted the need for active participation by students. Likewise, Vanslambrouck, Zhu, Tondeur, Phillipsen and Lombaerts (2016) point out the lack of interaction in online periods as a negative factor.

The flipped classroom began to be implemented based on the studies on Peer Instruction carried out at Harvard University by Mazur (1997) in the 90s, and began to take shape in the secondary teaching of professors Bergmann and Sams (2012) in the United States. It is a pedagogical method that uses asynchronous media such as videos, audio and other online resources to transmit master classes and reserve time in the classroom for participant interaction, problem solving and applying the material to real life situations (Bishop & Verleger, 2013). As Rotellar and Cain (2016) remark, the formal implementation of the flipped classroom methodology in higher education is relatively new, and so studies on its effectiveness and best practices are needed. The HEIs and educators require guidance in designing and teaching blended programmes and subjects, and assistance with the methodologies to be applied in such settings.

DeLozier and Rhodes (2016) conducted a review of the literature on the flipped classroom and the variety of existing focuses. They concluded that the utility of the activities depends on their capacity to motivate the students and that the main advantage of using videos resides in the time they provide for active learning. In highly competitive settings such as the one used by Chen and Chen (2016) in a study of IT students in Taiwan, it was found that this type of learning makes it possible to reduce the gap between industry and education.

Implementation of the flipped classroom methodology has been recommended in blended designs in order to deal with the challenges of higher education (Joseph & Nath, 2013; McLean, Attardi, Faden & Goldszmidt, 2016; Thai, De Weber & Valcke, 2017). However, there are few studies that provide relevant indicators for HEIs (Pérez-Sanagustín et al., 2017). It is therefore necessary to further investigate the effectiveness of the flipped classroom in hybrid education by analysing its impact on performance and student retention levels where studies are less common (Blair, Maharaj y Primus, 2016; Kerr, 2015). Our aim is to show that this methodology is suitable and provide indicators for decision making. One particularly important indicator is the student's perception. One of the main characteristics of the flipped classroom is the active participation and involvement of students in their own learning (Rotellar et al., 2016). Previous studies mention the advantage of students being able to work at their own pace (Hinojo, Aznar, Romero & Marín, 2019), better use of time, greater interaction with the teacher and working classmates (O'Flaherty & Phillips, 2015). On the other hand, there are also some difficulties, such as problem solving (Bognar, Sabli & Škugor, 2019), or factors such as the family context, autonomy, or students' motivation and self-esteem that may have an effect on the implementation of this type of active methodology (Mengual-Andrés, López Belmonte, Fuentes Cabrera & Pozo Sánchez, 2019).

It therefore becomes necessary to contrast students' opinions about the flipped classroom methodology in a hybrid setting. The first research questions are: what are students' preferences when comparing a hybrid setting with a 100% online one? Is it preferable to apply the traditional methodology or the flipped classroom in this hybrid setting?

Another issue to be considered in reviews of the literature is the impact on student performance. O'Flaherty and Phillips (2015) found only a small number of studies that had robust evidence to back up the hypothesis that the flipped classroom improves performance in learning. Zuber (2016) also found insufficient evidence in this regard. Likewise, Uzunboylu and Karagozlu (2015) reached similar conclusions about the application of the flipped classroom in many areas of health sciences, actuarial sciences, English and linear algebra. This in turn leads us to ask the following research question about the performance of the methodology analysed in the hybrid context: do students who study

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in hybrid settings with a flipped classroom methodology obtain better academic results and lower dropout rates?

Methodology and Sample

The sample used for this study consisted of students from *Laureate Universities Inc*., an institution that decided to progressively implement hybrid teaching in the syllabuses of its international network of higher education centres. For that, it was decided to encourage research in this field to know more about the impact of different practices in digital learning and teaching on learning outcomes. Several professors of the Faculty of Social Sciences and Communication of the Universidad Europea, who had been working on the flipped classroom methodology, prepared a research project to study the implementation of hybrid teaching with flipped classroom approaches in two HEIs from their international network: Universidad Europea (Madrid, Spain) and Kendall College (Chicago, United States). The activities for the 2017-2018 period were scheduled in detail, and the teaching staff of both institutions coordinated on a fortnightly basis. Part of this process consisted of a workshop in Chicago with the teaching staff of Kendall College, where results were discussed.

A methodological triangulation was used in this research project, with quantitative and qualitative research methods. According to Aguilar and Barroso (2015) these methods are complementary, crossing data to analyse the convergence of conclusions between one and the other, so their combination boosts their strengths while reducing their weaknesses.

The main objective for the first part of the research is to discover the perceptions of students in two educational settings (hybrid vs. online) and in two learning methodologies (flipped classroom vs. traditional). For that, we used two information-gathering techniques: closed-ended surveys and semi-structured group interviews. Firstly, the students participating in the study had to respond to a closed-ended questionnaire about their level of agreement with different statements, using a Likert scale with four response options (completely disagree, partially disagree, partially agree and completely agree). The main questionnaire, validated

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by educational experts[1], consisted of a total of 14 main questions, with which up to 58 questions could be formulated depending on the level of agreement with the main question. More specifically, the questions in the questionnaire were organised into the following main blocks:

- Preference for hybrid or exclusively online settings, and for flipped classroom or traditional methodologies.
- Distribution of face-to-face and online time with the hybrid format of learning-teaching.
- Specific characteristics of the learning process in each setting and methodology that was studied.

Secondly, focus groups were organised to complete and validate the information obtained in the surveys with a total of 19 participants (12 students in the Spanish institution and 7 in the American institution). The groups were directed by an external moderator who supervised and guided the session and asked open questions taken from a previously designed script that matched the questions used in the previous survey. Three group interviews were conducted, two with groups of the Spanish institution and one with students from the American centre. Once they were completed, qualitative research techniques based on discourse analysis were used to complement the results obtained in the quantitative surveys.

The population of this first part of the research consisted of university students who were studying subjects that used the hybrid teaching format, with a reduced number of face-to-face classes and where flipped classrooms were applied in over 80% of the classes. A random sample was run on the population, which is a widely used technique in educational research, on those subjects that met both conditions. The total sample was made up of 15 lecture groups in Spain and the United States, with 164 students (see Table I).

(1) The questionnaire was validated by the consultancy firm Telling Insights S.L.

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TABLE I. Distribution of number of respondents by location, sex and age

	Sex			Age		
	Male	Female	DK/DA	≤ 25 years	>25 years	DK/DA
Madrid	59.1%	38.2%	2.7%	59.1%	38.2%	2.7%
Chicago	48.1%	40.7%	11.1%	79.6%	9.3%	11.1%

Note: The total number of respondents was 164, of whom 110 were studying in Madrid and 54 in Chicago.

The second part of the research project set out to evaluate the possible existence of statistically significant differences in the students' performance (measured as academic output, pass rates and/or dropout levels) from the different teaching-learning formats: the hybrid and the exclusively online settings. To do so, the academic results of students who had studied with hybrid resources were compared with those obtained by students who had studied the same subject with a completely online format. Only the groups in the Spanish centre were used for this second part of the analysis, as the American centre did not have equivalent subjects with a 100% online approach, which hindered the comparison between both groups. The total sample size for this second part of the research project was 302 students.

Results and Discussion

To analyse the level of satisfaction with the hybrid setting and the flipped classroom methodology, eleven subjects at Universidad Europea de Madrid were selected from three different areas of knowledge (economics, business and law), and four subjects were selected at Kendall College, all of which were included in the area of General Education. The wide selection of subjects made it possible to incorporate heterogeneity into the subsequent analysis. The results of the first and second wave of surveys conducted during the second and third terms of the academic year 2016/17 showed a total participation of 164 students, with 67.1% of the surveys completed by students of the Universidad Europea de Madrid and the other 32.1% by students of Kendall College in Chicago.

Satisfaction with the hybrid setting versus 100% online.

To assess the level of student satisfaction with the hybrid learning environment, students had to state their level of agreement with the following statement: "I prefer to work in a hybrid setting (face-to-face and online) rather than working in a 100% online environment".

The results obtained showed that 79.3% of the students who took the survey preferred to work in a hybrid setting to working in a purely online one. Specifically, 51.2% of students completely agreed with this statement, while 28.1% partially agreed. Only 9.75% completely disagreed with this statement. After refining their preference, students had to indicate the main reasons for their choice. Table II shows the results of the percentage of agreement or disagreement with each of the reasons shown for the students who preferred hybrid courses. As shown below, the students pointed out that studying in this setting enabled them to make better use of face-to-face time and more effectively resolve their doubts, which generally provided them with more learning capacity. When results of this analysis are divided into the two HEIs, there is no evidence of statistically significant differences between the percentages of agreement or disagreement of both institutions, although it is true that the students of the Chicago centre did not consider the hybrid setting to create better use of their own time.

TABLE II. Reasons for preference: hybrid vs. 100% online setting

Reasons	Agree (%)	Disagree (%)
Better use of face-to-face time	89.2	10.8
Better resolution of doubts	88.5	11.5
Greater learning capacity	86.2	13.8
More active participation	86.2	13.8
Greater proximity to lecturer	83.1	16.9
Greater autonomy	73.1	26.9
Better use of student's time	70.8	29.2

Source: Compiled by authors

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Likewise, the students who preferred a completely online setting also had to give the reasons for their opinion. As Table III shows, the results obtained did not appear to be very conclusive as they show a reduced level of agreement with the reasons given in the survey for not preferring the hybrid setting. They only suggested that the proposed reasons are not reasons with sufficient weight for inference because the students do not prefer the hybrid learning setting when compared to a 100% online environment.

TABLE III. Reasons for not preferring a hybrid environment to a 100% online setting

Reasons	Agree (%)	Disagree (%)
Less autonomy	38.2	61.8
Do not understand the setting	35.3	64.7
Lower learning level	32.4	67.6
The online part is enough (without face-to-face classes)	29.4	70.6

Source: Compiled by authors

The results for preferences in the hybrid setting were also widely discussed in the students' focus group. Most of the students interviewed expressed a preference for this format over an exclusively online one ("*The hybrid environment combines the strong points and the best of online and face-to-face, and that's a good thing*"). They also stated that they learnt better because it increased proximity to the teacher, which enabled them to resolve their doubts more effectively while their learning process could be more effectively monitored ("*A teacher can realize that a student needs more support, because they don't notice that online*"). Students also highlighted the role played by face-to-face contact in improving the pace of study ("*The fact that there's face-to-face contact forces you to maintain a more constant pace*") and encourages contact with classmates. These aspects are greatly reduced in the online setting ("*Another very important thing, apart from the teaching itself, from a personal point of view, is the bonds you create with other people and with the university itself. After all, if you do everything online, there's no university life*"). All these factors therefore contribute towards increasing their motivation and perception of greater learning with the hybrid format ("*I've spent no time on the 100% online studies, they don't get*

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you hooked"). Finally, they also showed a greater preference for using blending in complex subjects that required understanding more difficult concepts and operations.

Satisfaction with the flipped classroom methodology

Students had to agree or disagree with the statement "*I liked the system of studying the theoretical aspects of the subject online and using the face-to-face sessions to clarify doubts and do practical work*", to show their level of satisfaction with the flipped classroom methodology. The results obtained showed that 66.4% of the students agreed with implementing the new educational methodology. Only 13.4% completely disagreed with it.

Once the students' preference for this methodology was identified, the following set of questions set out to identify the main reasons for their choice. As Table IV shows, the main advantages identified by the students were the greater amount of practice-centered learning, and better motivation regarding the subject and its study. At the opposite end of the scale, the reasons for the dissatisfied students' choice included a preference for traditional methodologies and the increased workload that using the method implied (Table V).[2]

TABLE IV. Reasons for preferring the flipped classroom methodology as opposed to traditional approaches

Reasons	Agree (%)	Disagree (%)
Improves my capacity to pass the subject	92.10	7.90
Improves practical application of the course	89.50	10.50
Improves my interest in the subject	84.21	15.79
Improves my motivation in comparison to traditional approaches	84.21	15.79
Improves my individual relationship with the teacher	81.58	18.42
Improves relationships with my classmates	71.05	28.95
Improves my teamwork skills	63.16	36.84

Source: Compiled by authors

(2) Once again, the results obtained after dividing them by the location of the HEI showed no statistically significant differences in the agree/disagree percentages between the centres.

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TABLE V. Reasons for not preferring the flipped classroom methodology to traditional approaches

Reasons	Agree (%)	Disagree (%)
I prefer more traditional methodologies	87.55	12.55
It means more work and effort for me	62.55	37.45
I prefer to do the practical work at home	50.00	50.00
I didn't like the course material	31.25	68.75
I didn't understand the methodology	12.55	85.55

Source: Compiled by authors

The students were also asked about the advantages they could identify in implementing the flipped classroom approach in the classroom itself. In this regard, 83% said that it provided greater autonomy for studying in comparison to traditional approaches thanks to the master classes and practical work outside the classroom. This result is very interesting, given that it is often considered that one of the main advantages of online teaching is the greater student autonomy resulting from asynchronous learning (Vanslambrouck et al., 2016). Therefore, the flipped classroom would maintain this increased autonomy in learning, while using the face-to-face sessions to reinforce and consolidate the knowledge acquired.

The above results were also confirmed and supplemented in the students' focus group. There, the main advantage of the flipped classroom methodology gleaned from the participants' comments was related to the option of better time management: dedicating face-to-face classes to more difficult tasks that require a teacher's presence, and using personal time, more autonomy, for simpler tasks. All this contributed towards making classes more enjoyable, which increased the students' involvement and motivation ("*There's more interaction in a flipped classroom, because there are always conversations between the teacher and students. It's like a ball being passed around again and again*"). Clarification of doubts is also faster with this methodology since questions can be asked in class with the teacher present and, although students work more in face-to-face sessions, the results are better ("*You make more of an effort, but it's more productive, because it obliges you to prepare in advance because if you don't, you end up in a dynamic of the person who goes, listens and has no obligation*"). The main disadvantage students commented on was

the difficulties of working on the theoretical aspects of the subject alone ("*I like to have the theory explained to me, because you can go to a class and cover a complete topic in an hour, and at home I can't do the same thing in one hour*"). They also emphasised the importance of having good quality materials to be able to correctly prepare the face-to-face sessions ("*Sometimes I had to look for information on my own because I felt that something was missing, that I didn't understand regarding something I'd been theoretically taught. The teacher ought to give you more complete and more specific material*").

These results are also backed up by research on students' perceptions in the flipped classroom (Awidi & Painter, 2019; Blair, 2016; Hernández Nanclares & Pérez Rodriguez, 2016), although our study has the unique feature of being applied in hybrid courses that reduce the number of classroom hours. The greatest difficulty in the flipped classroom is that of student responsibility, especially in work outside the classroom, which is crucial if the face-to-face time is to be effectively used (Bognar et al., 2019; He, Holton, Farkas & Warschauer, 2016; Touron & Santiago, 2015). In our case, where the hybrid classroom reduces time in class, students perceived "more effort", which meant that the teaching staff had to redesign materials and activities to provide greater support to student learning. This has been the goal of such HEI initiatives as including problem-based activities for learning (Çakıroğlu & Öztürk, 2017) or the integration of MOOCs into traditional courses (Joseph & Nath, 2013; Pérez-Sanagustín et al., 2017).

Distribution of face-to-face and online time in hybrid subjects

The survey also set out to analyse student perceptions of the proportions of face-to-face and online time in the hybrid subjects of the sample. In this regard, the subjects that participated in the study had 50% attendance in face-to-face classes and 50% online. The survey results show that almost 80% of the students prefer to spend more time in face-to-face classes. Table VI shows the main reasons for this larger percentage of face-to-face time. The main reasons are related to the possibility of more time for explaining practical concepts and to learn to manage their own resources more efficiently.

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TABLE VI. Reasons for preferring more face-to-face time

Reasons	Agree (%)	Disagree (%)
More practical explanations	94.7	5.3
Learn to manage my resources more efficiently	90.1	9.9
More practice in the subject	88.5	11.5
More individual work with the teacher	85.5	14.5
Acquire teamwork experience	81.7	18.3
More interactions with my classmates	79.4	20.6
More theoretical explanations	75.6	24.4

Source: Compiled by authors

We found similar results to those in previous studies, with the most recommended balance being 50%-50% for implementing hybrid teaching courses, although this proportion may be affected by other factors related to the subject area and the students' characteristics (Donnelly, 2010; Demirer & Sahin, 2013; Thai et al., 2017). The general opinions of the focus continued with the same arguments of demanding more face-to-face hours, because it promoted greater commitment to the subject and offered a better chance to interrelate with the teacher and other classmates. However, students who balanced their studies with a full-time job stated that more face-to-face time made it more difficult to attend classes, and also took away study time. Discussions in the group interviews not only focused on the most adequate proportion of hours between face-to-face and online time, but also on the fact that the students also wanted more rational organisation of the time dedicated to face-to-face sessions.

Academic results depending on the learning environment (hybrid and exclusively online)

This Section considers the statistically significant differences between the students' academic results, depending on the learning environment where they studied the subjects. To this end, the students' final marks in each

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subject were used, in the hybrid and exclusively online schemes[3]. It should be mentioned that the evaluation content and systems for each subject considered in each setting are the same. The total sample of students was 302, of which 49.01% studied in a hybrid teaching setting and 50.99% in an exclusively online environment. However, the final sample was reduced to 261 students, since 41 (10 in hybrid courses and 31 in online courses) dropped out of the subject and therefore did not have a mark in either of the two exams taken (first and second sitting of exam).[4]

According to the first analysis of Table VII, the students who took subjects in hybrid settings showed a higher average mark than those who studied in solely online environments (7.39 against 7.22 out of 10, respectively). However, this difference is not statistically significant (p-value >0.05).

TABLE VII. Students' performance in hybrid settings compared to online settings

		Obs.	Mean	Standard deviation	P-value Ha:diff.≠ 0
Average mark	**Online**	123	7.219	1.810	
	Hybrid	138	7.386	1.412	
	Total	261	7.307	1.611	
	Diff. Online-Hybrid		–0.167		0.4107
% Passed	**Online**	123	0.935	0.248	
	Hybrid	138	0.993	0.085	
	Total	261	0.966	0.183	
	Diff. Online-Hybrid		–0.058		0.0150
Success rate	**Online**	154	0.747	0.436	
	Hybrid	148	0.926	0.263	
	Total	302	0.834	0.372	
	Diff. Online-Hybrid		–0.179		0.0000

(3) The marks of Kendall College were not included in the student's performance analysis, as there were no marks for the same subject taught online. However, the final marks of the hybrid subjects were available in Grade Point Averages (A, B, C, D, E and F).

(4) If the student did not pass or dropped out of the subject in the first sitting and took it in the second, the second mark was the one to be used.

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Dropout rate	**Online**	154	0.201	0.402	
	Hybrid	148	0.068	0.252	
	Total	302	0.136	0.343	
	Diff. Online-Hybrid		0.134		0.0006

Source: Compiled by authors.

The second analysis set out to evaluate the statistically significant differences between the average percentages of students who passed the subject, again depending on the learning environment in which the subject was taught. For that, a dummy variable was created that was assigned a value of 1 if the student obtained a final mark that was the same as or better than five points, and 0 if the mark was below 5. As Table VII shows, the average percentage of successful grades in the exclusively online setting was 93.5%, while this rate in hybrid settings was 99.3%, which was a statistically significant difference at the 2% level. This result shows that the hybrid teaching system generates a higher percentage of passes than the online system.

However, the first two analyses have a major limitation in that they do not include students with a score of "not present", when it is evident that such students should be taken into account since they have not passed the subject. To overcome this limitation, the third analysis contrasts the existence of statistically significant differences between the success rates of passing the subject in each learning environment. To do this, a new dummy variable was constructed that took the value 1 if the final mark was greater than or equal to five, and 0 when the student failed the subject or did not take the exam in either sitting.

As Table VII shows, the percentage of students who successfully passed the subject was significantly higher in the hybrid setting than in an exclusively online environment. Specifically, the success rate in hybrid environments was 92.6%, compared to 74.7% in purely online settings. Likewise, the results show that the difference between both rates is statistically significant at the 1% level. This result would therefore support the implementation of subjects in hybrid settings, given that they lead to a higher number of students who successfully pass the subject.

Finally, the last analysis set out to statistically contrast the difference between student dropout rates depending on the two learning formats used. A new dummy variable was constructed that was assigned the

value of 1 if the student abandoned the subject (e.g. their final mark was "Not present"), and 0 if they had a score in their final mark (regardless of whether the score was more than, equal to or less than 5 points). The results showed that students who studied in hybrid settings had a lower dropout rate that those who studied in purely online settings. More specifically, the average dropout rate in the hybrid learning environment was 6.8% compared to 20.1% in the purely online setting, making this difference once again statistically significant at the 1% level. Such results would therefore support increasing the use of hybrid subjects over purely online ones, since they lead to a statistically significant reduction in the dropout rate of students.

To sum up, the results of this section show that there are statistically significant differences in student performance, in terms of passing/failing the subject, successfully/unsuccessfully passing and dropping out/not dropping out. However, no statistically significant differences were found in the average mark of students according to the learning environment used for the subject.

The results obtained may well suggest that the application of flipped classrooms in hybrid subjects generates a learning environment that improves the students' performance, which matches the results of more recent studies (Hinojo et al., 2019). The reasons for this affirmation are that they promote active learning and the acquisition of soft skills such as autonomy and teamwork, which improves student performance in hybrid subjects that have a lower number of face-to-face classes. The results show that HEIs that replace online methodologies with blended ones that include flipped classrooms can obtain better success rates and lower dropout rates from subjects, which has a positive impact on student retention levels.

Conclusions

HEIs need indicators to enable them to select teaching modalities and methodologies that can optimise their value proposal for Industry 4.0 and that help students acquire soft skills, autonomy and the capacity for active learning throughout their lives. In this study, we have used student satisfaction and performance indicators to evaluate the effectiveness of an active methodology, the flipped classroom, in blended or hybrid designs.

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The research took place in two HEIs, a university in Spain and a college in the United States, to make the results more relevant and transferable.

Results indicate that the students show more satisfaction with blended modalities than with 100% online approaches because of the potential for class work where doubts can be clarified, and for active learning and participation. In their opinion, the blended environments enable the strong points of face-to-face teaching and online learning to be combined and they are preferable in more difficult subjects. One of the first consequences of the results from our studies for HEIs is that they should be guided not so much by the area of knowledge but rather by the level of complexity of the subjects taught when selecting the course modality.

A second implication of the results from our study is the need to find an adequate percentage of class hours in relation to the online hours and to redesign the time used for the practical application of the subject and to achieve a more efficient management of resources. In this regard, the students felt it was essential to pay more attention to the quality of the materials for online learning.

Furthermore, the students' opinions showed that the HEIs that implemented blended programmes with flipped classrooms should employ resources that promote autonomous study and class interaction when preparing materials and designing activities. By doing so, one of the main challenges of these programmes - student responsibility for work outside class - could be overcome.

Another important outcome of our study is that success, measured in terms of passing subjects, is significantly higher in hybrid classrooms, with dropout rate being also significantly higher when using exclusively online environments. HEIs should rethink the suitability of keeping purely online courses in their syllabuses.

To summarize, this study provides evidence that blended teaching in flipped classrooms promotes active learning and the acquisition of soft skills, such as teamwork and autonomy, and boosts student performance. For all these reasons, we consider that this teaching modality can help HEIs to increase their value proposal, reducing the gap between industry and education.

Finally, one limitation of this study is the availability of data from one academic year alone, together with the fact that the academic results pertain to only one of the two HEIs. We would recommend replicating

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this study in future academic years and other HEIs to contrast the findings obtained over time. For future studies, it would be a good idea to add relevant indicators for the HEIs such as the costs and benefits of blended designs with flipped classrooms and extend the study to a larger number of HEIs.

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References

Aguilar Gavira, S., & Barroso Osuna, J. (2015). La triangulación de datos como estrategia en investigación educativa. *Píxel-Bit, Revista de Medios y Educación*, *47*, 73–88. doi:org/10.12795/pixelbit.2015.i47.05

Arbaugh, J. B. (2014). What Might Online Delivery Teach Us About Blended Management Education? Prior Perspectives and Future Directions. *Journal of Management Education*, *38*(6), 784–817. doi:org/10.1177/1052562914534244

Awidi, I.T. & Paynter, M. (2019). The impact of a flipped classroom approach on student learning experience. *Computers & Education, 128*, 269-283.

Bergmann, J., & Sams, A. (2012). *Flip your classroom: Reach every student in every class every day*. Virginia (USA): International Society for Technology in Education.

Bishop, J. L., & Verleger, M. A. (2013). The Flipped Classroom: A Survey of the Research. *120th ASEE Anual Conference & Exposition*. Atlanta, GA: American Society for Engineering Education.

Bisquerra Alzina, R. (2012). Metodología de la investigación educativa. In *Métodos de investigación educativa: Guía práctica* (3ª). doi:org/10.1017/CBO9781107415324.004

Blair, E., Maharaj, C., & Primus, S. (2016). Performance and perception in the flipped classroom. *Education and Information Technologies*, *21*(6), 1465–1482. doi:org/10.1007/s10639-015-9393-5

Bognar, B., Sablić, M., & Škugor, A. (2019). Flipped Learning and Online Discussion in Higher Education Teaching: Smart Pedagogy for Technology Enhanced Learning. In *Didactics of Smart Pedagogy* (pp. 371–392). doi:org/10.1007/978-3-030-01551-0_19

Chen, Y. T., & Chen, L. F. (2016). Effects of the Flipped Classroom Model on Student Performance for Vocational College Students. *2016 International Conference on Educational Innovation through Technology, EITT*, 117–121. doi:org/10.1109/EITT.2016.30

Çakıroğlu, Ü., & Öztürk, M. (2017). Flipped Classroom with Problem Based Activities: Exploring Self-regulated Learning in a Programming Language Course. *Educational Technology & Society, 20(1)*, 337–349.

DeLozier, S. J., & Rhodes, M. G. (2016). Flipped Classrooms: a Review of Key Ideas and Recommendations for Practice. *Educational Psychology Review*. doi:org/10.1007/s10648-015-9356-9

Demirer, V., & Sahin, I. (2013). Effect of blended learning environment on transfer of learning: An experimental study. *Journal of Computer Assisted Learning*, *29*(6), 518–529. doi:org/10.1111/jcal.12009

Donnelly, R. (2010). Harmonizing Technology With Interaftion In Blended Problem-Based Learning. *Computers and Education*, *54*(2), 350–359. doi:org/10.1016/j.compedu.2009.08.012

Dziuban, C., Hartman, J., & Moskal, P. (2004). Blended Learning. *EDUCASE Center for Applied Research. Research Bulletin*, *2004*(7).

Estrada Lizárraga, R., Zaldívar Colado, A., Mendoza Zatarain, R., Nava Pérez, L., & García Sánchez, O. V. (2013). Percepción de los estudiantes acerca de la implementación de la modalidad educativa blended-learning en la Educación Superior. *Revista Electrónica de Investigación En Educación Superior*, *1*(1), 1–12. Retrieved from http://www.iiies.org/reedies

Received: 21-03-2020 Accepted: 05-11-2020

Garrison, D. R., & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. *The Internet and Higher Education*, *7*, 95–105. doi:org/10.1016/j.iheduc.2004.02.001

Graham, C. R. (2006). *Blended learning systems: Definition, Current Trends, and Future Directions.* (C. J. Bonk y C. R. Graham, Eds.). San Francisco CA: Pfeiffer.

He, W., Holton, A., Farkas, G., & Warschauer, M. (2016). The effects of flipped instruction on out-of-class study time, exam performance, and student perceptions. *Learning and Instruction*, *45*, 61–71. doi:org/10.1016/j.learninstruc.2016.07.001

Hernández Nanclares, N., & Pérez Rodríguez, M. (2016). Students' Satisfaction with a Blended Instructional Design: The Potential of "Flipped Classroom" in Higher Education. *Journal of Interactive Media in Education*, *2016*(1), 1–12. doi:org/10.5334/jime.397

Hinojo Lucena, F. J., Aznar Díaz, I., Romero Rodríguez, J. M., & Marín Marín, J. A. (2019). Influencia del aula invertida en el rendimiento académico. Una revisión sistemática. *Campus Virtuales*, *8*(1), 9–18. Retrieved from http:// www.revistacampusvirtuales.es

Joseph, A. I. M., & Nath, B. A. (2013). *Integration of Massive Open Online Education (MOOC) System with in-Classroom Interaction and Assessment and Accreditation: An extensive report from a pilot study*. Retrieved from http://weblidi.info.unlp.edu.ar/worldcomp2013-mirror/p2013/eee3547.pdf

Kerr, B. (2015). The flipped classroom in engineering education: A survey of the research. *Proceedings of 2015 International Conference on Interactive Collaborative Learning, ICL 2015*, (September), 815–818. doi:org/10.1109/ICL.2015.7318133

Lizzio, A., Wilson, K., & Simons, R. (2002). University students' perceptions of the learning environment and academic outcomes: Implications for theory and practice. *Studies in Higher Education*, *27*(1), 27–52. doi:o rg/10.1080/03075070120099359

Mazur, E. (1997). *Peer instruction: A user's manual*. Prentice Hall Upper Saddle River, NJ.

McLean, S., Attardi, S. M., Faden, L., & Goldszmidt, M. (2016). Flipped classrooms and student learning: Not just surface gains. *Advances in Physiology Education*, *40*(1), 47–55. doi:org/10.1152/advan.00098.2015

Mengual-Andrés, S., López Belmonte, J., Fuentes Cabrera, A., & Pozo Sánchez, S. (2019). Modelo estructural de factores extrínsecos

Received: 21-03-2020 Accepted: 05-11-2020

influyentes en el flipped learning. *Educación XX1*, 1–27. doi:org/10.5944/educxx1.23840

Nortvig, A. M., Petersen, A. K., & Balle, S. H. (2018). A Literature Review of the Factors Influencing E-Learning and Blended Learning in Relation to Learning Outcome, Student Satisfaction and Engagement. *The Electronic Journal of E-Learning*, *16*(1), 45–55. Retrieved from http://www.ejel.org

O'Flaherty, J., & Phillips, C. (2015). The use of flipped classrooms in higher education: A scoping review. *Internet and Higher Education*, *25*, 85–95. doi:org/10.1016/j.iheduc.2015.02.002

Pérez-Sanagustín, M., Hilliger, I., Alario-Hoyos, C., Kloos, C. D., & Rayyan, S. (2017). H-MOOC framework: reusing MOOCs for hybrid education. *Journal of Computing in Higher Education*, *29*(1), 47–64. doi:org/10.1007/s12528-017-9133-5

Pérez-Sanagustín, M., Sapunar-Opazo, D., Pérez-Álvarez, R., Hilliger, I., Bey, A., Maldonado-Mahauad, J., & Baier, J. (2020). A MOOC-based flipped experience: Scaffolding SRL strategies improves learners' time management and engagement. *Computer Applications in Engineering Education*, (July), 1–19. doi:org/10.1002/cae.22337

Rotellar, C., & Cain, J. (2016). Research, perspectives, and recommendations on implementing the flipped classroom. *American Journal of Pharmaceutical Education*, *80*(2), 1–9. doi:org/10.5688/ajpe80234

Thai, N. T. T., De Wever, B., & Valcke, M. (2017). The impact of a flipped classroom design on learning performance in higher education: Looking for the best "blend" of lectures and guiding questions with feedback. *Computers & Education*, *107*, 113–126. doi:org/10.1016/j.compedu.2017.01.003

Tourón, J., & Santiago, R. (2015). El modelo Flipped Learning y el desarrollo del talento en la escuela. *Revista de Educacion*, 196–231. doi:org/10.4438/1988-592X-RE-2015-368-288

Uzunboylu, H., & Karagozlu, D. (2015). Flipped classroom: A review of recent literature. *World Journal on Educational Technology*, *7*(2), 142–147. doi:org/10.18844/wjet.v7i2.46

Vanslambrouck, S., Zhu, C., Tondeur, J., Phillipsen, B., & Lombaerts, K. (2016). Adult learners' motivation to participate and perception of online and blended environments. *Poceeding of the 15th European Conference on E-Learning, Charles University, Prague*, 750–757.

Wise, K.C. (1996). Strategies for teaching science: What works?. *Clearing House, 69*, 337–338.

Zuber, W. J. (2016). The flipped classroom, a review of the literature. *Industrial and Commercial Training*, *48*(2), 97–103. doi:org/10.1108/ICT-05-2015-0039

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Effectiveness of the flipped classroom model in university education: a synthesis of the best evidence

Eficacia del modelo de aula invertida (*flipped classroom*) en la enseñanza universitaria: una síntesis de las mejores evidencias

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Abstract

This paper explores the historical origin of the flipped classroom (FC) model and synthesizes the literature on the FC effectiveness in incorporating more active learning and creating a student-centred educational environment in Higher Education (HE). To this end, the literature on the FC and other pioneering methodologies has been reviewed, paying special attention to the impacts of the FC on student involvement and academic performance. The FC model is based on different methodological approaches –applied in university teaching since the 1990s– that encourage student preparation before classes: team-based learning, peer instruction and just-in-time teaching, where the teacher sends the information to his or her students through electronic means. This allows more class time to be devoted to active learning and formative assessment. The FC model became popular in secondary education with the use of videos to convey information to students. Recent research shows positive effects of the flipped classroom on multiple elements of the educational process. First, FC increases the motivation and involvement of students in activities outside and

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inside the classroom. Second, it improves overall comprehension and retention of the subjects taught, which results in an improvement in performance and a reduction in the failure rate. Third, it improves the development of competences and skills, and finally it increases the satisfaction of the students and teachers who put it into practice. These positive effects have been confirmed in many disciplines and geographical areas.

In addition, the flipped classroom model creates opportunities for students to interact earlier and more sustainably with instructional materials, improving their readiness to apply their understanding to classroom activities. Thus, students with a higher level of completion of preparatory tasks are those who obtain higher performance in the FC.

Key words: flipped classroom (FC); academic performance; active learning; student engagement; team-based learning; peer instruction; just-in-time teaching; skill and competence development; student perceptions; long-term effect.

Resumen

Este artículo explora el origen histórico del aula invertida y sintetiza las evidencias que valoran su eficacia para incorporar más aprendizaje activo en la educación superior y crear un entorno educativo centrado en las acciones que realizan los estudiantes. Para ello se ha revisado la literatura sobre el aula invertida y otras metodologías precursoras de la misma prestando especial atención a los impactos del aula invertida sobre la implicación estudiantil y el rendimiento académico. El aula invertida tiene precedentes en metodologías de fomento del estudio previo que se aplican en enseñanza universitaria desde los noventa: el aprendizaje basado en equipos, la instrucción por compañeros y la enseñanza a tiempo en las que el docente envía la información a sus alumnos mediante medios electrónicos. Así hay más tiempo de clase para dedicarlo al aprendizaje activo y la evaluación formativa. El aula invertida se popularizó en educación secundaria con el uso de vídeos para transmitir la información a los alumnos. La literatura muestra efectos positivos del aula invertida sobre el proceso educativo. Aumenta la motivación y la implicación de los alumnos en las actividades fuera y dentro de clase. Mejora la comprensión y la retención de las materias enseñadas que se traducen en una mejora del rendimiento y una reducción en la tasa de fracaso. Mejora el ejercicio y el desarrollo de competencias y finalmente aumenta la satisfacción de los alumnos y profesores que la ponen en práctica. Estos efectos positivos se han confirmado en múltiples disciplinas y ámbitos geográficos. El aula invertida crea oportunidades para que los alumnos interaccionen antes y de manera más sostenida con los materiales instructivos, mejorando su preparación para aplicar lo comprendido en las actividades de clase. Los alumnos con mayor nivel de realización de tareas preparatorias son los que obtienen superiores rendimientos en el aula invertida.

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Palabras clave: aula invertida; rendimiento académico; aprendizaje activo; implicación estudiantil; aprendizaje basado en equipos; instrucción por compañeros; enseñanza a tiempo, desarrollo de habilidades y competencias, percepciones estudiantiles; efecto a largo plazo

Introduction

In spite of pedagogical and technological advances, the use of traditional expository methodology predominates in current university curricula (Galway et al., 2014). Most of the class time is devoted to explaining the information on which assessment tests will focus (Moravec et al., 2010). Furthermore, curricula are boring for current university students and barely motivate them to attend. They do not involve students in self-regulated learning and do not effectively promote the development of their skills and competences (Mohr et al., 2017). In other words, traditional methodology and current university curricula do not help our students to develop the competences they will need as individuals and as professionals (Arum and Roksa, 2014, Medina, 2016).

Several studies show that a significant proportion of university students do not learn to reason critically, communicate professionally, or develop the complex reasoning skills that should be at the core of HE (Arum and Roska, 2010, Bok, 2017). University students often graduate without the critical thinking and professional writing skills that employers demand (Arum and Roksa, 2014). In current university education, the role of students is often predominantly passive and, therefore, does not encourage practice and development of the essential skills required in the labor market (Murillo-Zamorano, López-Sanchez and Godoy-Caballero, 2019).

In order to make a class an attractive learning experience for today's university students, we should rethink how and where class time is spent; we should provide students with in-class tasks that connect with their interests and help them to practice those skills that will increase their employability by bringing what they learn in class closer to what is required in their future professional roles and profiles (Lai, Hsiao and Hsieh, 2018). Therefore, the proposals for curricular and methodological

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reform in HE highlight the need to rethink traditional models of lecture-based courses and subjects in which teachers typically present the information to be learned (McLaughlin et al., 2014; Bok, 2017) .

To practice these competences and skills, teachers should propose activities in which students could apply the information learned to create solutions to relevant problems (Prieto, Díaz y Santiago, 2014a). This objective can be achieved by fostering out-of-class inquiry-based learning models, as current students are accustomed to searching for information on the Internet and applying it to problem solving (Mohr et al., 2017). If tasks are carried out outside the classroom, the students' interaction with the materials is more continuous throughout the term (Prieto, Díaz, Monserrat and Barbarroja, 2020b). This results in an increased volume of students' out-of-class work, which is currently much lower than the workload legally established in the ECTS credits (Souto-Iglesias and Baeza-Romero, 2018).

In the last decade, the methodological approach that has shown the greatest potential for incorporating more active learning in the university classrooms is the flipped classroom model (Prober and Heath, 2012). The increasing interest in this methodological approach is reflected in the significant growth of the citations about FC in Google Scholar, which have increased from 187 in 2009 to 11,000 in 2019. Over the last decade, the volume of publications about FC has totaled more than 52,000, justifying the need of a study of bibliographical synthesis such as the one offered in this paper on the origins and effects of this methodology.

The flipped classroom model is underpinned on an active blended-learning pedagogy, which fosters the out-of-class preparation of students for interactive classes. In the FC, the teacher first sends the learning materials to students so they can try to study and understand them for themselves. Then, students study individually to be prepared to participate in class activities. Finally, class time is devoted to deepening students' understanding and to assimilating knowledge through active and team-based learning activities, and problem-solving. Thus, learner-centred learning environments are created (Prieto and Giménez, 2020a) such as inquiry-based learning, case-study learning, problem-solving (Chiang, 2017), projects (Liu, Wu, Zhang and Guo, 2017) and formative assessment (Crouch and Mazur, 2001; Michaelsen, Parmelee, McMahon and Levine 2008; Costa, 2016). The flipped classroom may promote a more active approach to learning; transmitting the information to be

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learned online, the in-class time is no longer devoted to explaining concepts to students but to incorporating active learning and problem-solving activities in class. This model inverts what is traditionally done in the classroom –transmitting the information to be learned– and what is done outside of class –practicing activities.

The flipped classroom model combines two essential elements necessary to implement a new paradigm in the 21st century university education. On the one hand, it provides an innovative use of ICTs to establish two-way online communication with students. On the other, it fosters a new methodological proposal that requires a change in the way students work in and out of the classroom (Sola, Aznar, Romero and Rodríguez-García, 2019). The FC model is centered on the student (McLaughin et al., 2014), who is responsible for following the teacher's directions to attend classes with a basic understanding of the learning materials. This will allow him/her to become involved and participate in the in-class activities (Prieto et al., 2017).

In this synthesis of the best evidence, the pedagogical justification, the origin and the evolution of the flipped classroom model from the end of the last century to the present are reviewed. This critical synthesis of the evidence on the effects of the FC implementation on the students' involvement and academic performance will provide teachers with evidence to motivate a change in their teaching methodologies, from traditional expository teaching to the flipped classroom model.

Methods

The objective of this paper was twofold: first, to conduct a knowledge synthesis on the pioneering methods underpinning the flipped classroom method developed in the last decade of the last century; second, to gather information on the impacts that the implementation of the FC in Higher Education may have on students' motivation and involvement, academic performance, development of competencies and skills and on their perceptions of their learning experience. To this end, multiple Google Scholar searches were carried out on documents that included keywords used to name different variants of the flipped classroom method (flipped classroom, inverted classroom, flipped learning, classroom flip, reverse

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instruction) and its pioneering methods in English (peer instruction, team-based learning, just-in-time teaching).

In order to carry out a more exhaustive chronological analysis of the bibliographical references found, searches –with the above-mentioned keywords– limited by year were run. Numerical results are shown in Figures 1 and 2. Searches with the Spanish terms "aula invertida", "aprendizaje invertido", "enseñanza por compañeros", "aprendizaje basado en equipos" y "enseñanza a tiempo" were also conducted. Not only original research paper were selected, but also reviews, PhD theses, books and meta-analyses. Bibliographical references of the selected papers were also analyzed to find other studies potentially useful for our review. These papers were located through Google Scholar and PubMed. To select them, abstracts and full articles were reviewed to decide whether the information they contained was relevant to our research. Finally, our research focused on the extraction and thematic organization of relevant data to make a synthesis of the results obtained.

To measure the impact of the flipped classroom on academic performance or motivation, the effect size (ES) is used. The ES represents the number resulting from dividing the observed change by the average value obtained with flipped classroom with respect to the average value obtained with traditional methodology divided by the value of the standard deviation (s) obtained with traditional methodology.

Results

Scientific evidence has shown that introducing more active learning into university classrooms improves students' academic performance (Freeman et al., 2014). However, despite the excellent academic results of active learning, most university teachers have ignored scientific evidence and have not incorporated active learning into their regular methodological practice. Incorporating active learning implies dedicating part of the limited class time to application, reflection and debate; this time should necessarily be subtracted from the time traditionally devoted to the oral transmission of information to students, and this is something that most teachers are not willing to give up (Prieto et al., 2020a). Incorporating more active learning also requires an extra effort on the part of the teacher

and determination to confront the possible resistance of those students who feel more comfortable with the traditional expository method.

For these reasons, the expository method, in which teachers provide information to students in class, has continued to be the most used strategy in university classrooms during the first two decades of the 21st century. In this context, the FC model turns the classroom lessons into interactive learning environments, taking the initial transmission of information outside the classroom and dedicating class time to help students –already prepared for the class– to practice higher-order thinking skills such as problem-solving, discussion or debates proposed, revitalized and supervised by the teacher (Moravec et al., 2010). The FC model is therefore able to promote and enhance higher-order activities that give students a leading role –both in and outside the class– and contribute to making learning meaningful and impactful (Rahman et al., 2014).

Historical development of flipped classroom methodologies

An important fact about the flipped classroom model that is unknown in the literature (even to some FC pioneers) is that this model did not appear suddenly, but has deep historical roots and methodological precedents in the last century (Prieto, Díaz and Santiago, 2014a; Medina, 2016; Prieto et al., 2017). The FC, which combines electronic communication of information to be learned, students' out-of-class preparation of learning materials and introduction of active learning activities in class, has several precedents in different innovative methodologies that emerged in the last decades of the 20th century (Prieto et al., 2018a).

Among the methodological precedents of FC, those used for promoting and verifying previous study (out-of class pre-study) that combine face-to-face teaching with information delivered online to students stand out, that is methodologies used in blended or hybrid learning models (Prieto et al., 2020a). New methodologies such as Just-in-Time Teaching (JITT), Peer Instruction (PI), and Team-based Learning (TBL) were considerably implemented long before the popularization of the term 'flipped classroom' in the second decade of the 21st century (Prieto et al., 2018a). In these methodologies, teachers sent new materials –printed or electronic documents– to students to be studied before classes. They also provided students with indications to guide them in the understanding of

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these new materials. Teachers also emphasize the importance of the out-of-class pre-study phase to engage in higher cognitive tasks and apply knowledge in class, anticipating the training activities to be done in class in PI and TBL models and highlighting the completion of pre-preparation tasks –reflective self-assessment questionnaires in the JITT model.

Thanks to out-of-class preparation, active learning activities, formative assessment, and peer discussion could be introduced in the classroom, and students are prepared to receive feedback in class. These methodologies for promoting out-of-class pre-study are the precursors of those which years later incorporated podcast, slidecast or video as forms of online communication and began to be called flipped classroom (Moravec et al., 2010; Bergmann and Sams, 2012).

These methodologies, after prompting out-of-class preparation, used face-to-face class to carry out different types of activities. In the PI model, class time is spent both on answering conceptual questions –which bring out students' conceptual mistakes– and on discussion, first in pairs and finally in a plenary session (Crouch et al., 2001). In the JITT model, the teacher asks students for feedback on the doubts that remain after having studied the instructional materials. Based on the problems identified, the teacher rethinks his or her classroom activities and provides feedback, examples, and appropriate activities for the resolution of the difficulties identified (Novak et al., 1999). In the TBL model, students are encouraged to do the preparatory study by scheduling a short formative assessment test at the beginning of each unit, and then solving problems and case studies in teams (Michaelsen, Knight, and Fink 2002; Michaelsen et al., 2008).

The use of PI, JITT and TBL was extended in the 1990s, but they did not become very popular, as can be seen in the moderate impact they had on the literature. The impact took almost a decade to be achieved when developments in ICTs made it possible to facilitate communication with students and the electronic monitoring of their activities in and outside the class. During the 1990s and the first years of the 21st century, IP was the most frequently cited methodology in the literature, thanks to its combination with the then-fashionable technology: clickers (Bruff, 2009). However, this situation was later reversed when the popularity of IP was largely overtaken by that of TBL (Figure 1). Over the last decade, TBL has been the pre-study-based methodology most often cited in the literature. In fact, in some leading fields in educational innovation,

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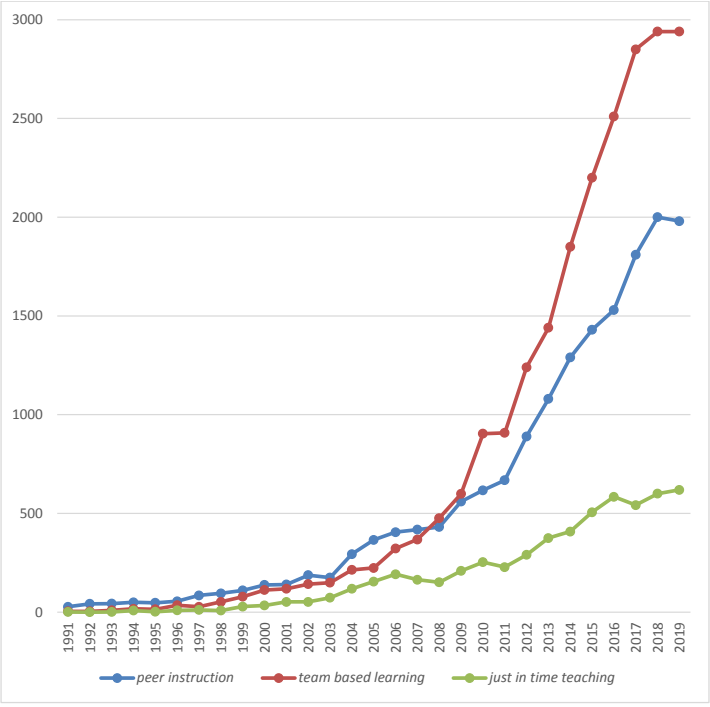
such as medicine, TBL has surpassed some well-established innovative methodologies, i.e. PBL, in terms of popularity and effectiveness (Burgess et al., 2017).

FIGURE 1. Number of annual citations in Google Scholar in the 1991-2019 period for the methodologies 'peer instruction', 'team-based learning', and 'just-in-time teaching' (precursors of the FC model)



The first references to 'classroom flip' and 'inverted classroom'– referring to blended methods that combine face-to-face teaching with virtual elements– date from the 1990s. In 1995, J. Wesley Baker realized that devoting classes to 'reciting' information–that was already on the slides– for students to copy was a waste of time, and asked students to access the materials online before class. He decided to use class time to work in teams from the preparatory tasks made by students outside the

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class. Baker began to refer to this teaching model as 'classroom flip' and named it so in a lecture he gave in 2000 (Baker, 2015; Talbert, 2017). Lage, Platt and Treglia (2000) developed a similar teaching methodology, in which they asked students to read documents and watch videos on VHS before class and called it 'inverted classroom'. Later, Strayer (2007) published a PhD thesis on the effects of classroom flip in the learning environment. In this thesis, he uses the term 'flipped classroom' three times, becoming the first author to use this term with its current meaning. This term would eventually become the most widely used form to name the inverted classroom model.

In 2007, Aaron Sams and Jonathan Bergmann–secondary school teachers– began recording vodcasts, screencasts, and online videos to provide their students with direct instruction outside the classroom and named their method 'reverse instruction'. Demetry (2010) successfully combined classroom flip with TBL. With the support of the Gates Foundation, Khan created the Khan Academy, an online repository of instructional videos to supplement in-class problems and activities (Sparks, 2011).

Other authors re-launched the JITT model and applied it to university education (Moravec et al., 2010; Prieto et al. 2014b); some even renamed it (Moravec et al., 2010) and called it LBL (learning before lecture). This name was perfectly in line with the definition of JITT, in which instructional materials were PowerPoint presentations with audio narrations.

The popularity of the FC model and its variants has significantly increased in Higher Education in the last nine years, with the number of papers published on this methodology also increasing (Figure 2). With the success of the term 'flipped classroom', a process of creating new methodological variants and terms within the flipped classroom model had begun, which continues today.

In 2012, the term flipped classroom exploded in popularity (Bergmann and Sams, 2012; Tucker, 2012). The success of the term 'flipped classroom' was such that authors already using JITT, PI or TBL renamed these methodologies to take advantage of the momentum of this fashionable term. Authors using JITT combined this method with videos and called it 'flipped classroom with JITT' (FC/JITT) (Prieto et al., 2014b; Prieto et al., 2017; Prieto et al., 2018b; Toriz, 2019). Authors promoting peer instruction also took advantage of the success of FC and started to refer to their practice as 'flipping classroom with PI', in order to associate

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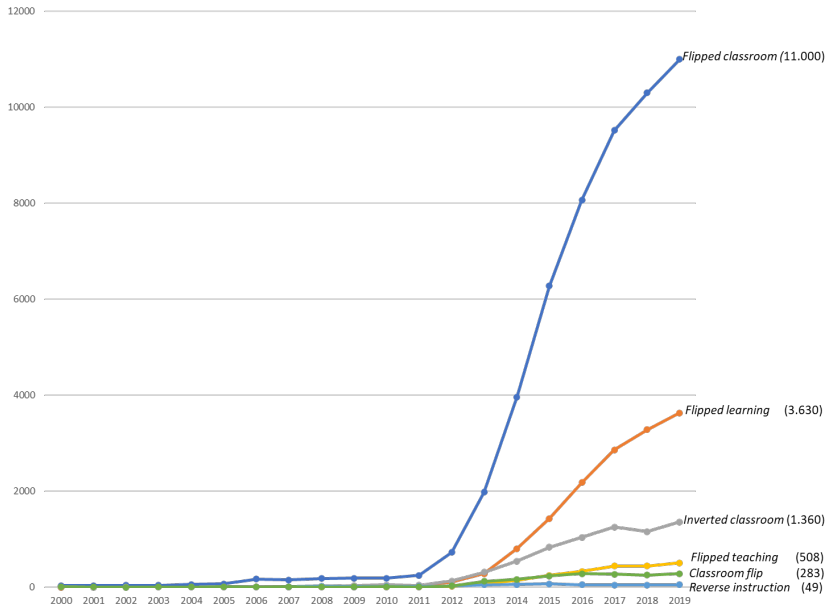
their own method to the one that was on the crest of the wave (Schell and Mazur, 2015). Other authors even went further by combining the FC model with TBL and PI (Costa, 2016). Finally, other authors– influenced by classroom flip and inverted classroom– developed the flipped teaching model and its derivatives (Wong et al., 2014).

FIGURE 2. Number of annual citations on Google Scholar in the 2000- 2019 period for the terms related to flipped classroom: 'flipped classroom', 'flipped learning', 'inverted classroom', 'flipped teaching', 'classroom flip', and 'reverse instruction'.



At the beginning of this decade, a group of FC pioneers and leaders of the self-styled 'Flipped Learning Network' promoted the term 'flipped learning' as the ideal outcome of the evolution of the FC model; they developed a formal definition of the term describing the main characteristics and pillar that quality flipped classroom should have in order to be called 'flipped learning' (Association of Flipped Learning Network, 2014). Despite the efforts of the promoters of the term 'flipped

learning' to refer to 'high-end flipped classroom', the term most frequently used in academic publications today continues to be 'flipped classroom' (Prieto et al., 2019). For this reason, we have used FC in this paper, leaving aside less used terms such as: reverse instruction, classroom flip, flipped teaching, inverted classroom, or flipped learning (Figure 2).

Literature on the Impact of the Flipped Classroom Model on University Education

There is an extensive literature on the effects of the flipped classroom model on different elements of the educational process, such as students' motivation, students' involvement in the learning process –overcoming simple initial challenges– and their participation in preparatory and class activities. The effects of the FC on all these elements of the educational process result in achieving a more meaningful learning, with a better understanding and comprehension of what is learned (Prieto et al., 2014a). There is also research focusing on how the FC model influences students' level of achievement and academic performance, in particular learning outcomes, competence acquisition and content learning (Estriegana, Medina and Plata, 2018; Låg , Sæle, 2019; Cheng et al., 2019; Zheng et al., 2020). A third group of works are mainly focused on assessing teachers' and students' level of satisfaction with the methodological change involved in FC (Dafonte-Gómez, García-Crespo, Ramahi-García, 2018; del Arco, Flores and Silva, 2019; Murillo-Zamorano et al., 2019; Awidi and Paynter, 2019).

In relation to the areas in which this methodology has been put into practice in university education, a number of papers on the impact of FC on health sciences, engineering, technological and computer sciences, science, social sciences and mathematics can be found in the literature. In terms of geographical origin, there is a predominance of papers published in the United States and other Western countries; publications on FC are also frequent in Eastern countries that have adopted the Western model of culture and economy, such as South Korea, Taiwan and Singapore. However, given the level of extension of FC methodologies, papers published all over the world can be found (Zheng et al., 2020).

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Effects of the Flipped Classroom Model on Students' Motivation and Involvement in Learning Activities in and Outside the Class

The effect of the flipped classroom on learning is based on its ability to stimulate students to do things to learn and to become more involved in their own learning. Therefore, the beneficial effects of the FC depend on its effects on students' motivation and their level of involvement in working in and outside the class (Gilboy, Heinerichs and Pazzaglia, 2015). In order to improve students' involvement with classroom activities and study outside the class, the FC model aims to facilitate and encourage preparatory study, students' engagement in the classroom, and face-to-face and online dialogue between students and teachers. In the FC model, preparatory study is fostered and tested, so that face-to-face class time can be focused on solving problems, doubts, and difficulties that arise during preparatory study. In the case of the adaptive flipped classroom model, students' doubts and difficulties are sent to the teacher by telematic means before the class. This pre-class feedback allows the teacher to choose activities and problems for students to practice with the contents in class and develop a deeper understanding of these contents, in a learning environment where they receive feedback from their peers and their teacher.

Students' involvement can be estimated by measuring their emotional manifestations –i.e. their interest in the topics covered– but especially by measuring their behavioral manifestations: class attendance, percentage of completion of preparatory tasks (Jovanovic, 2019; Wang, 2019, Prieto et al., 2020b), time dedicated to these preparatory tasks (Prieto et al., 2020b), and their participation in discussions and quizzes and in formative assessment questionnaires (Prieto et al., 2020b). In-class activities (problem-solving) motivate preparatory study among students (Wang, 2019); other authors use formative assessment (Michaelsen, et al., 2008, Crouch et al., 2001) and gamification –with small rewards– (Prieto et al., 2014) in exchange for the completion of preparatory tasks, which contributes to more students doing preparatory study regularly.

Evidence shows that students' involvement in both in-class and out-of-class activities improves in the FC model (Murillo-Zamorano et al., 2019). Studies show almost unanimously the positive effect of the FC model on student engagement in educational contexts where the FC has been implemented. Furthermore, the most comprehensive meta-analysis

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demonstrates an increase in the level of motivation of an effect size (ES) of 0.661 s for student motivation to learn (Zheng et al., 2020), being s the standard deviation of the level of motivation in the student population without a FC model. The 0.661 s increase equals a 24% percentile increase.

Effects of the Flipped Classroom Model on Students' Performance or Level of Academic Achievement

Most systematic reviews of the impact of the flipped classroom model on students' academic performance in HE have highlighted the positive effects of the FC on students' academic performance and satisfaction (O'Flaherty and Philips, 2015; Hinojo-Lucena, Aznar, Romero and Marin, 2019). The first meta-analysis on the impact of this methodology reviewed 15 studies on FC and found a positive effect on students' performance (Rahman, 2014). Subsequent meta-analyses found that the ES for academic performance was positive, moderate, and significant (Hew and Lo, 2018; Gillette et al., 2018; Van Alten et al., 2019; Låg et al., 2019; Cheng, Ritzhaupt, and Antonenko, 2019).

The most recent meta-analysis on the effect of the FC model on students' academic achievement or performance has demonstrated that the implementation of FC has a positive ES on academic performance at all educational levels studied, including university (Zheng et al., 2020). This meta-analysis included 78 studies in HE and showed that the ES for FC implementation was of 0.646 s at this educational level. This difference means that the median student (50th percentile) of a class taught by FC may obtain the same learning outcomes as the student in the 74th percentile of the same class taught by traditional methodology.

Some of these meta-analyses on the impact of the flipped classroom analyzed the moderating factors of that ES, showing that class size influences the ES achieved. Thus, smaller class sizes achieved higher ES than those observed in larger class sizes. Geographic area also had a moderating effect on the ES (Zheng et al., 2020): it was higher in Africa and Asia, intermediate in Europe, and lower in the United States. This difference shows that the implementation of the FC model may have even greater effects in those areas where the optimization degree of the traditional model is lower.

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In relation to the disciplinary domains of the subjects, Zheng et al. (2020) found no differences between the different domains studied. This shows that the FC model has similar effectiveness in the different domains analyzed –sciences, engineering and technological sciences, health sciences and social sciences. However, another meta-analysis found that although the TE for the FC was significant in general terms, the TE values were significantly moderate according to the disciplinary domain in which the FC was applied, reaching maximum values in the branch of arts and humanities (Cheng, 2019).

Regarding the use of technological tools, the meta-analysis by Zheng et al. (2020) showed that the implementation of online discussion forums and online games reached higher ES than the use of online learning platforms. Other meta-analyses incorporating moderating factor analyses showed that the performance of online quizzes increased the ES for academic performance (Hew et al., 2018; Van Alten et al., 2019). In terms of the impact on different types of learning, several works reported that the FC model was associated with an improvement in knowledge acquisition (Love, Hodge Grandgenett and Swift, 2014); however, other works highlighted an improvement in the development of skills and competencies (Elmaadaway, 2017; Zainuddin and Perera, 2017).

Flipped Classroom and Competencies and Skills Development in Students

The effect of flipped classroom on the development of management competences and skills (i.e. the competence to manage online tasks and activities) was studied by Zanuiddin and Perera (2017). They found that students in a flipped learning environment developed management competences and skills to a higher level than students in the control group –who did not learn in a flipped environment. Zanuiddin and Perera (2018) demonstrated that the use of a LMS platform, that provides continuous access to a variety of digital materials, fostered a high degree of interactivity among participants, and made the implementation of FC and self-directed learning easier. For these authors, FC is viewed as a strategy that can help students remain engaged and focused on improving their language skills (Zanuiddin and Perera, 2018). Hu et al. (2018), in a meta-analysis of 11 studies on nursing education, showed

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that the flipped classroom model was more effective than traditional lectures at improving students' theoretical knowledge and skill scores.

Estriegana et al. (2018) aimed at analyzing the development of competencies in the FC environment and demonstrated that this environment plays a key role in the acquisition and development of systemic, personal, and cooperative competencies. Their findings also suggested that the acquisition of skills and competencies, although considered a major issue in the HE qualifications framework, does not exactly match the academic outcomes measured during the assessment process. Additionally, Murillo-Zamorano et al. (2019) provided empirical evidence on the causal relationships among knowledge, skills, involvement, and students' satisfaction. This study confirms that the flipped classroom model has positive effects on students' involvement, resulting in an improved knowledge and skill acquisition.

Students' Perceptions on the Methodological Change from Traditional Methodology to Flipped Classroom

Several papers have focused on the effect of the flipped classroom model on students' satisfaction with their learning experience (Dafonte-Gómez et al., 2018; Del Arco et al., 2019). The students' level of satisfaction can be estimated from the students' assessment of the teachers' performance or from a comparison between their level of satisfaction with the FC and with the traditional models (Awidi and Paynter, 2019; Murillo-Zamorano et al., 2019).

McNally et al. (2016) differentiate in their research between students who are flip endorsers and flip resisters. Flip endosers have positive attitudes toward the performance of activities both in class and outside the class, are involved in the activities, and achieve the best academic results. It is essential that teachers who want to implement the flipped classroom model plan a strategy to convince students who resist participating in class, and to change their attitude and study habits. Teachers should motivate students to study the learning materials before the class, giving them reasons to foster preparatory study and class participation. The use of narrative and game-playing strategies may help teachers to convince more students of the need to change their study habits to succeed in the flipped classroom environment (Prieto et al., 2014b). In addition, it is

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very important to quantify and monitor the volume of student workload and provide them meaningful classroom activities (Al-Zhrani, 2015; Prieto et al., 2020b).

Different Models for the Flipped Classroom and their Effects

The traditional flipped classroom –used in secondary education– is focused on reordering and inverting the activities carried out in and outside the classroom (exposure to new materials outside the classroom and completing tasks inside the classroom). However, there are other aspects that can be optimized to further improve learning outcomes achieved through the implementation of the FC model. For example, some studies have compared the different strategies that can be used to produce preparatory learning of the contents before class, i.e. interactive tutorials, video classes and text reading; the result was a small advantage for video classes over the other alternatives studied (Jensen, Holt, Sowards, Ogden and West, 2018).

The methods for promoting previous study (pre-study) in university education in the 1990s –TBL, PI and JITT– already included strategies for improving learning, such as formative assessment, formal (TBL) and informal (PI) teamwork, answering pre-questionnaires and conducting preparation activities (JITT). Twenty years later, as explained above, some authors renamed the JITT method (Moravec et al., 2010) as 'learning before lecture'. The underlying idea –previously established by Novak– was that students' answers and activities could be used to redesign classroom activities and materials, taking what students had not understood or misunderstood as a starting point.

Teachers can provide feedback to students, either in class or online collectively, from the students' answers to questionnaires, creating the possibility of making the flipped classroom an adaptive strategy (adaptive flipped classroom). The teacher will thus be able to adapt the instructional materials and classroom activities to the interests and real needs of the students (Prieto et al., 2020b). In addition, students' responses also provide information about elements of the instructional material previously provided by the teacher that need to be improved, explained, or otherwise illustrated in order to be better understood (Contreras et al., 2017; Murillo-Zamorano et al., 2019). This two-way

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feedback strategy combines the work of the teacher and that of his or her students and intensifies the effect of the FC by providing cohesion to the activities carried out in and outside the classroom (Murillo-Zamorano et al., 2019). This strategy establishes a two-way dialogue that fosters mutual commitment and the establishment of a learning community in which the teacher acts as a coach to his or her students.

Other authors have also advanced this idea of improving flipped classroom outcomes by including additional tasks both in and outside the classroom. Outside the classroom, formative assessment (Robles, 2010) and reflective questionnaires (Prieto, 2014; Porcaro et al., 2016) have been proposed. Within the classroom, team problem-solving (Chiang, 2017) or team projects (Liu, Wu, Zhang and Guo, 2017) have been incorporated, in order to improve student involvement and favor that the class activities achieve more significant learning and develop skills and competences.

Studies on the Impact of the Flipped Classroom in the Different Disciplinary Domains

To evaluate the impact of the flipped classroom methodology in different disciplinary domains, original research and meta-analysis have been carried out focusing on specific disciplines within Higher Education. We summarize below the most outstanding works on the impact of the FC on learning in specific disciplinary contexts.

In the health sciences area, the meta-analysis by Hew et al. (2018) demonstrated a positive and significant ES in learning performance in favor of the FC compared to traditional methodologies. In addition, this meta-analysis showed that the FC increased its effectiveness when formative assessment quizzes were used at the beginning of each class. Students also showed a preference for the flipped class over the traditional class. Similar results were obtained in Chen's meta-analysis (2018). Sezer and Abay (2019) conducted a quasi-experimental design study with control, pre-test, and post-test groups, and demonstrated that first-year medical students who were taught with FC obtained a significantly higher level of academic achievement than the control groups. Students also had positive perceptions of the flipped classroom method. Hu's meta-analysis in 11 nursing studies (2018) showed that theoretical knowledge and skill scores were significantly higher in the groups that were taught by flipped

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classrooms than in the control groups that had been taught by traditional classes.

In the engineering and technology disciplines, Kerr's (2015) review showed that almost all studies on flipped classrooms in engineering resulted in high levels of student satisfaction with the new learning environment and improved performance. In science disciplines, Chen's (2018) meta-analysis showed that FC was associated with a higher level of academic achievement than teaching with expository classes. In maths, Lo, Hew, and Chen's (2017) meta-analysis determined a positive and significant effect of the flipped classroom whose value was estimated at 0.298 s over the starting value. In languages, as well as in arts and humanities, the flipped classroom model has also been used –specially in second language teaching– and the results have been positive, improving the motivation and language skills of students who participate in FC experiences (Hsieha, 2016). Finally, in social sciences, Olivan's recent study (2019) showed that FC was more effective in achieving better academic results than expository teaching.

Long-term Effect of the Flipped Classroom Model: Longitudinal Studies

Longitudinal studies that track the effect of the flipped classroom during a series of successive promotions of the same subject to determine its long-term impact are scarce in the literature. The recently published longitudinal study by Prieto et al. (2020b) shows that in four subjects in which the FC has been applied in at least four consecutive promotions, the ES on learning assessment test scores are lower in the first years of implementation (ES= 0.3 s), but increase during the second and third year; then, the values remain stable –around 1 s– over the initial values. This study has shown that the impact of the flipped classroom is not immediate, but is proportional to the modification of preparatory study habits over the course of different promotions. Therefore, the ES increases as the preparatory study habits of a greater number of students improve –a process that can last several years. Finally, this study also showed that the ES on the average score in the learning assessment tests correlates directly with the percentage of preparatory tasks carried out by the students; it is also observed repeatedly in different subjects that,

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although this percentage of task completion begins being modest in the first attempts, it progressively improves in successive years.

Conclusions

To date there has been a poor understanding of the methodological roots of the flipped classroom; this paper has connected the flipped classroom methodologies developed in the 21st century with the pioneering methodologies that emerged in university education at the end of the previous century. The review of the literature on these pioneering FC methodologies (peer instruction, team- based learning, and just-in-time teaching) shows how these methodologies –developed at the end of the last century– were widely used in the first decade of this century, years before the flipped classroom became popular in 2012. In recent years, the FC model has been increasing its popularity to become an alternative methodology widely used around the world by more university teachers every day.

In the second part of this paper, the review of the literature on the impacts of the FC allows us to conclude that the use of this methodology has multiple positive impacts: it increases student involvement, improves their level of academic achievement, allows the incorporation of more active learning and thus favors the development of skills and competences in students. It has also been demonstrated that the FC model improves students' perceptions of their learning experience. In short, the flipped classroom creates opportunities for students to interact earlier and more sustainably with instructional materials, thereby improving their readiness to apply what is learned to class activities and thus improving their academic performance.

References

Al-Zhrani, A.M. (2015). From passive to active: The impact of the flipped classroom through social learning platforms on higher education students' creative thinking. *British Journal of Educational Technology*, 46(6),1133-48.

Received: 09-07-2020 Accepted: 30-10-2020

Arum, R., Roska, J. (2010). *Academically Adrift: Limited Learning on College Campuses*. Chicago, Ill: University of Chicago Press.

Arum R., Roksa, J. (2014). Aspiring adults adrift: tentative transitions of college graduates. Chicago, Ill University of Chicago Press.

Association of Flipped Learning Network. (2014). Definition of flipped learning. Disponible en https://flippedlearning.org/definition-of-flipped-learning/

Awidi, I.T., Paynter, M. (2019). The impact of a flipped classroom approach on student learning experience. *Computers & Education*., 128,269-283.

Baker, J.E. (2000). The classroom flip: using web course management tools to become the guide by side. En Chambers, JA. Selected papers from the 11th International Conference on College Teaching and Learning (pp. 9-17) Jacksonville: FL.

Bergmann J., Sams, A. (2012). Flip your Clasroom: Reach every student in every class every day International Society for Technology in Education.

Bok D. (2017). The struggle to reform our colleges. Princeton New Jersey Princeton University press

Bruff D. (2009). Teaching with Classroom Response Systems: Creating Active Learning Environments. Jossey-Bass San Francisco

Burgess, A., Bleasel, J., Haq, I., Roberts, C., Garsia, R., Robertson, T., Mellis, C. (2017). Team-based learning (TBL) in the medical curriculum: better than PBL? Burgess et al. BMC Medical Education 17:243 DOI 10.1186/s12909-017-1068-z

Chen, K.S., Monrouxe, L., Lu, Y.H., Jenq, C.C., Chang, Y.J., Chang, Y.C., et al. (2018). Academic outcomes of flipped classroom learning: A meta-analysis. Medical Education,; 52(9), 910-924.

Cheng, L., Ritzhaupt, A.D., Antonenko, P. (2019). Effects of the flipped classroom instructional strategy on students' learning outcomes: A meta-analysis. Educational Technology Research & Development. 67:793–824 https://doi.org/10.1007/s11423-018-9633-7

Chiang, T.H. (2017). Analysis of learning behavior in a flipped programming classroom adopting problem solving strategies Interactive learning environments, 25(2) pp.189-202

Chua, K.J., Islam, M.R., (2020). The hybrid Project-Based Learning–Flipped Classroom: A design project module redesigned to foster learning

and engagement International Journal of Mechanical Engineering Education March DOI: 10.1177/0306419019838335

Contreras, J.A., Arias, J., Melo, M.G., Martín-Espada, R. (2017). Uso del modelo educativo de aprendizaje inverso para mejorar materiales educativos universitarios RISTI 23, 17-31

Costa, M.J. (2016). Flipped, team based peer instruction: uma metodologia híbrida aplicável a turmas com 100 ou mais alunos CNaPPES 2016, 241-246 241 Congresso Nacional de Práticas Pedagógicas no Ensino Superior 14 e 15 de Julho de 2016, Universidade de Lisboa

Crouch, C.H., Mazur, E. (2001). Peer instruction: ten years of experience and results. Am. J. Phys. 69:970-977.

Dafonte-Gómez, A. García-Crespo, O. Ramahí-García, D. (2018). Flipped learning y competencia digital: diseño tecno pedagógico y percepción del alumnado universitario. Index.comunicación, 8(2),275-294.

Del Arco Bravo, I., Flores Alarcia, Ò., y Silva, P. (2019). El desarrollo del modelo flipped classroom en la universidad: impacto de su implementación desde la voz del estudiantado. Revista de Investigación Educativa, 37 (2), 451-469. DOI: http://dx.doi.org/10.6018/rie.37.2.327831

Demetry, C. (2010). Work in progress- An innovation merging classroom flip and team based learning. In 40th IEEE Frontiers in Education Conferencie (FIE)

Elmaadaway, MAN. (2017). The effects of a flipped classroom approach on class engagement and skill performance in a Blackboard course: Effects of the flipped classroom approach. British Journal of Educational Technology 49(3) DOI: 10.1111/bjet.12553

Estriegana, R., Medina, J.A., Plata, R. (2018) Analysis of competence acquisition in a flipped classroom approach Computer Applications in Engineering Education 27(1) DOI: 10.1002/cae.22056

Flores, Ò., del-Arco, I., Silva, P. (2016). The flipped classroom model at the university: analysis based on professors' and students' assessment in the educational field. International Journal of Educational Technology in Higher Education 13: doi: 10.1186/s41239-016-0022-1.

Freeman, S., Eddy S.L, McDonough, M , Smith, M.K., Okoroafor, N., Jordt, H., y Wenderoth M.P. (2014). Active learning increases student performance in Science, Engineering, and Mathematics. Proc Natl Acad Sci U S A. 111(23): 8410-5.

Received: 09-07-2020 Accepted: 30-10-2020

Galway, L., Corbett, K.K., Takaro, T.K., Tairyan K y Frank E. (2014). A novel integration of online and flipped classroom instructional models in public health higher education. BMC Medical Education 14:181.

Gilboy, M.B., Heinerichs, S., Pazzaglia, G. (2015). Enhancing Student Engagement using the flipped classroom Journal of nutrition Education and behavior 47 (1) 109-114 https://doi.org/10.1016/j.jneb.2014.08.008

Gillette, C., Rudolph, M., Kimble, C., Rockich-Winston, N., Smith, L. y Broedel-Zaugg, K. (2018). A meta-analysis of outcomes comparing flipped classroom and lecture. American Journal of Pharmaceutical Education, 82(5), 433-440. https://doi.org/10.5688/ajpe6898

Hew, K.F., Lo, C.K. (2018). Flipped classroom improves student learning in health professions education: a meta-analysis. BMC Med Educ 18, 38 https://doi.org/10.1186/s12909-018-1144-z

Hinojo-Lucena, F. J., Aznar Díaz, I., Romero Rodríguez, J. M., Marín Marín, J. A. (2019). Influencia del aula invertida en el rendimiento académico. Una revisión sistemática. Campus Virtuales, 8(1), 9-18.

Hsieh, J.S.C., Wu W.-C.V., Marek, M.W. (2016) Using the flipped classroom to enhance EFL learning Computer Assisted Language Learning, http://dx.doi.org/10.1080/09588221.2015.1111910

Hu, R., Gao, H., Ye, Y., Ni, Z., Jiang, N., Jiang, X. Effectiveness of flipped classrooms in Chinese baccalaureate nursing education: A metanalysis of ramdom controlled trials International Journal of Nursing Studies. 2018; 79: 94-103.

Hu. X., Zhang, H. Song Y., Wu C., Zhang Q., Chen, W. (2018). Implementation of flipped classroom combined with problem based learning: an approach to promote learning about hyperthyroisdism in the endocrinology internship. BMC Medical Education 2019 19: 290

Hurtbuise, L., Hall, E., Sheridan, L. Han , L. (2015). The flipped classroom in Medical Education: engaging students to build competency. Journal of Medical Education and Curricular Development; 2: 35-43

Jensen, J.L., Holt, E.A., Sowards, J.B. Odgen, T.H., West R.E.. (2018). Investigating Strategies for Pre-Class Content Learning in a Flipped Classroom. J Sci Educ Technol 27, 523–535 https://doi.org/10.1007/s10956-018-9740-6

Kerr, B. (2015). The flipped classroom in engineering education: A survey of the research Proceedings of 2015 International Conference on interactive collaborative Learning (ICL) p815 Florence Italy

Låg, T., Sæle, R.G. ("019) Does the Flipped Classroom Improve Student Learning and Satisfaction? A Systematic Review and Meta-Analysis. AERA Open. 5(3): 1-17

Lage, M.J., Platt, G.J., Treglia. M. (2000). Inverting the classroom: a gateway to creating an inclusive learning environment. The Journal of Economic Education. 31(1): 30-43

Lai, H., Hsiao, Y.L., Hsieh P.J. (2018). The role of motivation ability, and opportunity in university teacher' continuance use intention for flipped teaching. Computers & Education, 124 37-50.

Liu, X., Wu, Z., Zhang, L., Guo, X. (2017). Practice of project-centric flipped classroom learning in microcomputer interfacing technology course 5th International conference on modern education DOI:10.12783/dtssehs/icome2017/19352

Lo, C.K., Hew, K.F., Chen, G. (2017) Toward a set of design principles for mathematics flipped classrooms: a synthesis of research in mathematics education. Educational Research Review; 22: 50-73.

Love, B., Hodge, A., Grandgenett, N., y Swift, A.W. (2014). Student learning and perceptions in a flipped linear algebra course, International Journal of Mathematical Education in Science and Technology, 45:3, 317-324, DOI: 10.1080/0020739X.2013.8225822014

McLaughlin, J.E., Roth, M.T., Glatt, D.M., Gharkholonarehe, N., Davidson, C.A., Griffin, L.M., Esserman, D.A., Mumper, RJ. The Flipped Classroom: A Course Redesign to Foster Learning and Engagement in a Health Professions School. Academic Medicine, 2014 Vol. 89, No. 2

Medina, J.L. (2016). La docencia universitaria mediante el enfoque del aula invertida Octaedro Barcelona.

Mellefont, L., Fei, J. (2016) Student Perceptions of 'Flipped' Microbiology Laboratory Classes International Journal of Innovation in Science and Mathematics Education, 24(1), 24-35, 2016.

Mennella, T. (2016). Comparing the efficacy of flipped vs. alternative active learning in a college genetics course. The American Biology Teacher, 78(6), 471-479.

Michaelsen, L.K., Knight, A., Fink, L.D. (2002) Team-based learning: a transformative use of small groups Praeger Publishers, Westport CT

Michaelsen, L.K., Parmelee, D.X., McMahon, K.K., Levine, R.E. (2008). Team based learning for health professions education. Stylus Publishing Sterling Virginia

Received: 09-07-2020 Accepted: 30-10-2020

Mohr, K. A. J., y Mohr, E.S. (2017). Understanding Generation Z Students to Promote a Contemporary Learning Environment. Journal on Empowering Teaching Excellence: Vol. 1 : Iss. 1, Article 9. DOI: https://doi.org/10.15142/T3M05T

Moravec, M. Williams, A. Aguilar-Roca, N. y O'Dowd. D.K. (2010). Learn before lecture: a strategy that improves learning outcomes in a large introductory biology class. CBE-Life Sciences Education, 9,4,473-481.

Murillo-Zamorano LR, López-Sanchez JA, Godoy-Caballero AL. (2019). How the flipped classroom affects knowledge, skills and engagement in higher education: effects on students' satisfaction Computers & Education, 141 , doi: https://doi.org/10.1016/j.compedu.2019.103608

Novak, G., Gavrin, A., Christian, W., y Patterson, E. (1999). Just-In-Time Teaching: Blending Active Learning with Web Technology. Upper Saddle River. NJ: Prentice-Hall.

O'Flaherty J., Philips C. (2015) The use of flipped classrooms in higher education: a scoping review Internet and Higher Education 25 85-95

Oliván, B., Masluk, B., Gascon, S., Fueyo, R., Aguilar-Latorre, A., Artola, I., Magallón, R. (2019). The use of flipped classroom as an active learning approach improves academic performance in social work: A randomized trial in a university. PLoS One. 14(4):e0214623. doi: 10.1371/journal.pone.0214623. eCollection 2019.

Park, K.H., Park, K.H., Chae, S.J. (2018). Experiences of medical teachers in flipped learning for medical students: a phenomenological study Korean Journal of Medical Education, 30:91-100

Porcaro, P., Jackson, D., McLaughlin, P. y O'Malley, C. (2016). Curriculum design of a flipped classroom to enhance haematology learning, Journal of Science Education and Technology, pp. 1-13. http://doi.org/10.1007/s10956-015-9599-8

Prieto, A., Diaz, D., Santiago, R. (2014a). Metodologías Inductivas: El desafío de enseñar mediante el cuestionamiento y los retos. Barcelona, Digital Text

Prieto, A., Díaz, D., Monserrat, J., Reyes, E., et al. (2014b). Experiencias de aplicación de estrategias de gamificación a entornos de aprendizaje universitario. ReVisión, 7 (2): 76-92

Prieto, A., Barbarroja, J., Cano, I., Díaz, D., Lara, I., Monserrat, J., Sanvicen, P., Vélez, J. (2017). Flipped learning: aplicar el modelo de aprendizaje invertido Ed Narcea (Colección Universitaria)

Prieto, A., Díaz, D., Monserrat, J., Alvarez-Mon, M., Sanvicén, P., Rinaldi, M.I. (2018a). Aula invertida y aprendizaje invertido. En: Las Tecnologías de la Información y la Comunicación como herramientas Mediadoras de los Procesos Educativos. Volumen I: Fundamentos y Reflexiones. Eds. Ocelli, M., García-Romano, L., Valeiras, N., Quintanilla Gatica, M., Santiago de Chile Ed, Bellaterra Ltda., pp.123-135

Prieto, A., Díaz, D., Lara, I., Monserrat, J., Sanvicen P., Santiago, R., Corell, A., Alvarez-Mon M., (2018b) Nuevas combinaciones de aula invertida con just in time teaching y análisis de respuestas de los alumnos. RIED Revista Iberoamericana Educación a Distancia.; 21(1): 175-194

Prieto, A., Barbarroja, E. Lara-Aguilera I, Díaz-Martín D, Pérez-Gómez A, Monstserrat J, Corell-Almuzara, A., Álvarez de Mon, M., . (2019). Aula invertida en enseñanzas sanitarias recomendaciones para su puesta en práctica FEM. Revista de la Fundación Educación Médica, ISSN 2014-9832, Vol. 22, Nº. 6, págs. 253-262

Prieto, A. y Giménez, X. (2020a). La enseñanza universitaria basada en la actividad del estudiante: evidencias de su validez. En Docentes universitarios. Una formación centrada en la práctica Porlan. R., de Alba Fernández N. Madrid. Ed Morata

Prieto, A., Díaz, D., Monserrat, J., Barbarroja, J., (2020b). La medición del impacto de las innovaciones metodológicas sobre los resultados de la docencia universitaria RIECS 2020 (en prensa)

Prince, M. (2004). Does active learning work? J. Engr. Education, 93 (3): 223-31.

Prober, ChG., Heath, Ch. (2012). Lecture halls without lectures A proposal for medical education N Engl J Med, 366:18 1657-1659

Rahman, A.A., Aris, B., Mohamed, H., Zaid, N.M. (2014).The Influences of Flipped Classroom: A Meta Analysis 2014 IEEE 6th International Conference on Engineering Education

Robles, G.; González- Barahona, J.M. y Prieto A. (2010). Fomentando la preparación de clase por parte de los alumnos mediante el Campus Virtual Relada, 4 (3), 240-248. http://polired.upm.es/index. php/relada/article/viewFile/117/113

Schell, J., Mazur, E. (2015) Flipping the Chemistry Classroom with Peer Instruction In Chemistry Education: best practices, opportunities and trends. García-Martinez J. y Serrrano-Torregrosa, E. Eds Wiley-VCHGmbH& Co Weinheim Germany Pp 319-343

Sezer, B., Abay, E. (2019). Looking at the Impact of the Flipped Classroom Model in Medical Education. Scandinavian Journal of Educational Research, 63 (6): 853-868

Sola, T., Aznar, I., Romero, J.M. Rodríguez-García, A.M. (2019). Eficacia del método flipped classroom en la Universidad: Meta-Análisis de la Producción Científica de Impacto REICE 17(1)25-38 https://doi.org/10.15366/reice2019.17.1.002

Souto-Iglesias, A., Baeza-Romero, M.T. (2018). A probabilistic approach to student workload: empirical distributions and ECTS. High Educ.; 76: 1007.

Sparks, SD. (2011). Schools "Flip" for lesson model promoted by Khan Academy. Educ week,31, 12-14.

Strayer, J.F. (2007). Effects of the classroom flip on the learning environment: a comparison of learning activity in a traditional classroom and a flip classroom that used an intelligent tutoring system. Doctoral Dissertation, Ohio State University, Columbus, Ohio,

Talbert, R. (2017). Flipped Learning: a guide for higher education faculty. Stylus. Sterling Virginia.

Tucker, B. (2012). The flipped classroom. Education Next: Vol.12. Nº 1 https://www.educationnext.org/the-flipped-classroom/. Accessed 28 May 2020.

Toriz, E. (2019). Learning based on flipped classroom with just-in-time teaching, Unity3D, gamification and educational spaces. Int J Interact Des Manuf, 13, 1159–1173 https://doi.org/10.1007/s12008-019-00560-z

van Alten DCD, Phielix C, Janssen J, Kester L. (2019). Effects of flipping the classroom on learning outcomes and satisfaction: A meta-analysis. Educational Research Review, 28:1-18

Wang FS (2019). On the relationships between behaviours and achievement in technology-mediated flipped class rooms: A two phase online behavioral PLS-SEM model Computers & Education , 142:103653

Wong, T.H., Ip, E.J., Lopes, I., Rajagopalan, V. (2014). Pharmacy Students' Performance and Perceptions in a Flipped Teaching Pilot on Cardiac Arrhythmias American Journal of Pharmaceutical Education 78 (10) 185; DOI: https://doi.org/10.5688/ajpe7810185

Zanuiddin, Z., Perera, C.J. (2017). Exploring students' competence, autonomy and relatedness in the flipped classroom pedagogical

model. Journal of further and Higher Education http://dx.doi.org/10.1080/0309877X.2017.1356916

Zanuiddin, Z., Perera, C.J. (2018). Supporting students' self-directed learning in the flipped classroom through the LMS TES BlendSpace. On the Horizon, Vol. 26 Issue: 4, pp.281-290, https://doi.org/10.1108/OTH-04-2017-0016

Zheng, L., Bhagat, K.K., Zhen, Y., Zhang, X. (2020). The Effectiveness of the Flipped Classroom on Students' Learning Achievement and Learning Motivation: A Meta-Analysis. Educational Technology & Society 23(1):1-15

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Research

The effect of contextual, personal and curricular factors on students' engagement[1]

Efecto de las variables contextuales, personales y curriculares en la implicación del estudiante

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Summary

Introduction: Students' engagement, defined as the behavioural and emotional actions developed by students towards academic tasks, is influenced among other factors by contextual factors (e.g. the school or the geographic context), personal variables (e.g. teachers' and students' gender or teachers' teaching experience) or curricular variables (e.g. subjects or educational level). The main aim of this study was the analysis of the effect of the already mentioned three groups of variables on students' engagement. Methodology: 7,114 students reported their perceptions about 410 teachers from 56 schools located in three different Spanish autonomous communities. The influence of the following variables on students' behavioural and emotional engagement has been analysed: teachers' teaching behaviour, school, autonomous community, teachers' and

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students' gender, teachers' teaching experience, subject and educational level. A multivariate analysis of variance and the analysis of effect sizes have been run to determine the influence of the predictor variables on criterion variables. Results: Teachers' gender and the autonomous community did not seem to have any influence on students' engagement (neither behavioural nor emotional one). On the other hand, the school variable demonstrated the highest effect size for students' engagement, biasing the effect of subjects on students' behavioural and emotional engagement. Regarding the influence of subjects, the lowest effect size on students' engagement has been found in exact and applied sciences and the highest effect has been obtained in vocational education and training subjects. Discussion: Current findings revealed the need to consider the analysis of students' behavioural and emotional engagement separately. In addition, this study has shown interesting differences between instrumental and vocational education and training subjects.

Key words: Teacher's teaching behaviour; students' behavioural engagement; students' emotional engagement; instrumental subjects; vocational education and training.

Resumen

Introducción: La implicación del estudiante entendida como las acciones conductuales y emocionales emprendidas por los discentes ante las tareas académicas, se encuentra expuesta al influjo de variables contextuales (centro docente, entorno geográfico), variables personales (género del docente y del estudiante, años de experiencia del docente y comportamiento docente) o variables curriculares (tal sería el caso de las asignaturas o la etapa educativa). Así, el objetivo principal de este estudio ha sido analizar el efecto de estos tres grupos de variables sobre la implicación del estudiante. Metodología: 7114 estudiantes emitieron sus percepciones sobre 410 docentes pertenecientes a 56 centros educativos de tres comunidades autónomas españolas. Se ha analizado la influencia de las siguientes variables sobre la implicación conductual y emocional del estudiante: comportamiento docente, centro docente, comunidad autónoma, género del docente y delos estudiantes, años de experiencia docente, asignaturas y etapa educativa. A tal efecto, se ha realizado un análisis multivariado de la varianza y un análisis del tamaño de los efectos para conocer la influencia de las variables predictoras sobre las variables criterio. Resultados: El género del docente y la comunidad autónoma no parecen tener influencia ni en la implicación conductual ni en la implicación emocional del estudiante. Asimismo, el centro educativo ha mostrado un importante efecto sobre la implicación de los estudiantes, sesgando la influencia que presentan las asignaturas. Respecto a la influencia de las asignaturas, el efecto menor sobre la implicación del estudiante se ha encontrado en las asignaturas de ciencias exactas mientras que el efecto mayor ha sido obtenido en las asignaturas específicas de formación profesional. Discusión: Las evidencias encontradas muestran la necesidad de

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considerar separadamente el análisis de la implicación conductual y emocional de los estudiantes, además de las diferencias entre las asignaturas instrumentales y las materias específicas de formación profesional.

Palabras clave: comportamiento docente, implicación conductual del estudiante, implicación emocional del estudiante, asignaturas instrumentales, Formación Profesional.

Introduction

Several factors determine student outcomes and their motivation and implication toward academic tasks. Existing research has tried to develop an image of all these factors by using different procedures to obtain the relational information. In some approaches, teachers are asked to explain what they do inside their classrooms or how they understand the teaching of their subjects; in other approaches, the focus of the questions is situated on students, trying to determine their opinions and perceptions about their teachers (De Jong & Westerhof, 2001; Le Baron, Kelcey & Ruzek, 2016). In few cases, information is obtained by observation procedures, which may be developed by experts or other colleagues (Irnidayanti, Maulana, Helms-Lorenz & Fadhilah, 2019; Pianta & Hamre, 2009; Maulana & Helms – Lorenz, 2016; Van der Lans, Van de Grift, Van Veen & Fokkens – Bruinsma, 2016). Each of these methods shows advantages and disadvantages in terms of their economical cost, reliability or time needed (Burdsal & Bardo, 1986; Furrer & Skinner, 2003; Maulana & Helms - Lorenz, 2016; Maulana, Helms - Lorenz & Van de Grift, 2015b; Stroet, Opdenakker & Minnaert, 2013; Van der Lans, Van de Grift & Van Veen, 2015).

Several studies have shown that classroom factors play a more important role than school factors when trying to understand students' engagement and outcomes (Kyriakides, Creemers & Antoniou, 2009). Research has demonstrated that teachers' behaviour is one of these important classroom factors which has a powerful effect on students' academic engagement (Coe, Aloisi, Higgins & Major, 2014; Fernández-García, Maulana; Inda-Caro, Helms – Lorenz y García Pérez, 2019; Inda-Caro, Maulana, Fernández-García, Peña-Calvo, Rodríguez-Menéndez y Helms – Lorenz, 2019; Klem & Connell, 2009; Kyriakides et al., 2009;

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Maulana, Opdenakker, Stroet & Bosker, 2012; Opdenakker, Maulana & Den Brok, 2012). Moreover, students' perceptions of their teachers' behaviour can predict their self – report academic engagement, suggesting that the better the teaching behaviour perceived by students, the higher the level of academic engagement tends to be (Maulana, Helms - Lorenz & Van de Grift, 2015a).

The aim of this paper is to investigate the relationship between teachers' teaching behaviour and students' engagement by taking into account the role of contextual factors (school and autonomous community), teachers' and students' personal factors (gender or teacher teaching experience) and also curricular factors (subject taught and educational level) in the Spanish context. As long as research on this particular topic in Spain has been hardly done, therefore, the present study will contribute to provide insights from the Spanish context.

Theoretical framework

Teachers inside classrooms

The concept of teacher behaviour is quite broad (Burdsal & Bardo, 1986; Guskey & Passaro, 1994; Muijs, Campbell, Kyriakides & Robinson, 2005). Furthermore, teachers develop in their daily routines many tasks, which have to do with organizational facts, the use of time, the attention to all kind of students or the control of discipline. The theoretical framework developed by Van de Grift (2007) has established the existence of six effective teaching domains which make easier the organization and study of all these tasks and their influence on student outcomes such as academic engagement. Not all of the teaching domains imply the same complexity, so the model also offers indications about their level of difficulty and subsequently some conclusions about which tasks should be easily reached by all teachers and which, on the contrary, require higher levels of experience (Van de Grift, 2007, 2014).

Safe learning climate requires the mutual respect not only between students and teachers but also among students, to encourage students' self – confidence and to facilitate good relationships in the classroom. Existing research suggests that learning is enhanced through personal

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interactions with their peers and also with their teachers (Cerda, Pérez, Elipe, Casas & Del Rey, 2019; Barr, 2016).

Efficient classroom management presumes that the teacher is able to organize the learning time with skills such us avoiding the waste of time, punctuality in the beginning and ending of the lesson, providing well-structured classes and not making students wait for their teachers' attention. Other important aspects are presenting information in an orderly manner and managing lesson and topic transitions accurately (Maulana et al., 2015a, 2017; Van de Grift, 2007).

Clarity of instruction includes a well-defined structure of the lesson, clarifying lesson objectives in order to let students know what they are expected to do during the lesson (Maulana et al., 2015b; Van de Grift, 2014), taking into account previous knowledge, giving clear examples, supervising the acquisition of objectives, the equilibrium of activities (dividing individual and group work clearly and in a balanced way) and offering immediate feedback to keep students on task, among others (Maulana et al., 2015a, 2015b; Van de Grift, Helms – Lorenz & Maulana, 2014).

Activating teaching entails connecting students' prior knowledge and the use of advance organizers (Van de Grift et al., 2014) so that contents make sense to students and let them be aware of the relevance of the lessons (Maulana et al., 2015b; Van de Grift, 2007).

Teaching learning strategies cover the use of scaffolds or other metacognitive strategies, which help students bridge the gap between the new concepts and the already known ones and to perform higher level procedures. They usually imply breaking problems down into more simple tasks that students have a real chance of solving (Van de Grift, 2007, 2014).

Differentiation requires adapting teaching to student individual differences,thinking about the factors which determine these individual differences, addressing students' levels, learning preferences and learning profiles (Lluch & Portillo, 2018; Maulana et al., 2015a). Several indicators reflect differentiated teaching strategies: devoting extra time and additional instructions, pre – teaching and re – teaching and implementing various effective teaching methods (Maulana et al., 2015b, 2017).

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Contextual and teacher factors influencing teachers' behaviours: the effect of subjects, gender and teaching experience

Research has been developed to analyse the differences observed among different subject teachers. Opdenakker, Maulana & Den Brok (2012) reported that science and mathematics teachers are often perceived as less favourable compared to other subject teachers. In another study, Maulana et al. (2012) based their research in an interesting idea, assuming among other factors, that the more knowledgeable the teachers are, the more engaged students tend to be, finding interesting differences in these features which may affect teachers ability to be knowledgeable and the subjects taught: differences were observed among maths teachers and English as foreign language ones, revealing that math teachers allocated more time in the introduction of the class and in some countries (The Netherlands) less time on closing the lesson. Telli (2006) also analysed students' perceptions of teachers' interpersonal behaviour across four categories of subjects in secondary education (science; social sciences; language and literature; arts and sports) finding interesting differences in some of the studied dimensions (control and affiliation) particularly in the case of male students and their maths teachers.

Opdenakker and Van Damme (2007) established that teachers' gender was also an important predictor of teacher classroom management so that male teachers tended to maintain order better than their female colleagues and had a better classroom organization. They also indicated that proximity was perceived lower in female teacher classes than in male teachers ones, meaning that female teachers seemed to be stricter, less cooperative and less friendly than male teachers (Opdenakker et al., 2012). All these differences concerning classroom management and relationship with teachers may also affect students' academic engagement. Teodorovic (2011) found in a study developed in a primary school in Serbia that teachers' gender proved to be a moderate predictor of student achievement in Serbian language, so having a male teacher was negatively associated with student achievement. Maulana et al. (2017) in their study with 264 pre – service teachers from 64 secondary schools from the Netherlands found that differences in learning climate and clarity of instruction could be explained by teacher gender, revealing that female teachers displayed better quality learning climate and clarity of instruction than male pre – service teachers. The study of Fernández-

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García et al. (2019) also concluded that Spanish female teachers obtained better ratings in all domains of teaching effectiveness in lower secondary education, higher secondary education and vocational education and training.

On the other hand, female students tended to rate their teachers more favourable than do their male peers (Opdenakker et al., 2012). Moreover, Lietaert, Roorda, Laevers, Verschueren and De Fraine (2015) concluded that girls showed higher behavioural engagement than boys not only based on their own reports but also on teachers and independent observers ones. Besides, girls also showed in this study a more positive perception of teacher support.

Although some studies have shown that teaching experience can be associated with a statistically significant positive effect on student achievement, with higher levels of student engagement or with a better wellbeing experienced by teachers (Antoniou, Kyriakides & Creemers, 2011; Kini & Podolsky, 2016; Reeve, Hyungshin, Carrell, Jeon & Barch, 2004) conclusions are not determinant in this sense. For instance, Opdenakker et al. (2012) determined that teacher influence and proximity decreased over time, and Conway and Clark (2003) found in their qualitative study with intern teachers that class management tasks (e.g. discipline or adopting a custodial approach to teaching) were not as important as it could be initially thought given their condition of novice teachers. On the other hand, several studies (De Jager, Coetzee, Maulana, Helms-Lorenz & Van de Grift, 2017; Fernández-García et al., 2019) have revealed that teachers with less experience were not the ones perceived by their students as less effective.

Teachers' teaching behaviour and students' academic engagement

Studies have revealed that teachers and their behaviours during their classes have a powerful effect on students' academic engagement (Bertills, Granlund & Augustine, 2019; Davidson, Gest & Welsh, 2010; Inda-Caro et al., 2019). Students' engagement is multidimensional and comprises several dimensions. It is frequently conceptualized as the extent to which students are behaviourally and psychologically engaged in academic tasks (Appleton, Christenson, Kim & Reschly, 2006; Van de Grift, 2007; Wang & Holcombe, 2010). Behavioural engagement is

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focused on students' actions and practices that are directed toward school and learning (e.g. if the student tries to work hard in class, shows a positive conduct or effort, participates in class discussions, follows the rules or pays attention) whereas students' emotional engagement assesses students' affective reactions and sense of identification with school, e.g. how students feel in the classroom, if they enjoy learning new things, get involved when they are working on something or show interest (Fredricks, Blumenfeld & Paris, 2004; Jimerson, Campos, & Greif, 2003; Wang & Holcombe, 2010). These two dimensions have a positive effect on students' achievement and grades.

The study developed by Maulana et al. (2017) revealed that the already mentioned teaching behaviour domains explained differences in students' academic engagement being classroom management and clarity of instruction the most significant predictors of pupils' engagement. In their research Inda-Caro et al. (2019) concluded that emotional engagement seemed to be more strongly related to student perceptions of teaching behaviour than behavioural engagement and that activating teaching was the most outstanding domain.Other studies (Ganottice & King, 2014) also concluded that engagement could be influenced by students' relationship with significant others like parents, teachers or peers. Indeed, all these social agents may provide certain kind of support which can act as a facilitator of school engagement and achievement outcomes.

Methodology

Participants

In this Spanish study, participants were 7,114 students of 410 teachers attending 56 educational institutions. 39 of them were public whereas 17 were private. Data were collected, on 2017,among three Spanish autonomous communities: 134 students were from Galicia (41 public schools and 93 private ones); 1,183 from Andalusia (1,084 attended public schools and 99 private ones) and 5,797 from the Principality of Asturias (3,577 from public and 2,220 from private schools). Regarding the numberof teachers, 8 of them were from Galicia, 69 from Andalusia and 333 from the Principality of Asturias.

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According to the educational level students were studying, the distribution was 72% from lower secondary education, 5% from upper secondary education and 13% from vocational education and training (VET).

A balance regarding gender can be observed, showing that 50% students were males and 48% were females. 2% of the students did not report their gender.

The average class size was 18 students, with a mean age of 18 years old. The mean age showed variations depending on the educational level: in lower secondary education the mean age was 16.55 years, in upper secondary education it was 19.19 years and, finally, in vocational educational and training it was 25.34.

The assessed subjects were: languages (native and foreign), exact and applied sciences (which included mathematics, physics, chemistry, natural sciences), social sciences, physical education, artistic education and VET subjects.

Teachers sample was formed by 410 participants. The major percentage of teachers (70%) gave their classes in lower secondary education; 14% of teachers in upper secondary education and 16% in VET. The sample was formed by a majority of female teachers (244, 60%) whereas 166 (40%) were male teachers. The mean age of teachers was 47.90 years old. The majority of teachers were responsible for subjects which have to do with languages, sciences and social sciences. These data are in line with general subject disciplines that constitute the core subjects of the Spanish curriculum.

Teachers' teaching experience mean was 18.91 years. The majority of the teachers (145; 35%) could be found in the category between 10 and 19 years of teaching experience, followed by teachers with between 20 and 29 years (130; 31%), teachers between 3 and 9 years (61; 15%), those with 30 or more years of teaching experience (60; 15%) and beginners with 3 or less years of experience (13; 3%). One teacher did not indicate his/her teaching experience. To sum up, this Spanish sample was formed by teachers with medium teaching experience. All the teachers had an official teaching certificate, as long as it is compulsory for all candidates of the secondary education teaching profession in Spain.

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Measures

Teaching behaviour

To tap student perceptions of teachers' teaching behaviour, we used the My Teacher Questionnaire (MTQ)based on the teaching behaviour model of Van de Grift (2007) and Van de Grift et al. (2014). The questionnaire was translated and back-translated for use in the Spanish context following the guidelines provided by Hambleton, Merenda, and Spielberger (2004). The MTQ consists of 41 items divided into six domains: learning climate, efficient classroom management, clarity of instruction, activating teaching, differentiation and teaching learning strategies. The responses range from 1 (never) to 4 (often). The alpha coefficient for the whole scale was .93. By domains, the alpha values were: learning climate α = .66, efficient classroom management α=.76, clarity of instruction α= .70, activating teaching α= .80, differentiation α= .60 and teaching learning strategies α= .71.

Students' engagement

To measure student engagement, the 10-items engagement scale of Skinner, Kindermann and Furrer (2009) was used. The scale consists of two dimensions of engagement: behavioural engagement (BEHE, 5 items) and emotional engagement (EMEN, 5 items). All responses were provided on a 4-point Likert scale, ranging from 1 (completely false) to 4 (completely true). The alpha coefficient for the whole scale was .88. The alpha coefficient for behavioural engagement was = .93 and .92 for emotional engagement.

Procedure

The research group contacted the educational authorities in order to get their authorization to do this research. The project obtained the approval of the Department of Education of the Principality of Asturias who authorizes which projects (Type C. New research and innovation projects of the University of Oviedo) involving cooperation with schools can be carried out (Educastur, 2017). Depending on the autonomous communities, the process followed to collect data differed: in Asturias, 137 schools were initially contacted although only 41 finally accepted to

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participate; in Andalusia and Galicia, due to the impossibility to contact local educational authorities, we were obliged to use a convenience sampling procedure.

Once the Principal of each school agreed with the participation in the study, the families were informed about the project and its objectives during the meetings developed in the schools at the beginning of the academic year. Only when these authorizations were obtained, the students filled out the questionnaire which took about 30 minutes to complete. Any families who did not allow their children participation, reported their decision to the Principal of the school so that their sons and daughters were not asked to answer the questionnaires.

Collection of data was done in a normal class time. There was no remuneration or course credit for participation and anonymity was guaranteed.. The questionnaires were administrated on a paper format. The research team went to all the schools in order to supervise the process and each of the researchers was assigned a class group to apply the instrument.

Data analysis

A multivariate analysis of variance was used to analyse the influence of certain variables (school, autonomous community, teachers' and students' gender, teacher's teaching experience, subject, educational level and teachers' teaching behaviour) on students' behavioural and emotional engagement. A separate estimation for behavioural and emotional engagement was done using IBM SPSS (version 22). Additionally, differences in criterion variables have been analysed focusing on the 'subject' variable. Due to the fact that the sample did not have neither national nor regional representativeness, analysis distinguishing between regions have not been carried out.

Results

Teaching support and student engagement

In order to test if data had the same distribution, the normality of the sample was initially tested and skewness and kurtosis values were calculated. All dimensions obtained values under 1 in absolute value, so the normality criterion was met. Likewise, to state the homogeneity of variances, the Levene's test was checked, finding values higher than .05 in behavioural and emotional engagement. Besides, in those predictor variables which did not show equality of variance, non-parametric tests were run.

Firstly, a model with all predictor variables (school, autonomous community, teachers' behaviour, students' gender, teachers' gender, teacher teaching experience, subject and educational level) was considered. Additionally, the interaction of all the possible predictor variables were included in the model, obtaining that these variables could explain the 8% of behavioural engagement and the 14% of emotional engagement. The individual influence of the predictor variables, was for behavioural engagement: teachers' behaviour ($F = 399.05$, $p < .001$, $\eta^2 = .06$),likewise, for emotional engagement the influence of teacher behaviour was ($F = 860.00$, $p < .001$, $\eta^2 = .11$). This fact means the teachers' skills had medium effect on students' behavioural engagement and medium-high effect on students' emotional engagement.

Secondly, we focused on teachers' teaching behaviour, consequently, a simpler model was analysed focusing on the interaction of this one with the other predictor variables (Table I). The percentage of explained variance was similar to the one obtained in the previous model: 8% of variability was explained in students' behavioural engagement, and 14% in students' emotional engagement. However, few predictor variables were necessary, because the single effects of each of them were not considered. Regarding behavioural engagement the following interactions showed a significant influence: teachers' teaching behaviour with students' gender and teachers' teaching behaviour with school.

Referring to students' emotional engagement, a significant relationship was found in the interaction of teachers' teaching behaviour with school, students' gender, teachers' teaching experience, subject and educational level.

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Due to the fact that no homogeneity of variance was found in the criterion variables for the school predictor variable, the Kruskal-Wallis' test was run. This fact implies that neither behavioural nor emotional engagement followed the same distribution in each of the schools. The results were in students' behavioural engagement ($\chi^2 = 196.74$, $p < .001$) and in students' emotional engagement ($\chi^2 = 233.06$, $p < .001$). However, it seemed interesting to test the model without the school variable. As a result, the model got the same values. In addition, the relationship between teachers' teaching behaviour and subject taught when the effect of the school was not considered was significant in students' behavioural engagement ($F = 5.34$, $p < .001$, $\eta^2 = .004$), and also increased in students' emotional engagement ($F = 7.21$, $p < .001$, $\eta^2 = .01$); meanwhile, as Table I shows this effect disappears when the school is taken into consideration.

TABLE I. Interaction between teachers' behaviour and school, autonomous community, teachers' gender, students' gender, teacher teaching experience, subject and educational level on students' behavioural and emotional engagement

	Students' Behavioural Engagement		**Students' Emotional Engagement**	
	F	η^2	F	η^2
Teacher's Teaching behaviour* School	2.23***	.02	2.27***	.02
Teacher's Teaching behaviour* Autonomous Community	0.28	.00	0.67	.00
Teacher's Teaching behaviour* Teachers' gender	1.47	.00	1.22	.00
Teacher's Teaching behaviour* Students' gender	26.14***	.004	27.19***	.004
Teacher's Teaching behaviour*Teacher's teaching experience	1.99	.001	2.55*	.001
Teacher's Teaching behaviour* Subjects	1.67	.001	2.65*	.002
Teacher's Teaching behaviour* Educational level	1.99	.001	8.24***	.002

* p< .05. **p < .01. *** p< .001.

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Students' behavioural and emotional engagement across subjects and students' gender

We also aimed to further analyse the interaction between students' gender and subjects. To reach this goal, Pearson correlations (Table II) and an analysis of variance with post-hoc comparisons were carried out in order to identify differences among subjects. As long as equality of variances was not obtained, in other words, the variability of students' engagement was different between subjects ,the Dunnett test was also considered to analyse the post hoc differences (Table III). Pearson correlations showed important differences between students' behavioural/emotional engagement and gender. Focusing on girls, the highest correlations with behavioural engagement and teachers teaching behaviour were obtained for artistic education (r = .37; p< .01) and physical education (r = .30; p< .01) whereas in the case of boys, the highest correlations could be observed with social sciences (r = .27; p< .01), languages (r = .26; p< .01) and VET subjects (r = .26; p< .01).

In the case of emotional engagement, girls' highest correlations with teachers teaching behaviour were obtained for artistic education (r =.53; p< .01) and for exact and applied sciences (r = .38; p< .01). On the other hand, for boys, the highest correlations with emotional engagement and teachers teaching behaviour, were found for social sciences (r = .41; p < .01) and languages (r = .36; p < .01). All correlations were positive, so when students perceived accurate teachers' teaching behaviours their behavioural and emotional engagement increased, whereas when students perceived weak teachers' teaching behaviours their behavioural and emotional engagement decreased.

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TABLE II. Pearson correlations between teaching behaviour and students' engagement considering gender and subjects

	Teachers' Teaching behaviour* Students' Behavioural Engagement		**Teachers' Teaching behaviour* Students' Emotional Engagement**	
	Girls *n* = 3,411	Boys *n* = 3,571	Girls *n* = 3,411	Boys *n* = 3,571
Languages (LE)	.28**	.26**	.34**	.36**
Exact and Applied Sciences (ES)	.25**	.24**	.38**	.31**
Social Sciences (SS)	.17**	.27**	.36**	.41**
Physical Education (PE)	.30**	.12	.33**	.30**
Artistic Education (AE)	.37**	.14	.53**	.08
Others (VET)	.22**	.26**	.29**	.30**

* p < .05. **p < .01. *** p < .001.

Differences among subjects in students' behavioural and emotional engagement were obtained not only in girls but also in boys (Table III). Although the effect of subjects on students' engagement was low, however, the comparison among subjects showed interesting findings.

Regarding behavioural engagement, the differences focused on girls. In female students the differences were concentrated between subjects, specially among VET subjects with language; VET subjects with exact and applied sciences and VET subjects with social sciences, showing a difference *(d)* range between -0.14 and 0.14; $p < .05$. Female students rated significantly higher in artistic education than in exact or applied sciences ($d = 0.16$; $p < .05$), obtaining this last subject the lowest relationship with engagement.

Focusing on emotional engagement, the findings were also different according to gender. While in the case of girls the differences were found between exact and applied sciences and VET subjects (d range between -0.12 to 0.12; $p < .05$) in boys, more differences could be observed. The values were higher in VET subjects than in language, exact and applied sciences and social sciences, depicting a d range between -0.21 to 0.14; $p < .05$ (Table III).

Languages, exact and applied sciences were the subjects where students' (boys and girls) emotional engagement showed lower values. On

the other hand, artistic and physical education were the subjects where students' emotional engagement was higher (Table III). The situation with students' behavioural engagement was slightly different between boys and girls: in the case of boys, languages and exact and applied sciences were the subjects where the lowest values were found whereas girls showed these values in exact and applied sciences and social sciences. The highest values were obtained in artistic and physical education if we focus on boys and VET and artistic education in the case of girls.

TABLE III. Analysis of differences in students' behavioural and emotional engagement considering students' gender and subjects.

	Students' Behavioural Engagement				**Students' Emotional Engagement**			
	Girls *n* = 3,411		Boys *n* = 3,571		Girls *n* = 3,411		Boys *n* = 3,571	
	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Languages (LE)	3.14	0.55	3.02	0.56	3.16	0.60	3.03	0.63
Exact and Applied Sciences (ES)	3.09	0.53	3.02	0.57	3.14	0.60	3.02	0.64
Social Sciences (SS)	3.13	0.53	3.06	0.58	3.18	0.61	3.10	0.63
Physical Education (PE)	3.17	0.57	3.15	0.57	3.26	0.59	3.17	0.70
Artistic education (AE)	3.26	0.47	3.18	0.52	3.23	0.58	3.10	0.61
Others (VET)	3.23	0.49	3.09	0.56	3.25	0.57	3.24	0.56
F	4.56***		3.32**		3.30**		10.52***	
η^2	0.01		0.01		0.01		0.02	
Dunnett's Post Hoc Test	LE-VET = -0.10*				ES-VET = -0.12*		LE-VET = -0.21*	
	ES-VET = -0.14*				VET- ES = 0.12*		ES-VET = -0.21*	
	SS-VET = -0.11*						SS-VET = -0.14*	
	AE-ES = 0.16 *						VET-LE = 0.21*	
	VET-LE = 0.10*						VET-ES = 0.21*	
	VET-ES = 0.14*						VET-SS =0.14*	
	VET-SS = 0.11*							

* p< .05. **p < .01. *** p< .001.

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Discussion and Conclusions

The developed analysis allow us to conclude in line with other studies (Wang & Holcombe, 2010) that engagement is a multidimensional construct so when the aim is the improvement of students' engagement we cannot avoid considering certain external factors that may be influencing students, their perceptions and behaviours. Ganottice and King (2014) reinforce this same idea when they state that school success and engagement are heavily influenced by the social context, not being possible to understand it as only a product of individual features. The study of Martin, Yu and Hau (2014) also focuses on the role of sociocultural dimensions in the shaping of motivations and engagement.

It is also important to pay attention to separate analysis regarding different kinds of engagement (Fredricks, Blumenfeld, Friedel & Paris, 2003). In accordance with our results, the most important factors for behavioural engagement are school, students' gender, teachers' teaching behaviour and subjects.The same results are obtained when we focus on emotional engagement. However, the multivariate analysis of variance shows some differences: whereas students' gender has the same importance in both models (the study of Archambault, Janosz, Morizot and Pagani in 2009 also found the significant effect of students' gender), teachers' teaching behaviour and subjects are more determinant for emotional engagement than for behavioural one. The aforementioned relationship between teachers teaching behaviour - which considers the creation of a good learning climate - and emotional engagement aligns with the literature which has also found the same connection (Reyes, Brackett, Rivers, White & Salovey, 2012). Following the results of Archambault, et al. (2009), as long as students invest time and effort in academic tasks to the extent that they find these tasks valuable and interesting, we also conclude that efforts need to be done to sustain this students' interest in academic issues, as a previous stage to reach their behavioural and emotional engagement.

As a consequence of the results obtained in the multivariate analysis of variance, in which the educational institution reveals its importance for behavioural and emotional engagement, it would be recommendable to deepen in this level of analysis. Although both criterion variables get the same effect sizes, in the school factor, the effect on students' behavioural engagement must be highlighted as long as it may bias the effect of

subject on students' engagement. It should be considered that in other Spanish researches important differences have been obtained in students' results according to their social environment and school (Mato-Vázquez, Chao-Fernández & Ferreiro-Seoane, 2015; Rendon &Navarro, 2007). What is sure is that in our research the educational institution needs to be considered, not being important on the other hand, other factors such as the political - geographical location of the school (no significant results have been obtained according to the autonomous community).

Focusing on teachers' teaching behaviour it is worth mentioning that they are a good predictor of students' behavioural and emotional engagement. So, in line with other studies (Maulana & Helms – Lorenz, 2016; Wang & Holcombe, 2010), our results show that students' perceptions about their teachers' behaviour have a considerable influence in their engagement. When teachers develop better teaching skills, male students' behavioural and emotional engagement increases in areas such as language and social sciences. In the case of female students, improving teachers' teaching behaviour positively affects their emotional engagement in exact and applied sciences and artistic education and besides their behavioural engagement in artistic education and physical education. These results concerning emotional engagement are crucial if we take into account the importance given in recent educational and psychological literature to STEM studies (science, technology, engineering and mathematics) in Spanish contexts (Inda-Caro, Rodríguez-Menéndez & Peña-Calvo, 2016; Peña-Calvo, Inda-Caro, Rodríguez-Menéndez & Fernández-García, 2016; Rodríguez-Menéndez, Inda-Caro & Fernández-García, 2016). Moreover, these studies have reached the conclusion of the importance of female students' participation and engagement in this kind of subjects to avoid school dropout and to achieve good results.

Although subjects do not seem determinant in other studies analysing their influence on teachers' behaviours (Maulana et al., 2017), in the current paper differences have been found among different subjects in relation with students' emotional and behavioural engagement. Furthermore, our data show diverse profiles between instrumental subjects (languages, mathematics and social sciences) and VET ones. Although the lowest values of the criterion variables have been obtained in the instrumental subjects, the correlations also show that this kind of subjects do matter for students' behavioural and emotional engagement. This conclusion means that educational systems and authorities should

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pay attention to them. Some of these correlations (e.g. the correlation between exact and applied sciences and emotional engagement) seem to be especially relevant, due to the fact that female students' emotional engagement mean in these subjects is the lowest one.

Limitations

When interpreting findings, there are a number of potential limitations that need to be considered and which may help to guide future research. First, teachers and students have participated on voluntary basis, so schools were allowed to include only certain groups, which could bias the study.

It would be necessary to develop more studies in other Spanish regions because only analysedthree Spanish autonomous communities have been considered. These studies would be very important because Spain has a decentralized educational system what means that autonomous communities have obtained important competences from the Spanish Ministry of Education, Culture and Sports in order to organize the education in their territory according to the particularities of their specific contexts e.g. introduction of certain languages, the content of some subjects or the regulation of timetables.

In a next phase of the study, it would be desirable to analyse the influence of each domain on students' behavioural and emotional engagement, having direct information from teachers and not only from students. Besides, it would be important to consider the difference between good teaching and students' perceptions of good teaching, as long as students' perceptions of teaching quality and other academic models of good teaching are not necessarily identical (Burdsal & Bardo, 1986). Thus, the future use of multiple sources of information and diverse methodologies (interviews, observations, surveys) can provide a more robust and complete method to study the influence of certain factors in school engagement (Wang & Holcombe, 2010). Additionally, it is worthwhile validating our findings with teachers' and observers' perceptions about teaching behaviours.

Finally, another limitation is based in the cross – sectional nature of the study which does not allow teachers' and students' assessment in each of the variables during a period of time. . Our results are describing

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the relationship and possible influence of some predictor variables on criterion ones at one time point and in a specific sociological context. Future studies would be needed to confirm or refute the results found so far.

References

Antoniou, P., A., Kyriakides, L. & Creemers, B. (2011).Investigating the effectiveness of a dynamic integrated approach to teacher professional development. *CEPS Journal*, *1,* 13-41.

Appleton, J.J. , Christenson, S.L., Kim, D. & Reschly, A.L. (2006). Measuring cognitive and psychological engagement: validation of a student engagement instrument. *Journal of School Psychology*, *44*, 427-445. DOI: https://doi.org/10.1016/j.jsp.2006.04.002

Archambault, I., Janosz, M., Morizot, J. & Pagani, L. (2009). Adolescence behavioral, affective and cognitive engagement in school: relationship to dropout. *Journal of School Health, 79*(9), 408-415. DOI: 10.1111/j.1746-1561.2009.00428.x

Barr, J.J. (2016). Developing a positive classroom climate. *IDEA, 61*, 1-9.

Bertills, K., Granlund, M., & Augustine, L. (2019) Inclusive teaching skills and student engagement in physical education. *Frontiers in Education*, *4:*74. DOI: 10.3389/feduc.2019.00074

Burdsal, C.A. & Bardo, J.W. (1986). Measuring student's perceptions of teaching: dimensions of evaluation. *Educational and Psychological Measurement, 46*, 63-79.

Cerda, G., Pérez, C., Elipe, P., Casas, J.A. & Del Rey, R. (2019). School Coexistence and Its Relationship with Academic Performance Among Primary Education Students. *Revista de Psicodidáctica*, *24*(1), 46-52. DOI: https://doi.org/10.1016/j.psicod.2018.05.001

Coe, R., Aloisi, C., Higgins, S. & Major, L.E. (2014). *What makes great teaching? Review of underpinning research*. London: The Sutton Trust, Centre for Evaluation and Monitoring & Durham University. Obtenido de: http://www.suttontrust.com/wp-content/uploads/2014/10/What-Makes-Great-Teaching-REPORT.pdf

Received: 02-02-2020 Accepted: 18-10-2020

Conway, P.F. & Clark, C.M. (2003). The journey inward and outward: a re – examination of Fuller's concerns – based model of teacher development. *Teaching and Teacher Education, 19*, 465-482. DOI: http://dx.doi.org/10.1016/S0742-051X(03)00046-5

Davidson, A.L.; Gest, S.D., & Welsh, J.A. (2010). Relatedness with teachers and peers during early adolescence: an integrated variable – oriented and person – oriented approach. *Journal of School Psychology*, *48*, 483-510. DOI: https://doi.org/10.1016/j.jsp.2010.08.002

De Jager, T., Coetzee, T., Maulana, R., Helms-Lorenz, M., & Van de Grift, W. (2017). Profile of South African secondary-school teachers' teaching quality: Evaluation of teaching practices using an observation instrument. *Educational Studies, 43*, 410-429. DOI: 10.1080/03055698.2017.1292457.

De Jong, R. & Westerhof, K.J. (2001).The quality of student ratings of teacher behaviour. *Learning Environments Research, 4*, 51-85. DOI: 10.1023/A:1011402608575S.

Educastur (2017). *Comisión valoración proyectos de alumnado Universidad de Oviedo. Lista definitiva*. Obtenido de: https://www.educastur.es/-/comision-de-valoracion-de-proyectos-de-alumnado-universidad-oviedo-lista-definitiva

Fernández-García, C.-M.; Maulana, R.; Inda-Caro, M.; Helms – Lorenz, M. & García Pérez, O. (2019). Student Perceptions of Secondary Education Teaching Effectiveness: General Profile, the Role of Personal Factors, and Educational Level. *Frontiers in Psychology,* 10:533. DOI: 10.3389/fpsyg.2019.00533.

Fredricks, Blumenfeld, Friedel & Paris (2003, March). School engagement. Paper presented at the Indicators of Positive Development Conference, Washington. United States of America. Retrieved from: https://www.childtrends.org/wp-content/uploads/2013/05/Child_Trends-2003_03_12_PD_PDConfFBFP.pdf

Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. *Review of Educational Research*, *74*, 59-109.

Furrer, C. & Skinner, E. (2003). Sense of relatedness as a factor in children's academic engagement and performance. *Journal of Educational Psychology, 95* (1), 148-162. DOI: 10.1037/0022-0663.95.1.148.

Ganotice, F.A. & King, R. (2014). Social influences on students' academic engagement and science achievement. *Psychological Studies*, *59*(1), 30-35. DOI: 10.1007/s12646-013-0215-9

Guskey, T.R. & Passaro, P.D. (1994). Teacher efficacy: a study construct dimensions. *American Educational Research Journal,* 31(3), 627-643.

Hambleton, R.K., Merenda, P., & Spielberger, C. (Eds.) (2004). *Adapting educational and psychological tests for cross-cultural assessment*. Hillsdale, NJ: Lawrence Erlbaum Publishers.

Inda-Caro, M.; Maulana, R., Fernández-García, C.-M.; Peña-Calvo, J.-V.; Rodríguez-Menéndez, C.; Helms – Lorenz, M. (2019). Validating a model of effective teaching behaviour and student engagement: perspectives from Spanish students. *Learning Environment Research, 22,* 229–251. DOI: org/10.1007/s10984-018-9275-z.

Inda-Caro, M., Rodríguez-Menéndez, C., & Peña-Calvo, J.-V. (2016). Spanish high school students' interests in technology. Applying social cognitive career theory. *Journal of Career Development*, *43*(4), 291-307. DOI: 10.1177/0894845315599253.

Irnidayanti, Y., Maulana, R., Helms-Lorenz, M., & Fadhilah, N. (2019). Relationship between teaching motivation and teaching behaviour of secondary education teachers in Indonesia. *Infancia y Aprendizaje: Journal for the Study of Education and Development*, *43*(2), 271-308. DOI: https://doi.org/10.1080/02103702.2020.1722413

Jimerson, S. R., Campos, E., & Greif, J. L. (2003). Toward and understanding of definitions and measures of school engagement and related terms. *California School Psychologist*, *8*, 7- 27.

Kini, T.& Podolsky, A.(2016). *Does teaching experience increase teacher effectiveness? A review of research*. Palo Alto: Learning Policy Institute. Retrieved from: https://learningpolicyinstitute.org/sites/default/files/product-files/Teaching_Experience_Report_June_2016.pdf

Klem,A.M. & Connell, J.P. (2009). Relationships matter: liking teacher support to student engagement and achievement. *Journal of School Health, 74*(7), 262-273. DOI: https://doi.org/10.1111/j.1746-1561.2004.tb08283.x

Kyriakides, L., Creemers, B.P.M. & Antoniou, P. (2009). Teacher behaviour and student outcomes: suggestions for research on teacher training and professional development. *Teaching and Teacher Education, 25*(1), 12- 23. DOI: http://dx.doi.org/10.1016/j.tate.2008.06.001

Received: 02-02-2020 Accepted: 18-10-2020

Le Baron, T., Kelcey, B. & Ruzek, E. (2016). What can student perception surveys tell us about teaching? Empirically testing the underlying structure of the tripod student perception survey.*American Educational Research Journal, 53*(6), 1834-1868. DOI:10.3102/0002831216671864

Lietaert, S. , Roorda, D., Laevers, F., Verschueren, K. & De Fraine, B. (2015). The gender gap in student engagement: the role of teachers' autonomy support, structure and involvement. *British Journal of Educational Psychology*, *85*, 498-518. DOI: 10.1111/bjep.12095.

Lluch, L. & Portillo, M.C. (2018). La competencia de aprender a aprender en el marco de la educación superior. *Revista Iberoamericana de Educación*, *78*(2), 59-76.

Maulana, R. & Helms – Lorenz, M. (2016). Observations and student perceptions of the quality of preservice teachers' teaching behaviour: construct representation and predictive quality. *Learning Environment Research, 19,* 335-337.DOI: 10.1007/s10984-016-9215-8

Maulana, R., Helms – Lorenz, M. & Van de Grift, W. (2015a). Development and evaluation of a questionnaire measuring pre – service teachers' teaching behaviour: a Rasch modelling approach. *School effectiveness and school improvement; an International Journal of Research, Policy and Practice*, *26*(2), 169-194. DOI: http://dx.doi.org/10.1080/09243453.2014.939198

Maulana, R., Helms – Lorenz, M. & Van de Grift, W. (2015b). Pupils' perception of teaching behaviour: evaluation of an instrument and importance of academic motivation in Indonesian secondary education. *International Journal of Educational Research, 69*, 98-112. DOI: http://dx.doi.org/10.1016/j.ijer.2014.11.002

Maulana, R., Helms – Lorenz, M. & Van de Grift, W. (2017). Validating a model of effective teaching baheviour of pre – service teachers. *Teachers and Training. Theory and practice, 23*(4), 471-493. DOI: http://dx.doi.org/10.1080/13540602.2016.1211102

Maulana, R., Opdenakker, M.C., Stroet, K. & Bosker, R. (2012). Observed lesson structure during the first year of Secondary Education: exploration of change and link with academic engagement. *Teaching and Teacher Education*, *28*, 835-850. DOI: http://dx.doi.org/10.1016/j.tate.2012.03.005

Martin, A.J., Yu, K. & Hau, K.T. (2014). Motivation and engagement in the 'Asian century': a comparison of Chinese students in Australia, Hong Kong and Mainland China. *Educational Psychology. An International*

Journal of Experimental Educational Psychology, 34(4), 417-439. DOI: https://doi.org/10.1080/01443410.2013.814199

Mato-Vázquez, M.D., Chao-Fernández, R. & Ferreiro-Seoane, F.J. (2015). Análisis estadístico de los resultados de las pruebas de rendimiento académico del alumnado de la ESO, participante en los premios extraordinarios. *Revista Española de Orientación y Psicopedagogía, 26* (1), 25-43. DOI: DOI: https://doi.org/10.5944/reop.vol.26.num.1.2015.14340

Muijs, D., Campbell, J., Kyriakides, L. & Robinson, W. (2005). Making a case for differentiated teacher effectiveness: an overview of research in four key areas. *School Effectiveness and School Improvement*, *16*(1), 51-70. DOI: http://dx.doi.org/10.1080/09243450500113985

Opdenakker, M.C., Maulana, R. & Den Brok, P.J. (2012). Teacher – student interpersonal relationships and academic motivation within one school year: developmental changes and linkage. *School effectiveness and school improvement; an International Journal of Research, Policy and Practice*, *23*(1), 95-119. DOI: http://dx.doi.org/10.1080/09243453.2011.619198

Opdenakker, M.C. & Van Damme, J.V. (2001). Relationships between school composition and characteristics of school processes and their effects on mathematics achievement. *British Educational Research Journal, 27*(4), 407-432. DOI: 10.1080/01411920120071434

Opdenakker, M.C. & Van Damme, J.V. (2007). Do school context, student composition and school leadership affect school practice and outcomes in secondary education? *British Educational Research Journal, 33*(2), 179-206. DOI: 10.1080/01411920701208233

Peña-Calvo, J.-V., Inda-Caro, M., Rodríguez-Menéndez, C., & Fernández-García, C.-M. (2016). Perceived Supports and Barriers for Career Development among Second-Year STEM Students. *Journal of Engineering Education*, *105*(2), 341-365. DPI: https://doi.org/10.1002/jee.20115

Pianta, R.C. & Hamre, B.K. (2009). Conceptualization, measurement and improvement of classroom processes: standardized observation can leverage capacity. *Educational Researcher, 38*(2), 109-119.

Reeve, J., Hyungshin, J., Carrell, D., Jeon, S. & Barch, J. (2004). Enhancing students' engagement by increasing teachers' autonomy support. *Motivation and Emotion, 28*(2), 147-169. DOI: https://doi.org/10.1023/B:MOEM.0000032312.95499.6f.

Received: 02-02-2020 Accepted: 18-10-2020

Rendón, S. & Navarro , E. (2007). Estudio sobre el rendimiento en matemáticas en España a partir de los datos del informe PISA 2003. Un modelo jerárquico de dos niveles. *Revista Electrónica Iberoamericana sobre Calidad, Eficacia y Cambio en Educación,* 5(3), 118-136.

Reyes, M.R., Brackett, M.A., Rivers, S.E., White, M. & Salovey, P. (2012). Classroom emotional climate, student engagement and academic achievement. *Journal of Educational Psychology, 104*, 700-712. DOI :10.1037/a0027268

Rodríguez-Menéndez, C., Inda-Caro, M., Fernández-García, C.-M. (2016). Influence of social cognitive and gender variables on technological academic interest among Spanish high-school students: testing Social Cognitive Career Theory. *International Journal for Educational and Vocational Guidance, 16*(3), 305-325. DOI: https://doi.org/10.1007/s10775-015-9312-8

Skinner, E.A., Kindermann, T.A., & Furrer, C.J. (2009). A Motivational Perspective on Engagement and Disaffection Conceptualization and Assessment of Children's Behavioral and Emotional Participation in Academic Activities in the Classroom. *Educational and Psychological Measurement*, *69*(3), 493-525. DOI: 10.1177/0013164408323233

Stroet, K., Opdenakker, M.C. & Minnaert, A. (2013). Effects of need supportive teaching on early adolescents' motivation and engagement: a review of the literature. *Educational Research Review*, *9*, 65-87. DOI: https://doi.org/10.1016/j.edurev.2012.11.003

Telli, S. (2016). Students' perceptions of teacher interpersonal behaviour across four different school subjects: control is good but affiliation is better. *Teachers and Teaching. Theory and Practice, 22*(6), 729-744. DOI: http://dx.doi.org/10.1080/13540602.2016.1158961

Teodorovic, J. (2011). Classroom and school factors related to student achievement: what works for students? *School Effectiveness and School Improvement*, *22*(2), 215-236. DOI: http://dx.doi.org/10.1080/09243453.2011.575650

Van de Grift, W. (2007). Quality of teaching in four European countries: a review of the literature and application of an assessment instrument. *Educational Research*, *49*(2), 127-152. DOI: http://dx.doi.org/10.1080/00131880701369651

Van de Grift, W. (2014). Measuring teaching quality in several European countries. *School effectiveness and school improvement. An*

International Journal of Research, Policy and Practice¸ 25(3), 295-311. DOI: http://dx.doi.org/10.1080/09243453.2013.794845

Van de Grift, W., Helms – Lorenz, M. & Maulana, R. (2014).Teaching skills of student teachers: calibration of an evaluation instrument and its value in predicting student academic engagement. *Studies in Educational Evaluation, 43*, 150-159. DOI: http://dx.doi.org/10.1016/j.stueduc.2014.09.003

Van der Lans, R.M., Van de Grift, W. & Van Veen, K. (2015). Developing a teacher evaluation instrument to provide formative feedback using student ratings of teaching acts. *Educational Measurement: issues and practices, 34*(3), 18-27.DOI: 10.1111/emip.12078

Van der Lans, R.M., Van de Grift, W., Van Veen, K. & Fokkens – Bruinsma, M. (2016). Once is not enough: establishing reliability criteria for feedback and evaluation decision based on classroom observations. *Studies in Educational Evaluation, 50*, 88-95- DOI: http://dx.doi.org/10.1016/j.stueduc.2016.08.001

Wang, M.T. & Holcombe, R. (2010). Adolescents' perceptions of school environment, engagement and academic achievement in middle school. *American Educational Research Journal*, *47*(3), 633-662. DOI: 10.3102/0002831209361209

Wilkinson, L., & Task Force on Statistical Inference, American Psychological Association, Science Directorate. (1999). Statistical methods in psychology journals: guidelines and explanations. *American Psychologist, 54*(8), 594-604. DOI: http://dx.doi.org/10.1037/0003-066X.54.8.594.

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Teaching use intention and self-perception of bLearning in higher education[1]

Intención de uso y autopercepción docente del bLearning en educación superior

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Abstract

In recent years the training scenarios are undergoing major transformations, mostly caused by the arrival of information and communication technologies. One of these changes has been translated into the expression Blended Learning, a formative methodology that combines face-to-face and online teaching largely embraced by the education field. Although it is true that research in this model is very abundant, the study on the adoption and perception of Blended Learning by teachers seems to have been neglected. For this reason, a quantitative study is presented focused on researching university teacher's perception regarding this formative modality. A total of 982 teachers from 35 Spanish public universities responded to the Questionnaire on Combined Formative Modality. The results show that, although a high percentage of teachers say that they know how this modality works and the advantages it reports, the percentage of teachers that acknowledge not having integrated it into the courses they teach is high. On the

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other hand, although the training offered by universities is considered important for its implementation, the intention of use is positively correlated with the teacher's self-perception of the resources and knowledge at their disposal. In this sense, it is important to point out the need to recognize, by higher education institutions, both the training and the adaptive work of teachers in the implementation of the combined training strategy.

Key words: *bLearning*, Higher Education, teacher perception, intention of use, teacher training, incentives.

Resumen

En los últimos años los escenarios de formación están sufriendo grandes transformaciones, provocadas en gran medida por la llegada de las tecnologías de la información y la comunicación. Uno de estos cambios se ha visto traducido en la expresión *Blended Learning*, modalidad formativa que combina la enseñanza presencial y la *online* y de gran acogida en el ámbito educativo. Si bien es cierto que la investigación en esta modalidad de aprendizaje es abundante, el estudio sobre la adopción y percepción del *Blended Learning* por parte del profesorado parece haberse descuidado. Por este motivo, se presenta un estudio de corte cuantitativa centrado en investigar la percepción del docente universitario respecto de esta modalidad o estrategia formativa. Un total de 982 docentes de 35 universidades públicas españolas respondieron al Cuestionario sobre Modalidad Formativa Combinada. Los resultados muestran que, si bien un elevado porcentaje de docentes afirma conocer de qué trata esta modalidad educativa y las ventajas que reporta, es elevado el porcentaje de docentes que reconoce no estar integrándola en las materias que imparte. Por otro lado, aunque se considera importante la formación ofrecida por parte de las universidades de cara a su implementación, la intención de uso se correlaciona positivamente con la autopercepción docente sobre los recursos y conocimientos a su disposición. En este sentido, es importante señalar la necesidad de reconocer, por parte de las instituciones de educación superior, tanto la formación como el trabajo adaptativo de los docentes en la implementación de estrategias formativa de carácter combinado.

Palabras clave: bLearning, Educación Superior, percepción docente, intención de uso, formación docente, incentivos.

Background

There is no doubt whatsoever that 2020 will go down in history as the year of the COVID-19 pandemic; a virus that has led to the lockdown of millions of people all over the world, shaking our economic system to the very core, and undermining humanity's social nature. An unprecedented event that has also clearly been reflected within the field of education. In Spain's case, the quarantine has prompted the closure of schools and colleges (El País, 2020) and the hurried and compulsory shift from face-to-face teaching to online learning. In the specific case of higher education, the Ministry of Higher Education (Government of Spain, 2020) has issued a document that refers to a new "adapted presentiality" for the 2020/2021 academic year; in other words, it recommends combining face-to-face classes and remote learning whenever possible. Yet there is nothing new about this, as in recent decades technology has meant that learning scenarios have undergone major transformations (García del Dujo & Martín, 2019; Paredes-Labra & Freitas, 2020; Solé, 2020) through having to adapt to fresh ways of communicating, working and learning (Floridi, 2014; García, Muñoz, & Hernández, 2015; Mace, 2020). Precisely one of the options that will enable us to cope in the best possible manner with the coming academic year at Spanish universities involves Blended Learning (henceforth bLearning), as a type of education that adopts a flexible, balanced and holistic approach to the combination of presential (face-to-face) learning and virtual (online) education (Garrison & Vaughan, 2008; Martín-García, 2014; Martín-García, García del Dujo, & Muñoz, 2014), catering for, on the one hand, the restructuring of teaching practice by overcoming spatiotemporal barriers in the education process and, on the other, by providing new options for interaction and communication (Bartolomé 2004; Graham, Woodfield, & Harrison, 2013; Salinas, Benito, Pérez, & Gisbert, 2018). It involves a format that is advancing toward an educational scenario in which the boundary between online and offline is becoming increasingly blurred; this means that bLearning essentially merges presential with virtual, together with technology and pedagogy. Nevertheless, although the educational community is already familiar with the term bLearning, the complexity of face-to-face learning added to the ubiquity provided by the virtual environment have meant there is as-yet no consensus on the definition of this type of education, which explains the appearance of different proposals, definitions and formats

for the application of bLearning over the past ten years (Bartolomé, García, & Aguaded, 2018; Martín-García, Martínez, & Reyes, 2019; Smith & Hill, 2018).

Where most of the studies conducted so far do in fact coincide is on the advantages stemming from the use of this format at both institutional and instructive level, reporting an increase in flexibility, an improvement in academic performance, the development of personal autonomy and self-regulated learning, a higher degree of engagement, improved financial results, and a higher level of personal academic satisfaction, among others (Smith & Hill, 2018).

On the other hand, the use of this format has also faced serious hurdles, with a clear example being the lack of teaching expertise to properly implement it (Mirriahi, Alonzo, & Fox, 2015) or the reluctance to use digital technology (Johnson, Adams, & Cummins, 2012). In order to deal with the challenges today's society poses, there is a need for teaching staff capable of transitioning to new methodological formats and strategies that enable us to conflate pedagogy and technology. Although it is true to say that recent years have witnessed a growing interest in teacher training in this particular field (Bartolomé, et al., 2018), few studies have so far focused on exploring lecturers' intentions and perception regarding bLearning, as aspects of considerable importance when introducing changes in teaching methods, and upon which the research presented forthwith focuses.

Theoretical underpinnings

The large amount of literature and research published over the past decade testifies to the warm reception that bLearning has received in the field of education (Bartolomé et al., 2018; Duarte, Guzmán, & Yot, 2018; Means et al., 2010; Picciano, Dziuban, & Graham, 2014). The bulk of this scientific output has focused on theoretical-practical aspects, seeking to provide a common framework for implementing this format, with some of these contributions being made by Garrison and Vaughan (2008) and by Stein and Graham (2014). Other scholars have also focused on analysing and explaining the mechanisms that institutions have used to adopt bLearning (Porter & Graham, 2016).

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Although this format has been applied and studied in different areas and levels in education, it should be stressed that most of the projects involved in the application of bLearning have been undertaken by universities (Bartolomé et al., 2018). There are several possible reasons for this: on the one hand, university students' maturity and greater capacity for self-regulation facilitate the implementation of these kinds of semi-presential practices, and on the other, there is the economic efficiency it provides for these institutions (Martín-García, 2014; Smith & Hill, 2018).

Most of these studies have hitherto focused on students rather than on teaching staff (Bartolomé et al., 2018; Boelens, Voet, & De Wever, 2018; Smith & Hill, 2018); what's more, those studies that have focused on teaching staff have adopted a somewhat technological perspective, and not a pedagogical viewpoint, as their purpose has been to explore and analyse lecturers' effective use of technology rather than the adoption of bLearning. This latter approach entails attending to factors that go beyond the handling of technological devices, considering the learning factor in all its dimensions, as noted by Martín-García et al. (2019).

Although research has already flagged the importance of considering lecturers' attitudes and experiences when embracing changes in education, in the case of bLearning this aspect seems to have been overlooked (Porter & Graham, 2016). Nevertheless, the studies conducted so far agree upon the need to hone lecturers' technological and pedagogical skills with institutional support when using this format (Garrison & Vaughan, 2013; Korr, Derwin, Greene, & Sokoloff, 2012). In view of this, it is no surprise that many scholars agree upon the need to examine the adoption of bLearning from a lecturer's perspective (Porter, Graham, Spring, & Welch, 2014).

The findings of studies conducted along these lines up until now contend that despite being a key factor, lecturers' lack of training and instruction in these kinds of methods seems to be one of the main obstacles for deciding to use them in their subjects (Duarte et al., 2018; King & Boyatt, 2014; Martín-García, 2014; Martín-García et al., 2019; Mozelius & Rydell, 2017; Sheffield, McSweeney, & Panych, 2015; Wanner & Palmer, 2015). Moreover, one of the problems that has scarcely been addressed, and which seems to influence the adoption of bLearning by teaching staff, refers to the lack of institutional support, meaning not only the existence of rules and regulations that govern the format's use and application, but also the lack of time set aside for training, together

with a shortage of incentives (Boelens, et al., 2018; González, 2012; Porter & Graham, 2016; Tay, 2016; Wanner & Palmer, 2015; Zhu, Valcke, & Schellens, 2010).

Finally, it is worth stressing that most of the studies published point to the importance of considering lecturers' perceptions of bLearning and ways of adopting it (see, Bartolomé et al., 2018; King & Boyatt, 2014; Martín-García et al., 2019; Sheffield et al., 2015).

Method

This research adopts a qualitative approach within a non-experimental design of an ex–post-facto nature, given that none of the study's variables has been modified or altered. In line with prior studies undertaken by the research group (Martín-García & Sánchez, 2013; Martín-García, García del Dujo, & Muñoz Rodríguez, 2014), the aim is delve further into the analysis of the relationship between the intention to use bLearning (dependent variable) and lecturers' perception of the training received, prior experience, feelings of contentment, and the advantages and disadvantages found (independent variables), bearing in mind a series of intervening variables such as professional category or years of teaching experience.

Sample

The cohort consists of all the lecturers at Spanish public universities. A priori, we know there are 50 public universities and that the total number of teaching and research staff for the 2018-2019 academic year in Spain (according to data provided by the Ministry of Education and Occupational Training) is 122,910. Given the voluntary nature of the lecturers' participation, the sampling technique involved a causal non-probabilistic or accessibility approach, with the participating sample finally consisting of a total of 982 lecturers from 35 Spanish public universities, specifically located in 15 regions or Autonomous Communities (which in descending order are as follows: 16.6% from Andalusia, 12.02% from Madrid, 11.81% from Castilla y León, 9.8% from Murcia, 7.84% from the Community of Valencia, 4.9% from Aragon, 4.8% from the Canary Islands,

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3.8% from the Basque Country, 3.6 from Castilla La Mancha, 3.1% from Cantabria, 2.7% from Extremadura, 2.1% from Galicia, and 0.8% from Navarre and Asturias, respectively).

In terms of gender, the breakdown is very similar (51% male and 49% female), with Table 1 providing the figures for age, teaching experience, and professional category.

TABLE I. Characteristics of the participating sample

Age (in years)	f	%	Teaching Experience (in years)	f	%	Professional Category	f	%
25 and under	7	.7	5 or fewer	130	13.2	Professor with chair	99	10.1
26-34	87	8.9	6-10	149	15.2	Associate prof./Univ. college prof.	345	35.1
35-44	266	27.1	11-15	127	12.9	Lecturer/Univ. college lecturer	194	19.8
45-54	373	38	16-20	148	15.1	Assistant PhD/ Assistant	90	9.2
55-64	228	23.2	21-25	160	16.3	Associate/ Part-time lecturer	199	20.3
65 and over	21	2.1	26 and over	268	27.3	Others	55	5.6

Considering the different knowledge areas taught by the lecturers taking part, a proportional representation of the sample is obtained, with 15.9% of those surveyed teaching Art & Humanities, 15.3% Sciences, 15,7% Health Sciences, 13.4% Architecture and Engineering, and 39.7% Social Sciences and Law. As regards professional category and experience, the highest proportion of participants (35.2%) correspond to permanent staff in the category of Associate Professor or University College Professor, reporting more than 25 years' experience; a contractual situation that, in turn, corresponds to the reality of the hiring policy at Spanish universities.

Instrument

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Application was made of a Spanish questionnaire on Blended Learning at Universities called *Cuestionario sobre Modalidad Formativa Combinada en las Universidades*, drawn up and previously validated by the research team (Martín-García & Sánchez, 2014; Martín-García, Martínez-Abad, & Reyes González, 2019). As a self-report measure, the instrument is divided into three blocks of content. A first block that addresses personal and academic data (11 items), a second block on expertise, beliefs and attitudes involving bLearning (60 items), and a third block on users' experience with it (29 items). The scoring consists mainly of a combination of Likert-type scales (of 5 or 7 points depending on the degree of agreement with each one of the statements) and dichotomous answers, which permits an in-depth study of the variables according to their characteristics (nominal or scale).

The data-gathering process involved the questionnaire's online administration, making access easier for the population under study and speeding up the process, as the study was undertaken nationwide. Specifically, the questionnaire was administered via the Google Drive platform.

Procedure

The data-gathering process was held between January and March 2018, with the referent being the institutional email addresses of the teaching staff at Spanish public universities. The email contained a letter of introduction outlining the research's social value and its ethical criteria (voluntary participation and confidential treatment of data, complying with the Regulations of Salamanca University's Bioethics Committee), as well as the procedures for their observance, including the link to the questionnaire and providing the option of receiving feedback or guidance via email from the research group.

Data analysis

The data were analysed using the SPSS (v.22) statistical package. Based on an initial descriptive analysis of the variables' characteristics, we have proceeded to study the relationship between them, supported by the

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pertinent correlational studies, mainly using the Spearman correlation coefficient for measuring ordinal variables and the chi-squared statistic when the aim has been to study the relationship between categorical and nominal variables.

Results

Perception of the use of bLearning among university teaching staff

According to the data obtained (see Table II), most university teaching staff (60.4%) report some degree of disagreement when asked if they are unaware of the bLearning method, which therefore indicates that they are generally familiar with it; only 24.7% admit to knowing nothing about this methodology. In turn 37.3% say they are familiar with bLearning, but do not use it in their teaching.

A small percentage of participants (3.4%) state that they are trying to master the basics of bLearning, while a much higher percentage (41.4%) state that they are not receiving any instruction in the matter. In turn, an even higher percentage (55.7%) admit that they do not include bLearning in their teaching.

Around 52% of the lecturers say they feel comfortable combining the specific activities or tasks of face-to-face teaching with on-line activities, or vice versa. The data suggest (albeit with a degree of variability) that around 41.1% of the lecturers may use bLearning in different contexts, being capable of introducing innovations and applications.

The descriptive responses to the issue of whether they are interested in using this method suggest that they are not, as the highest percentage disagree with this statement (66.6% of the cohort).

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TABLE II. Lecturers' perception of the use of bLearning

About bLearning	1		2		3		4		5		Total	
	f	%	F	%	f	%	f	%	f	%	f	%
1. I am not familiar with bLearning	377	38.4	216	22.0	146	14.9	13	13.5	110	11.2	982	100
2. I am familiar with bLearning, but I do not normally use it	258	26.3	188	19.1	168	17.1	248	25.3	120	12.2	982	100
3. I am currently trying to master the basics of bLearning	407	41.4	222	22.6	190	19.3	130	13.2	33	3.4	982	100
4. I am beginning to gradually introduce bLearning into my teaching	351	35.7	196	20.0	179	1.2	214	21.8	42	4.3	982	100
5. I feel comfortable combining the specific activities or tasks of face-to-face teaching with online activities	133	13.5	105	10.7	233	23.7	272	27.7	239	24.3	982	100
6. I know how to use bLearning in any context, being capable of introducing innovations and new applications	162	16.5	187	19.0	229	23.3	232	23.6	172	17.5	982	100
7. I have no interest is using bLearning	648	66.6	112	11.4	143	14.6	49	5.0	30	3.1	982	100

A study of the relationship between professional category and the variable on the use of bLearning (using the chi-squared statistic) reports results on the intention of mastering the basics of bLearning, finding that positions such as associate lecturers or those with temporary contracts are willing to learn, while those with settled positions (such as the category of professor) are the ones with the least intention (see Table III). Taking as our reference the chi-squared test, the results record a figure of 32.96 with a p value < 0.05 (p = 0,03), revealing a relationship of dependence between these two variables.

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TABLE III. Relationship between mastering bLearning and professional category (cross-tabulation)

		I am currently trying to master the basics of bLearning					
Professional category		**1**	**2**	**3**	**4**	**5**	**Total**
Professor with chair	**Count**	44	29	10	14	2	99
	%	10.8%	13.1%	5.3%	10.8%	6.1%	10.1%
Associate prof./ Univ. college prof.	**Count**	157	71	70	37	10	345
	%	38.6%	32.0%	36.8%	28.5%	30.3%	35.1%
Lecturer/Univ. college lecturer	**Count**	87	47	36	19	5	194
	%	21.4%	21.2%	18.9%	14.6%	15.2%	19.8%
Assistant PhD/Assistant	**Count**	28	21	25	11	5	90
	%	6.9%	9.5%	13.2%	8.5%	15.2%	9.2%
Associate/Part-time lecturer	**Count**	69	45	37	40	8	199
	%	17.0%	20.3%	19.5%	30.8%	24.2%	20.3%
Others	**Count**	22	9	12	9	3	55
	%	5.4%	4.1%	6.3%	6.9%	9.1%	5.6%
	N	407	222	190	130	33	982

Advantages and disadvantages of bLearning

The lecturers were asked to rate the advantages and disadvantages of using bLearning if they planned to apply this method in the near future (next semester or academic year).

The lecturers perceive (see Table IV) that bLearning will basically help them to streamline their organisation and presentation of information and content, making subjects more interesting and engaging. In addition, they consider it will help to facilitate students' learning process, increasing their motivation and improving class planning; the lowest mean scores are recorded when rating whether bLearning adds to professional prestige, or when considering that it increases a lecturer's workload.

TABLE IV. Advantages and disadvantages of bLearning

Advantages and disadvantages of bLearning	n	$\bar{x}$	Sx
1. It would help me to improve my professional performance	982	3.19	1.110
2. It would help me to make my classes more interesting and engaging	982	3.62	1.084
3. It would help to improve or facilitate my students' learning process	982	3.62	1.029
4. It would improve my class planning	982	3.45	1.118
5. It would increase my students' motivation	982	3.46	1.068
6. I would give me more time to develop content	982	3.24.	1.194
7. It would increase my workload, with nothing new or better	982	2.80	1.134
8. It would probably be better than using a single format	982	3.51	1.140
9. It would make my teaching more efficient	982	3.46	1.041
10. It would increase the efficiency of assessment processes	982	3.40	1.090
11. It would streamline the organisation and presentation of information and the content to be learnt	982	3.63	1.023
12. It would probably enhance my professional image	982	3.18	1.089
13. It would help to refresh my professional performance, putting me on a par with my peers in these matters	982	2.79	1.128
14. My peers that use bLearning enjoy greater prestige and exposure than those that do not	982	2.46	1.059
15. The use of one or other format at this university has no kind of social or professional significance	982	3.11	1.219

A study of the relationship between variables according to professional category and the self-perceived advantages or disadvantages (Tables V and VI) revealed significant relationships regarding the statement whereby they considered that the use of bLearning would help them to improve their professional performance ($\chi^2 = 34.491$, $p < 0.05 = .023$) or when considering that it would enhance their professional image ($\chi^2 = 33.23$, $p < 0.05 = .032$).

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TABLE V. Study of the relationship between the perception of bLearning according to the improvement in professional performance and professional category (cross-tabulation)

		The use of bLearning would help me to improve my professional performance					
Professional category		**1**	**2**	**3**	**4**	**5**	**Total**
Professor with chair	**Count**	9	19	34	26	11	99
	%	9.4%	13.7%	10.4%	8.2%	10.9%	10.1%
Associate prof./ Univ, college prof.	**Count**	40	53	119	101	32	345
	%	41.7%	38.1%	36.4%	31.7%	31.7%	35.1%
Lecturer/Univ. college lecturer	**Count**	28	27	49	66	24	194
	%	29.2%	19.4%	15.0%	20.7%	23.8%	19.8%
Assistant PhD/ Assistant	**Count**	5	15	33	30	7	90
	%	5.2%	10.8%	10.1%	9.4%	6.9%	9.2%
Associate/Part-time lecturer	**Count**	10	20	66	81	22	199
	%	10.4%	14.4%	20.2%	25.4%	21.8%	20.3%
Others	**Count**	4	5	26	15	5	55
	%	4.2%	3.6%	8.0%	4.7%	5.0%	5.6%
	n	96	139	327	319	101	982

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TABLE VI. Study of the relationship between the perception of bLearning according to the enhancement of professional image and professional category (cross-tabulation)

		The use of bLearning would probably enhance my professional image					
Professional category		**1**	**2**	**3**	**4**	**5**	**Total**
Professor with chair	**Count**	6	15	29	39	10	99
	%	7.4%	15.2%	13.6%	9.4%	5.8%	10.1%
Associate prof./ Univ. college prof.	**Count**	31	34	73	151	56	345
	%	38.3%	34.3%	34.1%	36.4%	32.4%	35.1%
Lecturer/Univ. college lecturer	**Count**	25	16	35	79	39	194
	%	30.9%	16.2%	16.4%	19.0%	22.5%	19.8%
Assistant PhD/ Assistant	**Count**	2	12	21	42	13	90
	%	2.5%	12.1%	9.8%	10.1%	7.5%	9.2%
Associate/Part-time lecturer	**Count**	16	19	40	84	40	199
	%	19.8%	19.2%	18.7%	20.2%	23.1%	20.3%
Others	**Count**	1	3	16	20	15	55
	%	1.2%	3.0%	7.5%	4.8%	8.7%	5.6%
	n	81	99	214	415	173	982

Evaluation of the short-term individual use of bLearning

The lecturers did not report any incompatibility when using bLearning, indicating that it is a matter of workload, time and predisposition. They also affirm that given their resources and expertise, they could use bLearning without any problems, saying they were not at all intimidated by using a computer or other IT systems. Nevertheless, they also indicate that it depends on the subjects, as it is not simple or easy to use this format with certain ones.

It is significant that the lowest rated item or aspect involves the question on the degree of agreement or disagreement with feeling awkward when using virtual devices.

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TABLE VII. Short-term individual use of bLearning

Short-term individual use of bLearning	n	$\bar{x}$	Sx
1. It's difficult because I don't have enough expertise, information or skills in handling ICTs	982	2.16	1.179
2. It'll be complicated, because I don't have enough teaching knowledge on combining the two formats	982	2.30	1.145
3. It depends on the subjects. It is not or won't be easy in mine	982	3.03	1.153
4. I find it easy to use bLearning	982	3.29	1.078
5. I cannot imagine higher education without a high percentage of face-to-face teaching	982	2.81	1.174
6. It would be very difficult to implement because of the absence of a material infrastructure or resources at this university	982	2.34	1.127
7. bLearning is not compatible with the scenarios, tasks and activities involved in my subjects	982	2.18	1.070
8. It would not be easy to implement because of a lack of support from management at my university/college	982	2.33	1.161
9. I don't see any incompatibility, it's just a question of time, work and predisposition	982	3.63	1.095
10. I would be willing to use bLearning if someone taught me how to go about it	982	3.06	1.220
11. I'm not confident about virtual teaching, I feel as if I'm losing control of my students	982	1.81	1.028
12. I don't feel the need to use it, I feel comfortable and satisfied with the way I've been teaching and the results obtained	982	2.41	1.194
13. Given my resources and knowledge, I could easily introduce bLearning	982	3.55	1.106
14. I'm not at all put off by the use of computers or digital devices in the classroom	982	4.36	.915
15. I find the use of complex tasks and activities in virtual environments quite bewildering	982	1.82	1.025
16. I feel awkward about using computers and other digital devices in the classroom	982	1.57	.971

Lecturers' thoughts on the use of bLearning

Lecturers generally consider that the implementation of bLearning is or can be beneficial, as well as enjoyable and fun. They also stress, nonetheless, that in their opinion it is a cumbersome and laborious task and is not an essential requirement.

TABLE VIII. Lecturers' self-perceived feelings about the use of bLearning

Thoughts on the use of bLearning	n	$\bar{x}$	Sx
It is (or may be) pleasant	982	3.83	.917
It is (or may be) cumbersome, laborious	982	3.02	1.239
It is (or may be) awkward	982	2.23	1.053
It is (or may be) beneficial	982	4.05	.821
It is (or may be) essential	982	2.98	1.133
It is (or may be) fun	982	3.54	.998
It is (or may be) insecure	982	2.15	1.037

Intention to use bLearning

Lecturers declare a firm intention to use bLearning in the future, albeit less so in the short or medium terms.

TABLE IX. Intention to use bLearning

Intention to use bLearning	n	$\bar{x}$	Sx
I intend to use bLearning in my subjects next year	982	4.57	2.187
I intend to use bLearning as much as possible in the future	982	5.13	1.801

A correlational study between the intention to use bLearning in the future and the perception of its appeal and benefits, using the Spearman correlation coefficient, records significant results ($p > 0.01$), with values ranging between $\rho = 0.41$ and $\rho = 0.57$ (see Table X), finding a positive relationship between variables, which is higher when there is no specific intention to use bLearning in the next academic year.

TABLE X. Correlations between the intention to use bLearning and thoughts about it

	Intended use next year	Intended use in the future
Appeal	.412**	.509**
Benefits	.460**	.574**

** The correlation is significant at the 0.01 level (bilateral).

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Training received and experience in bLearning at the university

A high percentage of lecturers (56.1%) report that public universities provide them with instruction in bLearning; nevertheless, 76% state that the use of bLearning is voluntary, while 40.4% declare that their universities consider the use of bLearning in their quality policies. By contrast, almost 40% indicate that their universities do not provide any incentives to encourage or acknowledge the work of lecturers that use new information technologies. There is a significantly high level of unawareness when the lecturers are asked whether their universities have rules and regulations on their use of bLearning (56%), whether it is considered in management and promotion policies (43.1%), even with a higher percentage than those that say they do in fact consider it a quality indicator in innovation policies (41.6%).

As regards instruction, a fairly similar percentage of lecturers report having received training from the university (41.1%) as those that have not (48.6%), with this figure being higher when the focus is on receiving instruction from a centre or organisation other than the university, with 71% reporting that they have not received any outside training.

TABLE XI. Training and experience in *bLearning*

Training and experience in bLearning	Yes		No		DK/NO		Total	
	f	%	f	%	f	%	f	%
Your university provides teaching staff with training in bLearning	551	56.1	120	12.2	311	31.7	982	100
The use of bLearning by lecturers at your university is voluntary	746	76.0	56	5.7	180	18.3	982	100
There are rules and regulation on bLearning at your university	190	19.3	242	24.6	550	56.0	982	100
Your university considers bLearning in its management policies and the promotion of teaching staff	233	23.7	326	33.02	423	43.1	982	100
The use of bLearning at your university is considered an indicator of the quality of innovation processes	397	40.4	176	17.9	409	41.6	982	100
Your university provides incentives for encouraging and recognising the work of teaching staff that use new information technologies	266	27.1	384	39.1	332	33.8	982	100

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Your university's institutional plan for the introduction of virtual learning allows you to work with professionals from the private sector	90	9.2	287	29.2	605	61.6	982	100
Your university has agreements on instruction in bLearning that are privately funded	65	6.6	207	21.1	710	72.3	982	100
In your own specific case, you have received some form of instruction in bLearning provided by your university	404	41.1	477	48.6	101	10.3	982	100
In your own specific case, you have received some form of instruction in bLearning provided by other centres or organisations outside your university	159	16.2	697	71.0	126	12.8	982	100

A study of the relationship between intended use and other variables, such as the instruction received, resources, or the expertise lecturers think they have, does not show a significant relationship in aspects related to the training received, but instead intention correlates positively with a lecturer's self-perception of their resources and knowledge for implementing bLearning, finding a negative correlation with the incompatibility that lecturers report between bLearning and the scenarios, tasks and activities their subjects require (see Table XII).

TABLE XII. Correlations between intended use and other variables such as resources and task incompatibility

	Intended use next year	**Intended use in the future**
Resources	,491**	,459**
Incompatibility between bLearning and subject tasks	-,418**	-401 **

** The correlation is significant at the 0.01 level (bilateral).

On this occasion, the relationship between the necessary compatibility and resources is closer when the intended use focuses on the final year, which is also the case when we analyse the relationship between incentives that encourage and acknowledge the work of teaching staff using ICTs in their classrooms and their intended use in following year, whose results (Table XIII), based on the chi-squared test, record a value of 25.653, with p value < 0.05 (p = 0.012).

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TABLE XII. Study of the relationship between intended use and the existence of incentives (cross-tabulation)

		Intended use							
Existence of incentives		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Total**
YES	**Count**	29	18	25	28	34	50	82	266
	%	21.2%	15.0%	38.5%	30.8%	26.6%	29.1%	30.5%	27.1%
NO	**Count**	58	58	21	41	41	66	99	384
	%	42.3%	48.3%	32.3%	45.1%	32.0%	38.4%	36.8%	39.1%
DK/NO	**Count**	50	44	19	22	53	56	88	332
	%	36.5%	36.7%	29.2%	24.2%	41.4%	32.6%	32.7%	33.8%
	n	137	120	65	91	128	172	269	982

Discussion

Our findings shed light on significant aspects that are consistent with prior studies conducted along similar lines. Specifically, there is ample knowledge about the type of bLearning referred to in this study; nevertheless, it is still not being extensively used at Spanish public universities. More than 60% of the sample report that they have no interest in using this type of educational format, especially so those lecturers that have a more secure contract and longer trajectory in higher education; those that do use it, however, say they feel comfortable and apply it in different contexts.

University teaching staff consider that bLearning may be a suitable strategy for streamlining the organisation of information and content and its presentation to students, increasing the appeal of subjects and improving student motivation. There is also a widespread belief that bLearning increases a lecturer's workload without adding anything new or any improvement. These findings coincide with prior studies both on bLearning and on eLearning that also single out lecturers' lack of time (González, 2012; Wanner & Palmer, 2015).

Accordingly, and considering issues of time, workload and predisposition, the lecturers are of the opinion that the implementation

of bLearning depends on the subjects or topics, with some actually affirming that the use of technology in the classroom makes them feel awkward, even today. In this vein, studies such as the one by Mozelius and Rydell (2017) coincide in highlighting that even lecturers that are highly motivated to learn and adapt to a new technique or tools see it as an endeavour that requires time and dedication. Therefore, in agreement with Wanner and Palmer (2015), a high percentage of lecturers are still undecided, and are potentially misinformed about the educational value these strategies have, moreover citing limitations and lack of technological support (González, 2012; Zhu, Valcke, & Schellens, 2019).

Our research interest has also focused both on exploring lecturers' intention to use bLearning in the short and medium terms and on verifying whether or not the instruction received is associated with a greater intention to do so. Accordingly, we found a potential intention for future use, albeit not imminently so, expressed mainly by teaching staff with little experience and currently on temporary contracts. We also found that more than half the sample reports receiving instruction in bLearning at their universities, which confirms that public universities are making an effort to recycle their teaching staff in this matter. Along these same lines, the study's results show that intended use correlates positively both with the lecturers' expertise for implementing bLearning and with the resources at their disposal and their self-perception in terms of self-esteem and satisfaction, with these findings also coinciding with studies such as the one by Wanner and Palmer (2015).

These latter aspects of self-perception and resources are likewise related to the dissatisfaction lecturers express over the fact universities do not take the use of bLearning into account, besides the effort they say it entails, either in quality policies or in the provision of incentives that encourage and acknowledge its use, which therefore depends on an individual or collective predisposition. These findings coincide with those reported by Zhu, Valcke, and Schellens (2010) and the studies by King and Boyatt (2014), which have already noted that lecturers' mindsets, their self-confidence and skills will influence their use of learning methods via technology, and those by Porter and Graham (2016) that link intended use to the availability of infrastructures and means together with technical and institutional support.

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Conclusions

There are sundry conclusions to be drawn that testify to the value of this study's contribution and the application of its findings. On the one hand, universities can no longer ignore the fact that the implementation of teaching methods such as bLearning means adapting to technological innovation and the new scenarios in both society as a whole and in higher education in particular, as they enable us to merge virtual and face-to-face formats. Furthermore, they respond to the requirements of a society and a labour market that call for more realistic, hands-on and flexible education, catering for different settings, environments, timeframes, and even stakeholders. A clear example of how models related to bLearning are capable of facilitating and adapting teaching-learning processes to social demands is the firm commitment made by Spain's Ministry of Higher Education to implement teaching formats consistent with bLearning to deal with the health crisis that we are currently facing (Government of Spain, 2020). Higher education should therefore take onboard the views and opinions of teaching staff as the main drivers of change, continuing with its thorough analysis of our main strengths and those weaknesses that need to be remedied. A lot is to be said, therefore, for the new technology acceptance models (TAM; Venkatesh & Bala, 2008; Venkatesh & Davis, 2000), in which the teaching role has a significant impact on the way students perceive this type of education.

The use of ICTs in higher education helps to reinforce the interaction between lecturers and students (Duarte et al., 2018); moreover, those that have experienced the benefits of the use of ICTs in the classroom find them appealing, appreciate their benefits, and consider their application to be compatible with their subjects' requirements, being more inclined to use innovative teaching methods (Çardak & Selvi, 2016). Nonetheless, it should be noted that universities' educational innovation plans should acknowledge lecturers' efforts to adapt accordingly, considering incentives, providing training and technical resources and, as indicated by a high percentage of the sample involved in this study, adding value to teaching assessment processes.

It is therefore important to highlight the need for drafting institutional policies in several areas: agreeing upon a definition and plan for the implementation of teaching methods based on bLearning in different branches of knowledge and academic courses, as already reported in

prior studies by Porter et al. (2014). A training plan, not only in purely technical and instrumental terms, but also in the field of pedagogy, which stresses the benefits for lecturers and students alike, and which coincides with the studies by Martín-García et al. (2019) and Mozelius and Rydell (2017). Finally, a plan for acknowledging lecturers' endeavour in terms of educational innovation, a commitment to teaching and learning, and the far-reaching transformation of education, as already stressed by Garrison and Vaughan (2013).

To conclude, we should focus on some of the study's limitations, basically involving its national setting and public universities. Future research could focus on a comparison with other universities with more experience in the implementation of bLearning.

References

Bartolomé, A.R. (2004). Blended Learning. Conceptos básicos. *Pixel-Bit, 23*, 7-20.

Bartolomé, A.R., García, R. y Aguaded, I. (2018). Blended learning: panorama y perspectivas. *RIED. Revista Iberoamericana de Educación a Distancia, 21*(1), 33-55. http://dx.doi.org/10.5944/ried.21.1.18842

Boelens R., Voet M. y De Wever B. (2018). The design of blended learning in response to student diversity in higher education: Instructors' views and use of differentiated instruction in blended learning. *Computers & Education, 120,* 197-212. https://doi.org/10.1016/j.compedu.2018.02.009

Cardak, C. S., y Selvi, K. (2016). Increasing teacher candidates' ways of interaction and levels of learning through action research in a blended course. *Computers in Human Behavior, 61*, 488-506. https://doi.org/10.1016/j.chb.2016.03.055

Duarte, A., Guzmán, C. y Yot, C. (2018). Aportaciones de la formación Blended learning al desarrollo profesional docente. *RIED. Revista Iberoamericana de Educación a Distancia, 21*(1), 155-174. http://dx.doi.org/10.5944/ried.21.1.19013

Received: 24-01-2020 Accepted: 04-09-2020

El País (12 de marzo de 2020). Cierran los centros educativos de toda España. Recuperado de: https://cincodias.elpais.com/cincodias/2020/03/12/economia/1584015314_646035.html

Floridi, L. (2014). *The 4th revolution. How infosphere is reshaping human reality*. UK: Oxford University Press.

Graham, C.R. (2013). Emerging practice and research in blended learning. En M.J., Moore (Ed.) *Handbook of distance education.* New York: Routledge. 333-350.

García del Dujo, A. y Martín-Lucas, J. (2020). Towards "onlife" education. How technology is forcing us to rethink pedagogy. En Martín García, A.V. *Blended Learning: convergence between technology and pedagogy.* Switzerland: Springer. https://doi.org/10.1007/978-3-030-45781-5

García del Dujo, A., Muñoz Rodríguez, J.M. y Hernández Serrano, M.J. (2015). Medios de interacción social y procesos de (re-de) formación de ciudadanías. *Teoría de la Educación. Revista interuniversitaria, 27* (1), 85-101. http://dx.doi.org/10.14201/teoredu201527185101

Garrison, D. R. y Vaughan, N. D. (2008). *Blended learning in higher education: Framework, principles and guidelines.* San Francisco: Jossey-Bass.

Garrison, D. R. y Vaughan, N. D. (2013). Institutional change and leadership associated with blended learning innovation: two case studies. *The Internet and Higher Education, 18*, 24–28. https://doi.org/10.1016/j.iheduc.2012.09.001

Government of Spain (2020). *Recomendaciones del ministerio de universidades a la comunidad universitaria para adaptar el curso universitario 2020-2021 a una presencialidad adaptada*. Ministerio de Universidades. Recuperado de: https://www.ciencia.gob.es/stfls/MICINN/Universidades/Ficheros/Recomendaciones_del_Ministerio_de_Universidades_para_adaptar_curso.pdf

González, C. (2012). The relationship between approaches to teaching, approaches to e-teaching and perceptions of the teaching situation in relation to e-learning among higher education teachers. *Instructional Science, 40*(6), 975–998. http://doi.org/10.1007/s11251-011-9198-x

Johnson, L., Adams, S., y Cummins, M. (2012). *Technology Outlook for Australian Tertiary Education 2012-2017: An NMC Horizon Report Regional Analysis.* Austin, Texas: The New Media Consortium.

King, E. y Boyatt, R. (2014). Exploring factors that influence adoption of e-learning within higher education. *British Jorunal of Educational Technology, 46*(6), 1272-1280. https://doi.org/10.1111/bjet.12195

Korr, J., Derwin, E. B., Greene, K. y Sokoloff, W. (2012). Transitioning an adult-serving university to a blended learning model. *The Journal of Continuing Higher Education, 60*(1), 2–11. https://doi.org/10.1080/07377363.2012.649123

Mace, R. (2020). Reformulando lo ordinario: ciberespacio y educación. *Teoría de la Educación. Revista interuniversitaria, 32,* (2), 109-129. http://dx.doi.org/10.14201/teri.22473

Martín-García, A.V. (2014). *Blended Learning en educación Superior. Perspectivas de innovación y cambio.* Madrid: Síntesis.

Martín-García, A. V., García del Dujo, Á. y Muñoz, J. M. (2014). Factores determinantes de adopción de Blended Learning en Educación Superior. Adaptación del modelo UTAUT. *Educación XXI,2* 217-240. https://doi.org/10.5944/educxx1.17.2.11489

Martín-García, A.V., Martínez-Abad, F. y Reyes-González, D. (2019). TAM and stages of adoption of blended learning in higher education by application of data mining techniques. *British Journal of Educational Technology, 0* (0), 1-17. https://doi.org/10.1111/bjet.12831

Martín-García, A.V. y Sánchez, M.C. (2014). Modelo predictivo de la intención de adopción de Blended learning en profesores universitarios. *Universitas Psychologica*, *13*(2), 15-28.

Means, B., Toyama, Y., Murphy, R., Bakia, M., y Jones, K. (2010). *Evaluation of Evidence-Based Practices in Online Learning. Structure. A Meta-Analysis and Review of Online Learning Studies*. Washington: Department of Education, Office of Planning, Evaluation, and Policy Development. Center for Technology in Learning.

Mirriahi, N., Alonzo, D. y Fox, B. (2015). A blended learning framework for curriculum design and professional development. *Research in Learning Technology, 23*(1), 28451. doi:10.3402/rlt.v23. 2845

Mozelius, P. y Rydell, C. (2017). Problems affecting successful implementation of blended learning in higher education- The teacher perspective. *ICTE Journal, 6* (1), 4-13. doi:10.1515/ijicte-2017-0001

Paredes-Labra, J. y Freitas Cortina, A. (2020). Las representaciones de los futuros profesores sobre los usos de la tecnología en la escuela. Un estudio narrativo. *Teoría de la Educación. Revista Interuniversitaria, 32* (2), 157-180. http://dx.doi.org/10.14201/teri.21616

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Picciano, A., Dziuban C. R. y Graham, C. R. (2014). *Blended learning: research perspectives*. New York and London: Routledge.

Porter, W.W. y Graham, C.R. (2016). Institutional drivers and barriers to faculty adoption of blended learning in higher education. *British Journal of Educational Technology, 47(*4), 748-762. https://doi.org/10.1111/bjet.12269

Porter, W.W., Graham, C.R., Spring, K.A. y Welch, K.R. (2014). Blended learning in higher education: institutional adoption and implementation. *Computers & Education, 75,* 185-195. http://dx.doi.org/10.1016/j.compedu.2014.02.011

Salinas Ibáñez, J., de Benito Crosetti, B., Pérez Garcías, A. y Gisbert Cervera, M. (2018). Blended Learning, más allá de la clase presencial. RIED. *Revista Iberoamericana de Educación a Distancia, 21*(1), 195-213.

Sheffield, S.L., McSweeney, J.M. y Panych, A. (2015). Exploring Future Teachers' Awareness, Competence, Confidence, and Attitudes Regarding Teaching Online: Incorporating Blended / Online Experience into the Teaching and Learning in Higher Education Course for Graduate Students. *Canadian Journal of Higher Education, 45*(3), 1-14.

Smith, K. y Hill, J. (2018). Defining the nature of blended learning through its depiction in current research. *Higher Education Research & Development*, *38*(2) 383-397. https://doi.org/10.1080/07294360.2018.1517732

Solé Blanc, J. (2020). El cambio educativo ante la innovación tecnológica, la pedagogía de las competencias y el discurso de la educación emocional. Una mirada crítica. *Teoría de la Educación. Revista Interuniversitaria, 32,* (1), 101-121. http://dx.doi.org/10.14201/teri.20945

Stein, J. y Graham, C.R. (2014). *Essentials for Blended Learning: A Standars-Based Guide.* New York: Routledge.

Tay, H. Y. (2016). Investigating engagement in a blended learning course. *Cogent Education, 3*(1), 1-13. https://doi.org/10.1080/2331186X.2015.1135772

Venkatesh, V. y Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management science, 46*(2), 186–204.

Venkatesh, V. y Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. *Decision Sciences, 39*(2), 273–315.

Wanner, T. y Palmer, E. (2015). Personalizing learning: exploring student and teacher perceptions about flexible learning and assessment in a flipped university course. *Computers & Education, 88,* 354-369. https://doi.org/10.1016/j.compedu.2015.07.008

Zhu, C., Valcke, M. y Schellens, T. (2010). A cross cultural study of teacher perspectives on teacher roles and adoption of online collaborative learning in higher education. *European Journal of Teacher Education, 33*(2), 147-165. http://dx.doi.org/10.1080/02619761003631849

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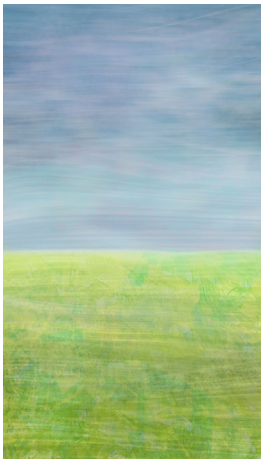

Reviews

Reviews

Motos, T. (2020). *Teatro en la educación (España, 1970-2018).* Barcelona: Octaedro, 276 pp. ISBN: 978-84-18083-01-3.

The book makes a journey through the relationship between Theatre and Education in Spain between 1970 and 2018. Starting from the different terms used to name the performing Arts Applied to Education and the pedagogical and psychological theories in which they have their roots, the content is organized in the periods of validity of the Educational laws. In addition, the contributions of seminal authors are analysed on whose ideas, the pedagogy of Theatre in Education (TE) are based on. Here is the content of the first part of the book.

In its pages it is defended that both academics, teachers and educators and other people who work with dramatic activities in their professional practice should become aware of the need to know how ET has evolved. The main reason is that whoever ignores history -as postulated by the author- will always repeat what others have already done, including their mistakes, since we are what we are because others did what they did. If we do not know where we come from, where we are and where we can go, we will be unable to build the future.

The author emphasizes that when it comes to making any study on Education , it is found that it is inexorably prescribed by the executive powers of the Government, which are the ones that draft and impose educational laws, and that, in turn, these are conditioned by the economic powers. The second section of the book covers the duration of the LGE (1970-1990) and focuses on the boom in Children's and Youth Theatre, on the self-training of teachers, on the authors and entertainment companies of the 70s and 80s and on the birth of ASSITEJ and Independent Theatre.

The third part covers the period between 1990 and 2002, in which the decline of socialist ideology and the rise to power of the Popular Party took place, which meant that neoliberal thought permeated Politics, Economy, Education and Social Values. It refers to the time that the LOGSE was in effect until the LOCE was implemented. The type of

teacher training in TE is exposed, the works and the authors of Child and Youth Theatre as well, the birth of Municipal Drama Schools and the use of didactic guides, as material to mediate between creators, artists and spectators, and so on.

The fourth part looks at the period of validity of the LOE and LOMCE educational laws (years 2004 to 2018). The socio-political context is specified by the two Socialist mandates and the two periods of the Popular ones confirms the failure of neoliberal policies. A review of the Theatre for young people today is made and the possibilities of new fields that Applied Theatre opens. In this sense, the use of dramatic strategies for teaching a second language is proposed and for inclusion and attention to diversity. In addition, it deeps into the expansion of Social Media and its impact, both in conventional theatre and in TE. And finally, the author analyses the postdramatic theatre and the changes that the fact of facing other narrative schemes different from the Aristotelian ones bring to the theatrical literacy of the young people.

The book concludes with the following reflection: since the second half of the 20th century, Theatre and Dramatic Activities have been a renewing agent of pedagogical thought and educational practices, fostering the miscegenation of ideas and procedures, and thus becoming in one of the dynamic elements of Education. The school, which is a closed system, and which teaches through images of reality and not reality itself, has been fertilized by Theatre, which is an open practice. Theatre helps to break down the walls of the classroom. Paraphrasing the author, "Theatre, despite of being an ephemeral art, always leaves a trace", we think that this book will also leave traces on the reader and it will help to put Theatre in Education, with all that this implies, in the social and educational planification.

Antoni Navarro Amorós

Martín Vegas, R. A. (2019). *Desarrollo de la competencia lingüística y literaria en la educación primaria*. Madrid: Editorial Síntesis. 212 pp. ISBN: 978-84-917173-5-5.

The linguistic and literary competence of kids in Elementary Education is key in that language is fundamental to human life because

we use it to communicate with others, to speak about ourselves and to transmit the culture of our speech community and, at the same time, it has a determining role in education, as it allows us to access curricular knowledge, as well as "learning to learn".

In this sense, the book by Professor Martín Vegas, *Desarrollo de la competencia lingüística y literaria en la educación primaria* is a very important work. It promotes reflection, social skills and the integration of content into the teaching of the Spanish language in primary school, in order to improve the ability to understand and express all kinds of messages in the most diverse communicative situations and taking into account the student`s competence, age and development (p.11). This is the second volume of the collection *Recursos didácticos en lengua española y literatura* edited by Síntesis and that the author began in 2015 with the work *El desarrollo del lenguaje en la educación infantil*, a mandatory reference book.

Specifically, this volume consists of seven chapters, the first one is the introduction. The author states her theoretical and applied methodologies of linguistic and literary issues which are intended for practicing and training teachers, as well as for other educators, tutors and relatives who, in a complementary and conscious way, want to facilitate children's language development (p.15).

Chapter 2. The first topic is effective communication techniques. Unlike other works, this begins by referring to the communicative capacity of the teacher and not of the student. For the author, the effectiveness of her teaching depends both on the communication techniques she uses in class, as well as on her command of the language and knowledge of the basic principles of language science in communication.

In the chapters that follow, like chapter 3, the author focuses on different aspects of student training. Literacy refers to reading and writing, which is a topic of paramount importance in primary school as it affects both the child's education and his own life in a transversal way. In addition to traditional issues such as spelling and textual typology, this chapter also deals with literacy in relation to digital competence.

In Chapter 4. Promotion of reading and literary education: culture and access to classic texts presents a series of proposals in order to work on literary education, as well as to promote reading habits in elementary schools, a clear and constant objective at this stage, and the initiation in reading the classics.

Chapter 5. The oral and written creative discourse in which the author claims creativity and offers a theoretical-practical reflection on the teaching of oral and written texts, on the genres and proposals of activities in the classroom.

Language teaching in a multicultural and multilingual school is a crucial issue in education. Hence, Martín Vegas dedicates a chapter of her work to this social fact, specifically, Chapter 6. The teaching of the Spanish language in a multicultural school with the suggested integration of language teaching, which helps both native and foreigners studying in Spain.

The book closes with Chapter 7. Metalinguistic awareness for language development. This chapter focuses on teaching grammar in the Elementary classroom. For this, it attends to the different linguistic levels starting from linguistic, morphological, syntactic and discursive awareness.

In short, it is a coherent, functional and innovative proposal that provides the reader with the knowledge and strategies which are necessary to promote the development of linguistic and literary communication skills at elementary school.

Margarita Isabel Asensio Pastor

Llaneza, P. (2019). *Data Nomics*. Barcelona: DEUSTO S.A. Ediciones. 304 pp. ISBN: 978-84-234302-0-8.

Llaneza addresses in this book, masterfully, how our data are used and how reading our data give a faithful reflection of our behaviours, attitudes, thoughts and ideals. This allows States and other companies to take decisions about us. Artificial intelligence let to predict behaviours more accurate and let anticipate on what will happen. Other concepts that are worked on the book are related with the construction of the digital identity versus privacy in areas as: family environment, search history on Google, the intrusion of the Internet of Things, the creation of biometric databases, our DNA, etc. Each chapter reflects in depth on concrete and real cases in terms that George Dyson anticipated: the problem will be that we are building systems that are beyond of our control capabilities.

Thus, in times where the contradiction of wanting to keep your life out of minds, who try to troyanize it, in a space-time line. It is necessary to act and safeguard privacy from the analysis of the intrusiveness that mobile technologies make of our lives, through the use and consumption of data. But not only, mobile technologies are mobiles, but also iPad, activity trackers, cloud storage, and their implication at different areas of our lives.

In this work, she analyzed through facts and reports, the hidden faces of personal data that we provide on Internet and the use of them for the benefit of a few. It is very important to be aware of this reality, and how personal information is collected and is used for unethical purposes. For that, it is important to open minds to propose future interventions with students at the classroom. This is a practical and enlightening book that gives us keys, tips, tools and proposals about how we can protect our privacy.

The monopoly of GAFA (Google, Apple, Facebook and Amazon) is such that, according to this author, it hinders innovation by abusing its position of dominance in the market. The EU has begun to take unprecedented action towards these companies not only because of abuse of dominance in the market, but also because of the continued campaigns of misinformation (fake news) and political manipulation uncovered through the Cambridge Analytica data scandal.

Facebook as one of the largest repositories of *doppelgänger* (literary figure that is defined as the twin-ghost of a living person) configures, quite accurately, our digital alter ego due to data that we provide them. Think about consequences of uploading pictures of our children from the very beginning on Facebook. They will grow up with a digital twin since they were born or since the first ultrasound was shared via whatsApp. They will not have an independent life because someone uploaded personal information about them. This data will be stored for life, subject to diverse legislation, which will change over time and with unpredictable consequences for children.

On the other hand, it is important point out that Google has become our eternal memory. It has more than one billion monthly active users without mention the huge amount of data it collects from all of us.

Another point this book rely on using of techniques to create psychological dependencies from social networks. Facebook and Twitter usually apply similar methods to those of the gaming industry use, to keep users hooked on their apps.

The author treats in an excellent way how *datismo* evolves and acquires value when the data is analyzed in combination with others. According to data scientists, the challenge for the medium-term future is to come up with algorithms that are capable of accurately predicting and manipulating the behaviour of individuals. Here there is a high risk that can directly affect to personal cybersecurity. The debate is analyzed from different disciplines such as artificial intelligence (AI), data processing, cloud, computing capacity, machine learning, and ethics. The truth is that mathematical models are not entirely neutral. They imply the biases of the person who programs them and the errors of their design. According to the author they are "mathematics of mass destruction".

In 2018, Tim Cook warned that the enormous treatment of data by certain companies seriously damages society. Therefore privacy laws are necessary at global level to protect global citizens.

Perhaps, it is the moment where the privacy is a key issue on which citizen must be sensitized. They need tools to exercise the right to rectify and cancel personal data when they deem appropriate.

Generation Z is aware of the importance of their online reputation and they take steps to protect it. However, for this generation the desire to be connected, get social approval, and social reciprocity outweigh the consequences of sharing private information to third parties for exchange other services. The generation Z is more concerned with privacy than millennial, but less than Generation X or Baby Boomers.

These are some of the arguments and reflections of this book, written by Paloma Llaneza. She affirms that the potential of technology is based on the faith that people have in it. We count our lives, we publish our thoughts and the devices do the rest.

Alicia González-Pérez

Revista de Educación is a scientific publication of the Spanish Ministerio de Educación y Formación Profesional. Founded in 1940, with the title *'Revista de Educación'* since 1952, it has been an exceptional witness of the evolution of Education in the last decades, as well as a regarded channel for the diffusion of the advances in Research and Innovation in the field of Education from a national and international perspective. *Revista de Educación* is published by the Subdirección General de Atención al Ciudadano, Documentación y Publicaciones, and is at present attached to the Instituto Nacional de Evaluación Educativa de la Dirección General de Evaluación y Cooperación Territorial.

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