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Research Article

Evaluating face-to-face and online flipped learning on performance and satisfaction in marketing and communication students

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ABSTRACT

The research evaluates the impact of face-to-face and online flipped learning (OFL) on the academic performance in students of single-degree (SD) and double-degree (DD), compared to that achieved in the traditional methodology. A descriptive, quasi-experimental, cross-sectional, quantitative study was carried out with a sample of 223 university marketing and communication students. The study was conducted in three phases: before, during, and after the COVID-19 pandemic. Results align with previous studies, which find that flipped learning (FL) face-to-face yields higher performance than traditional methodology. Like other studies, the highest scores in asynchronous activities were found for DD students. However, this study reveals that those adopting FL, both online and face-to-face, demonstrated superior academic performance compared to SD students using the traditional method in practical assessments. Notably, DD students who used OFL methodology outperformed their SD peers who used the traditional method in the overall subject score and in the synchronous and asynchronous activities. Furthermore, although modality did not influence the ratings of FL methodology; DD students who experienced this methodology online or face-to-face reported more positively on their attitudes, perceptions, interactions, academic results, and perceived satisfaction than SD students. These findings contribute to understanding of how the adoption of diverse learning methods and modalities influence the performance, attitudes, perceptions, interactions, results, and satisfaction of SD and DD students in the fields of marketing and communication. In conclusion, university business education institutions can enhance student performance and satisfaction by expanding DDs offerings and integrating active learning methods.

Keywords: flipped learning, single and double degrees, online and traditional learning, academic performance, student satisfaction

INTRODUCTION

Digitalization and global crises have transformed education. During the COVID-19 pandemic, a noticeable decline in student engagement with the learning process has led to a concerning erosion of knowledge

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acquisition within the educational community. This phenomenon has consequently resulted in suboptimal learning outcomes, drawing attention from scholars (Dorn et al., 2020; Lambert & Rennie, 2021). To overcome this challenge, it is imperative that educators receive comprehensive training in pioneering learning methodologies and cutting-edge technologies. This training is not only essential to improve pedagogical practices, but also to facilitate better learning outcomes in higher education (HE) (Guevara-Otero, Cuevas-Molano, et al., 2023). Furthermore, educators are encouraged to proactively incorporate innovative learning methods that harness the potential of digitization in these educational contexts (Reflianto et al., 2021).

Institutions such as UNESCO (2018) prioritize assistance to member states with the purpose of leveraging information and communication technologies (ICTs) to achieve education goals by 2030. European Union urges HE to provide digital infrastructure and support to their institutions as part of their educational strategies (EURASHE, 2020), as well as to continuously update teaching methods to ensure a more practical and autonomous learning experience than in the traditional model (European Commission/EACEA/Eurydice, 2020). On the other hand, to reinforce employment skills, international mobility, resilience, and specialization in the education of European youth, European Union has proposed policies that promote the creation of joint degrees (single-degree and double-degree) and incorporate technology, more flexible curriculum models, and active learning methodologies to respond to needs of the job market (European Commission/EACEA/Eurydice, 2020). Thus, it seems that HE and labor market are returning to specificity in university degrees (Leighton & Speer, 2020), including marketing fields studied in this research. In this sense, it is also necessary to study active learning methodologies that consider these classrooms in universities.

Flipped learning (FL) stands out among those active methodologies for its positive effects on learning (Li et al., 2021) and argues that the teacher is not the main protagonist but a guide and promoter of learning (Strelan et al., 2020). FL is related to the use of technology in the classroom as a support tool to encourage students to prepare for classes, engage in classroom activities (active learning), and consequently, allow both teachers and students to make the most of their time in the classroom (Al-Samarraie et al., 2020). This is all accomplished through online and face-to-face channels. On the other hand, it is an efficient methodology in terms of student satisfaction, interaction, motivation, and active learning (Li et al., 2021; Lin et al., 2022; Martínez-Jiménez & Ruiz-Jiménez, 2020; Young et al., 2014).

FL has been extensively researched in HE (Al-Samarraie et al., 2020; Strelan et al., 2020). However, research about the impact of the learning methodology and the degree type on the students´ academic performance is limited in various aspects. Firstly, various of studies on FL do not investigate the influence of this methodology on students' academic performance; rather, they confine their analysis to students' perception of this methodology (Aidoo et al., 2022; Buil-Fabregá et al., 2019; Murillo-Zamorano et al., 2019). Secondly, there are studies that compare the academic performance of university students with different learning methodologies (Drozdikova-Zaripova & Sabirova, 2020; García-Alonso et al., 2019; Stratton et al., 2020). However, these are limited to comparing classroom-based teaching methodologies such as face-to-face FL vs. traditional learning (TL) (Durrani et al., 2022; Stratton et al., 2020); project-oriented learning v. service-learning, and FL (García-Alonso et al., 2019); face-to-face FL vs. blended learning (Drozdikova-Zaripova & Sabirova, 2020) and the differentiation between FL modalities (online and face-to-face) in conjunction with TL is not readily apparent. Thirdly, there are studies that investigate the potential influence of FL on the students' academic performance. But these are centered around the overall grade obtained by students (Stratton et al., 2020), the comparison of the students' motivation (Drozdikova-Zaripova & Sabirova, 2020), and a comparison between the theoretical and practical training of the students (García-Alonso et al., 2019). The objective of this research is to address these knowledge gaps found in previous works and to shed new light on the potential influence of online and face-to-face FL vs. TL on academic performance, including tests scores, continuous evaluation of synchronous and asynchronous assessments, satisfaction, interaction, and active learning of the students.

Therefore, to address the aforementioned gaps, this research aims to compare and analyze FL modalities and TL in heterogeneous groups, i.e., single-degree (SD) and double-degree (DD) in marketing and communications of a Spanish public university before, during, and after the COVID-19 pandemic. Specifically, it focuses on the following objectives:

(1) analyzing whether the academic performance of students using FL methodology in online or face-to-face modalities surpasses that of students employing TL methodology,

(2) exploring whether the students' academic results of DD are better than those of SD while applying different methodologies and learning modalities,

(3) determining whether the students' academic performance of DD using FL methodology, both online and face-to-face, is superior to that of SD employing TL methodology,

(4) analyzing whether the academic performance of DD are better than those of SD while applying the same methodologies and learning modalities,

(5) examining whether the assessment of students with FL methodology varies based on the online or face-to-face modality, and

(6) comparing the differences in the assessment of FL (online and face-to-face) among SD and DD students in terms of attitude, perception, interaction, results, and satisfaction.

Single- & Double-Degrees in Social Sciences

A DD is a specific type of multiple degree that educates students in two specialized HE fields, where students receive two credentials upon completing their studies, while an SD trains them in only one field, where students receive only one credential (European Commission, 2023).

Among the advantages that DDs offer to universities, they stand out for providing added value. They provide students with greater opportunities to find employment (Beriain & Fondevila Gascón, 2012), and when international mobility is involved, they provide greater development of soft skills and more exposure to cultural diversity (Borsetto & Saccon, 2022).

Students pursuing DDs, unlike those pursuing SDs, have better academic performance (Kocsis & Pusztai, 2021; Orenes Lucas & Sánchez Martín, 2021). Orenes Lucas and Sánchez Martín (2021) analyze academic performance in social and legal sciences degrees, and they find that DD students achieve a higher average grade than SD students, for instance, 16.0% of students in DDs achieve grades between nine and 10 out of 10, compared to 1.2% of SDs. These data are consistent with their grades prior to university.

HE and labor market are gravitating towards better specificity in university degrees. Degrees with greater specificity tend to generate higher salaries in their early careers but secure fewer managerial positions in later jobs (Leighton & Speer, 2020). Conversely, more generalist careers such as philosophy and business achieve lower starting salaries but later attain more managerial positions. This could be attributed to the fact that generalist careers require both specific knowledge and broad labor market skills (Leighton & Speer, 2020).

In Europe, during 2020, 60.0% of universities students were pursuing bachelor's degrees, and the most awarded degree was management and administration (Eurostat, 2023). In Spanish universities, there is a total of 3,112 official degrees, encompassing both SDs and DDs of which 971 are DDs with different modalities: face-to-face, online, and blended learning. In the social and legal sciences, there are 1,105 SDs and 538 DDs, constituting the 35.5% of SDs and more than half, 55.4% of DDs (Ministerio de Universidades, 2022). Notably, there is an excessive production of graduates in business and economics (Salas-Velasco, 2021) and within the curriculum of these programs, subjects such as marketing and communication, which are the focus of this research, are included.

There are contributions pertain to learning methodologies and their impact on students' performance and perceptions in SDs and DDs. On one hand, there are studies illustrating the application of FL in SDs and DDs, exemplified by Murillo-Zamorano et al. (2019). Their research revealed that the knowledge acquired, skills developed, and engagement achieved through FL had a positive effect on student satisfaction in SD program of business administration and management and DD program of management and law and business administration. Buil-Fabregá et al. (2019) further studied two SD programs, namely business and innovation management, and DD in tourism and leisure management. Their findings reflected a positive student perception regarding business sustainability and the enhancement of active learning. However, these studies did not conduct a comparative analysis between FL and non-FL approaches, nor did they employ control groups.

In contrast, García-Alonso et al. (2019) explored a combination of project-oriented learning vs. service-learning, collaborative work and FL in DD program of industrial design engineering and product development and in SD program of mechanical engineering. They found an enhanced comprehension among students in relation to theory and practical applications (final project, presentations, and computer programs usage), improved development of their ideas, analytical skills, oral and written expression, as well as a more positive attitude and willingness to work in teams and engage in collective thinking. Moreover, Ruiz-Jiménez et al. (2022) demonstrated an improvement in perceived student satisfaction and the enhancement of positive emotions, not only for students but also for teachers.

On the other hand, there are studies examining the impact of alternative active methodologies on SDs and DDs. Kocsis and Pusztai (2021) studied dual-degree programs, finding that project-based learning resulted in better academic performance and improved learning outcomes (self-assessment) and practical skills in dual-degree students compared to SD participants. López Rodríguez et al. (2015) applied gamification and collaborative learning, leading to higher academic performance among students engaged in group work, underscoring the advantages of collaborative learning. However, they also found higher average grades in a DD program using traditional teaching methods.

Similarly, Gutiérrez et al. (2020) studied various active methodologies, including transmedia narrative supported by ICTs, resulting in improved learning strategies, a deeper understanding of the topics, enhanced problem-solving, and increased classroom satisfaction, without distinguishing between SDs and DDs. Monteiro et al. (2018) found that students demonstrated slightly more significant differences in their attitudes towards culture, professionalism, and serving underserved populations when engaged in collaborative work, as compared to SD students. Calvert (2022) using traditional methodology, compared the performance (grades) of DD students in management and engineering with two SDs programs, concluding that DD students achieved the same level of specialization engineering and business administration.

However, some studies did not find significant differences in aspects like knowledge retention (Blaich et al., 2021) or knowledge acquisition in specific subjects (Calvert, 2022) between SDs and DDs.

Regarding the previous context, a continuous examination of this degrees and vigilant monitoring of the active methodologies employed within them remain necessary (European Commission/EACEA/Eurydice, 2020). To address gaps in previous research, this study compares and analyses FL and TL between SD and DD students taking marketing and communication courses at a Spanish public university. In addition, we include three time periods in the analysis: before, during and after the COVID-19 pandemic.

Student Performance & Assessment Using Flipped Learning

In FL, the learning process is student-centered (Koh, 2019) and the student actively engages in learning taking an active role (Li et al., 2021). Active learners seek new information rather than passively awaiting it, acknowledge when they are learning, choose learning strategies, and collaborate with peers to foster ongoing learning (American Psychological Association, 2023). The implementation of FL in the teacher-student dynamic within the classroom involves three phases: pre-class activities, where students prepare the content; in-class activities, where students reflect with the teacher; and after-class activities, where students' knowledge and skills are reinforced (Al-Samarraie et al., 2020). This interaction takes place in both online and face-to-face settings, encompassing synchronous activities, where student-teacher engagement occurs in real time, and asynchronous activities, where immediate interaction is absent (Salas-Rueda, 2021). According to Koh (2019), FL encompasses four pedagogical dimensions. These include personalization, allowing students to choose learning time, materials, modes, and locations, with teachers utilizing class time tailored instruction. Higher-order thinking, fostering critical thinking, reflection, and synthesis through activities like problem-solving and case studies. Furthermore, FL addresses job market skills (Li et al., 2021). Self-direction is encouraged as students engage with class material before and after class, and collaboration that promotes cooperative work is fostered.

Based on the assessment of the academic performance as indicated by grades, positive effects are demonstrated. Förster et al. (2022) discovered that students who viewed pre-class videos achieved higher grades in the final exam in the short term and maintained this trend in subsequent long-term assessments. These findings align with those from another research (Lapitan et al., 2021). Both Guevara-Otero, Diaz-Iglesias,

et al. (2023) and Salas-Rueda (2021) employ synchronous online exams and asynchronous practices for knowledge consolidation (pre- and post-class), leading to enhanced academic performance. Strelan et al. (2020) note that pre-class discussions and immediate post-tests following synchronous in-class activities yield improved grades. Hong et al. (2023) adds face-to-face in-class activities (such as diagnostic discussions and pre-class material reflection) enhance clinical practices and final exam results.

Comparative analyses of FL and TL methods indicate that students who attain high grades through FL experience a more pronounced improvement (Martínez-Jiménez & Ruiz-Jiménez, 2020; Xu et al., 2021). Furthermore, it has been observed that higher grades are attained through TL to FL (Durrani et al., 2022), and in certain instances, the evidence is insufficient to guarantee an enhancement in exam results (Price & Walker, 2021).

However, FL is not immune to certain criticisms. Drawbacks arise in its implementation due to students' lack of prior preparation and the resulting workload for both teachers and students (Al-Samarraie et al., 2020). Moreover, the scientific literature displays limited clarity in its implementation (instructional design) and insufficient exploration of learning theories (Li et al., 2021), alongside a burgeoning call for research in the realm of business education (Senali et al., 2022). Building on the overview, this study posits the following hypotheses:

1. Hypothesis 1 (H1): The academic performance of students using online flipped learning (OFL) and face-to-face flipped learning (FFL) methodologies outperforms that of students using TL methodology.
    a. Hypothesis 1a (H1a): The academic performance of students using OFL methodology outperforms that of students using TL methodology.
    b. Hypothesis 1b (H1b): The academic performance of students using FFL methodology outperforms that of students using TL methodology.
2. Hypothesis 2 (H2): Within OFL and FFL methodologies, the academic performance of DD students surpasses that of SD students who use TL methodology.
    a. Hypothesis 2a (H2a): The academic performance of DD students employing OFL methodology outperforms that of SD students using TL methodology.
    b. Hypothesis 2b (H2b): The academic performance of DD students implementing FFL methodology excels beyond that of SD students using TL methodology.
3. Hypothesis 3 (H3): The academic performance of DD students surpasses that of SD students when the same methodology and learning modality are employed.
    a. Hypothesis 3a (H3a): The academic performance of DD students using TL methodology outperforms that of SD students using TL methodology.
    b. Hypothesis 3b (H3b): The academic performance of DD students using OFL methodology excels beyond that of SD students using OFL methodology.
    c. Hypothesis 3c (H3c): The academic performance of DD students employing FFL methodology outperforms that of SD students using FFL methodology.

Attitude, Perception, Interaction, Results, & Satisfaction of Students With Flipped Learning

There are studies that compare the effect of FL and traditional teaching on students' attitudes towards learning. For example, the study by Saglam and Arslan (2018) concludes that students who received classes through FL had a better attitude and appreciation for the teaching they received compared to those attending a class with a traditional methodology. Davies et al. (2013) discovered that FL method facilitates learning, making classes more effective and motivating. In some cases, a student's positive attitude is reinforced when their grades are high, and negative when their grades are low (Xiao et al., 2021). In other instances, students´ perception and evaluation of FL reveal that positive emotions like enjoyment, enthusiasm, and fun significantly impact a greater inclination to continue learning through this approach (Jeong et al., 2018; Ruiz-Jiménez et al., 2022). Also, factors like acquired knowledge, learning strategies, and engagement play a role (Murillo-Zamorano et al., 2019). Furthermore, an increase in motivation is perceived in comparison to traditional classroom settings (Durrani et al., 2022).

Concerning academic outcomes and learning, students recognize the advantages of FL in developing the skills demanded for their future careers, such as improved autonomy in their learning and a positive influence on the development of their communication skills (Latorre-Cosculluela et al., 2021). However, others do not believe it fosters their writing, oral, and argumentation skills (Colomo-Magaña et al., 2020). Students perceive that it promotes the enhancement of their digital competencies (Colomo-Magaña et al., 2020), provides accessibility to materials and content (Latorre-Cosculluela et al., 2021), and improves their ability to grasp content from various perspectives, thus enhancing their understanding of the topics (Jia et al., 2023). Additionally, they perceive that the opportunity for pre-class exercise repetitions of in-class exercises provided prior to the class, increased personal time, and self-evaluation of learning progress (Lapitan et al., 2021; Xiao et al., 2021). In summary, these benefits indicate a heightened level of personalization and self-direction in their learning experiences (Aidoo et al., 2022; Guevara-Otero, Cuevas-Molano, et al., 2023; Lapitan et al., 2021; Paechter & Maier, 2010; Xiao et al., 2021). While interesting studies suggest that students' perception of their academic outcomes and the methodology is subject to certain variables, such as the better their disposition towards learning under FL and the application of formative assessment, the more favorable their perception of their academic results will be (Ruiz-Jiménez et al., 2022).

Regarding satisfaction, Yunusa and Umar (2021) posits that satisfaction reflects students' perception of their learning experiences, and it constitutes one of the five elements of quality learning. According to these authors, student satisfaction is one of the measures contributing to the continuous improvement of quality. These measures are also referred to as pillars of quality and include learning effectiveness, cost-effectiveness, institutional commitment, and accessibility (Moore, 2005). In line with this, Talan and Gulsecen (2019) find that students who study with FL method show higher engagement and satisfaction grade compared to those who study with face-to-face traditional methodology.

Furthermore, research has shown that students' satisfaction with their hybrid courses (a combination of online and face-to-face) is related to the perceived effectiveness of the courses and individual teaching and learning preferences (Chen & Tat Yao, 2016; Zhu, 2017). Chen and Tat Yao (2016) found that students' satisfaction with the hybrid model played a crucial role in assessing the effectiveness of learning using this combination of teaching methods. However, Zhu (2017) argued that differences in students' perceptions of the effectiveness of their hybrid courses remain unclear. Likewise, as Fisher et al. (2021) have found that students' positive attitudes and satisfaction can be independent of their academic results.

Previous researchers noted that student learning outcomes are the most critical reflection of the success of an educational process (Kurucay & Inan, 2017). Consequently, the authors suggested that learning outcomes can be measured either through performance grades, academic performance measures such as credits, or through perceived learning achievements as reported by students (Eom & Ashill, 2016).

In relation to interaction, student experiences can be categorized into three types of interactions, as utilized in recent studies, such as the one conducted by Lin et al. (2022). These interactions include student-content interaction (cognitive interaction with the material and knowledge), student-instructor interaction (instructions, feedback between students and the instructor), and student-student interaction (exchange of knowledge, ideas, and feedback among students). These researchers believe that these three types of experiences can provide insights into learning outcomes and satisfaction in learning methodologies. Specifically, Lin et al. (2022) found that all three types positively influence students' perceived learning, with student-student interaction being the most significant. In addition, research confirms that interaction in terms of information engagement and support, both with the instructor and classmates, is perceived favorably by students (Li et al., 2021; Lin et al., 2022). Other evidence from the literature suggests that collaboration fostered by FL, which entails the dynamic between peers and teachers encouraging active learning (Li et al., 2021), leads to positive outcomes in individual participation with instructors and among peers during out-of-class activities. Collaboration is facilitated through group activities, promoting individual learning while benefiting from peer contributions (Koh, 2019), also referred to as interaction (Hong et al., 2023). Based on the above, the following hypotheses are proposed.

4. Hypothesis 4 (H4): The attitudes (H4a), perceptions (H4b), interactions (H4c), results (H4d), and satisfaction (H4e) perceived by students with FL methodology and online modality are different from those perceived by students with FL methodology and face-to-face modality.

5. Hypothesis 5 (H5): DD students exhibit a superior attitude, perception, interaction, results, and perceived satisfaction with OFL methodology compared to SD students.
    a. Hypothesis 5a (H5a): DD students manifest a more positive attitude towards OFL methodology than SD students.
    b. Hypothesis 5b (H5b): The perception of OFL methodology is more favorable among DD students than SD students.
    c. Hypothesis 5c (H5c): DD students experience enhanced interaction with OFL methodology compared to SD students.
    d. Hypothesis 5d (H5d): DD students attain better results with OFL methodology than SD students.
    e. Hypothesis 5e (H5e): The satisfaction level with OFL methodology is higher among DD students in comparison to SD students.
6. Hypothesis 6 (H6): DD students exhibit a superior attitude, perception, interaction, results, and perceived satisfaction with FFL methodology compared to SD students.
    a. Hypothesis 6a (H6a): DD students manifest a more positive attitude towards FFL methodology than SD students.
    b. Hypothesis 6b (H6b): The perception of FFL methodology is more favorable among DD students than SD students.
    c. Hypothesis 6c (H6c): DD students experience enhanced interaction with FFL methodology compared to SD students.
    d. Hypothesis 6d (H6d): DD students attain better results with FFL methodology than SD students.
    e. Hypothesis 6e (H6e): The satisfaction with FFL methodology is higher among DD students in comparison to SD students.

METHOD

Participants

The study involved students across three distinct classes at a Spanish public university, spanning three academic years from 2019 to 2022. These three cohorts comprised students enrolled in the same subject within two undergraduate programs: a bachelor's degree in marketing (SD marketing) and a DD in advertising and public relations-marketing (DD marketing). Different methodologies and learning modalities were implemented within each class. The initial class, known as the pre-COVID-19 group, employed TL approach, using ICTs in learning management system environments before the pandemic. The subsequent class, referred to as the COVID-19 group, adopted OFL methodology during the pandemic. Lastly, the third class designated as the post-COVID-19 group, adopted FFL methodology towards the end of the pandemic. Both types of degrees maintain the same curriculum throughout the three assessed periods.

To gather students' perceptions of their experience with FL methodology, voluntary questionnaires were administered, ensuring participant. In addition, informed consent was obtained online.

In the pre-COVID-19 group, 94 students participated, comprising 24.0% male and 66.0% female students. Of this group, 86.0% were SD students, while 14.0% pursued DD programs, with ages ranging from 19 to 21 years and an average age of 20.2 years. Within the COVID-19 group, 63 students were involved of which 33.3% were male and 66.7% were female. This cohort consisted of 82.5% SD students and 17.5% DD students, with ages spanning from 20 to 22 years and an average age of 20.3 years. Similarly, the post-COVID-19 group included 66 students, of whom 36.4% were male and 66.6% were female. This group comprised 89.4% SD students and 10.6% DD students, with ages ranging from 20 to 22 years and an average age of 20.2 years. The sample was non-probabilistic and purposefully selected, structured into three independent class groups for the experiment.

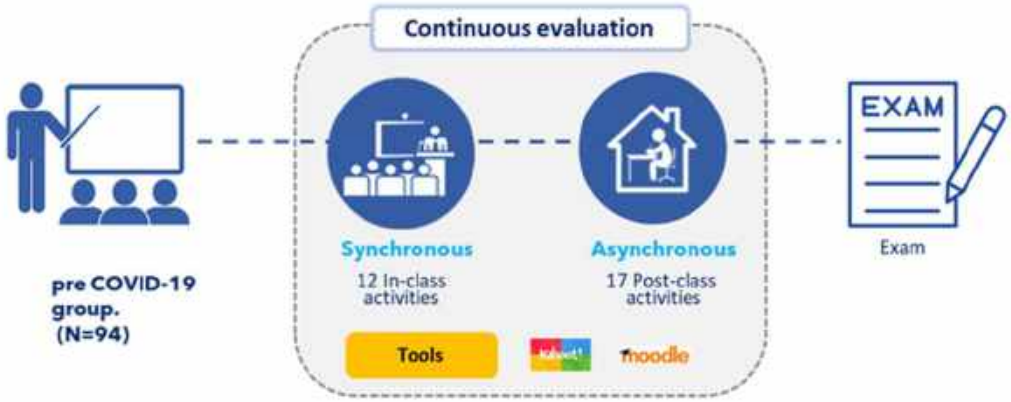

Figure 1. Diagram showing experimental process with traditional learning in pre-COVID-19 group (Source: Authors)

Figure 2. Diagram showing experimental process with online flipped learning in COVID-19 group (Source: Authors)

Procedure

The three classes were conducted across distinct academic courses under the tutelage of the same instructor. The subject was delivered over the initial four months of each course, encompassing a span of 15 weeks and a total of 30 sessions, each lasting two hours. The specific procedure is elaborated in the following.

In the pre-COVID-19 group (**Figure 1**), TL methodology was employed, using ICTs within learning management system environments. The instructional approach encompassed teacher-developed materials, complemented by illustrative videos and supplementary reference materials within the classroom setting. Interactive classroom activities were synchronously conducted over 12 sessions, incorporating group debates, case studies, and questionnaires, aiming to solidify understanding through collaborative and individual efforts. Furthermore, 17 asynchronous practical exercises, contextually linked to real-world applications, were assigned as homework, adaptable to each student's pace, with a designated week-long deadline. At the conclusion of the 15-week period, an examination was administered, assessing students' academic performance using TL approach. The exam featured 32 multiple-choice questions, with a single correct answer out of five options. Incorrect responses incurred a 25.0% deduction from the question's value. All questions were equally weighted, with a pass grade of five out of 10 on the exam.

The COVID-19 group (**Figure 2**), employed OFL methodology, comprising a blend of six asynchronous pre-class activities, 27 synchronous online practical activities during sessions, and six post-class asynchronous assignments, thus spanning before, during, and after class (Salas-Rueda, 2021). Pre-class activities facilitated the grasp of foundational theoretical and practical knowledge, facilitated by video capsules and interactive resources. Subject materials underwent transformation into interactive audiovisual content. Online in-class activities aimed at reinforcing comprehension through both individual and collaborative efforts (**Appendix A**). Post-class assignments, conducted asynchronously, provided contextualized real-world application, promoting both individual and group-based consolidation of learning (**Appendix A**).

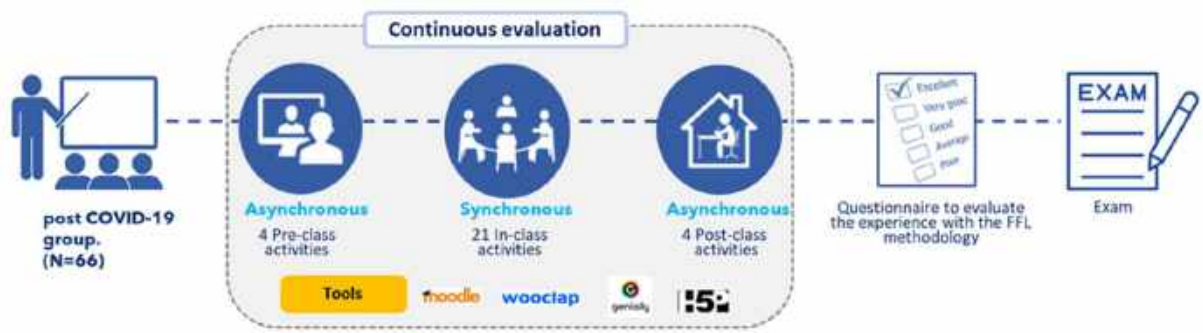

Figure 3. Diagram showing experimental process with face-to-face flipped learning in post-COVID-19 group (Source: Authors)

Tools such as Microsoft Teams, BlackBoard, Moodle, Power Point, Wooclap, Genially, and H5p formed the backbone of OFL methodology. Upon completion of the last class session, a test was administered to gauge students' academic performance. This online assessment used Moodle exam tool and BlackBoard, housing a question repository of over 210 questions. The exam was designed for sequential navigation and single attempts, featuring of 32 weighted and balanced questions in terms of content and complexity. Each question was configured as multiple choice, with one correct answer out of five. The order and content of the questions were randomized, and incorrect answers resulted in a deduction of 25.0% of the value of the question. Achieving a score of five out of 10 was deemed a passing grade for the exam.

At the final session, an anonymous and voluntary online questionnaire was administrated by the teacher, with the students' consent to assess their experience with OFL methodology. The questionnaire was completed in 15 minutes.

In the post-COVID-19 group (**Figure 3**), FFL methodology was adopted, modifying the materials used in the COVID-19 group to suit this face-to-face method. For FFL approach, four asynchronous preparatory activities were designed ahead of class sessions, aiming to facilitate the grasp of foundational theoretical and practical knowledge. During sessions, 21 synchronous practical activities were restructured (**Appendix A**), focused on reinforcing understanding through both individual and collaborative efforts. Four post-class asynchronous activities were introduced, contextualized to connect with real-world application (**Appendix A**). These activities adhered to Salas-Rueda (2021) criteria, encompassing pre-, during, and post-class phases. Commonly used tools for FFL methodology included Moodle, PDF, Wooclap, Genially, and H5p.

At the final session, an anonymous and voluntary online questionnaire was administrated by the teacher, with the students' consent to assess their experience with FFL methodology. The questionnaire was completed in 15 minutes. One week following the final session, a test was administered to evaluate the students' academic performance. The exam was administered in-person using computer-based tools, employing the Moodle exam platform. The question bank comprised over 250 questions, allowing unrestricted navigation through questions and a single attempt. This test encompassed 32 multiple-choice questions, each featuring a single correct answer from a set of five options. Questions were randomized in both order and answer arrangement. Incorrect responses incurred a 25.0% deduction from the question's value. All questions were uniformly graded and balanced in content and complexity. Achieving a score of five out of 10 was deemed a passing grade for the examination.

Instruments & Variables

For the three methodological groups (TL, OFL, and FFL), the measured variables included: average scores of synchronous in-class practical activities (PIC), average scores of asynchronous out-of-class practical activities (POC), encompassing both pre- and post-class assignments, exam scores (TEST), and overall subject grades (OG), all ranging from 0 to 10. Additionally, the variable GRADE indicated the type of degree, with 0 for SD and 1 for DD. METH, which indicates the methodology, was assigned values: 0 for TL, 1 for OFL, and 2 for FFL. Furthermore, GRADE_METH was introduced, a polytomous variable with six values: 0: TL SD, 1: TL DD, 2: OFL SD, 3: OFL DD, 4: FFL SD, and 5: FFL DD. Also, for FFL methodology group, a custom questionnaire comprising five dimensions was used, on existing instruments in scientific literature for assessing attitude,

Table 1. Descriptive values of academic results

Learning methodology		SD				DD			
		n	Mean	STD	Median	n	Mean	STD	Median
PIC	TL	81	6.5	30.9	8.3	13	6.5	38.3	8.5
	OFL	52	7.4	16.6	7.8	11	8.9	0.7	9.0
	FFL	59	7.3	3.5	10.0	7	9.3	1.8	10.0
POC	TL	81	6.8	23.9	7.6	13	7.5	27.2	8.2
	OFL	52	7.8	24.7	8.9	11	9.4	18.0	10.0
	FFL	59	8.0	24.4	9.0	7	9.1	0.9	9.6
TEST	TL	81	7.3	1.2	7.5	13	8.7	0.7	8.8
	OFL	52	6.9	1.0	7.0	11	9.0	1.0	9.0
	FFL	59	7.0	1.0	7.0	7	7.6	2.3	8.2
OG	TL	81	7.3	1.5	7.5	13	8.6	0.8	8.7
	OFL	52	7.5	1.1	7.7	11	9.1	0.9	9.5
	FFL	59	8.0	1.8	8.0	7	7.8	2.8	9.0

Note. n: sample size; STD: Standard deviation; TL: Traditional learning (pre-COVID-19 group); OFL: Online flipped learning (COVID-19 group); & FFL: Face-to-face flipped learning (post-COVID-19 group)

perception, interaction, results, and satisfaction with OFL and FFL methodologies (**Appendix B**). A 5-point Likert scale was employed for all items, with ratings ranging from 1 ("strongly disagree") to 5 ("strongly agree").

The presented questionnaire exhibits satisfactory psychometric properties, which were established through a range of validation and reliability tests. The authors conducted factor analysis and reliability testing employing Cronbach's alpha, resulting in commendable values across the various conducted tests. This validates the suitability of the instrument.

Appendix C presents Cronbach's alpha and McDonald's omega for each scale for both groups separately. The scales were at least acceptable, and mostly excellent, according to George and Mallery (2009) recommendation for interpreting Cronbach's alpha values.

Analysis

The data was analyzed using SPSS version 28 and G*power 3.1.9.7 statistical software. Initially, data distribution was assessed, revealing non-normality ($p<.05$). Consequently, mean scores were used for interpretations. Subsequently, descriptive and comparative analyses of variables and their dimensions were conducted based on grade type (single or double), methodology, and learning modality. For independent sample comparisons, the Mann-Whitney U statistic was employed, while the Kruskal-Wallis H test compared more than two independent samples (scores of average range). Effect size (g Hedges) for Mann-Whitney U was calculated, with interpretation, as follows: small (g Hedges≥0.10), medium (g Hedges ≥ 0.30), and large (g Hedges≥0.50) (Hedges, 1981). Kruskal-Wallis H effect size utilized the eta squared coefficient (η^2) for interpretation: small ($\eta^2 \geq 0.01$), medium ($\eta^2 \geq 0.06$), and large ($\eta^2 \geq 0.14$) (López-Martín & Ardura-Martínez, 2023). Furthermore, statistical significance was determined by p-values <.05.

RESULTS

Table 1 presents the academic results of SD and DD students across the three applied methodologies (TL, OFL, and FFL). The data indicates comparable and moderately high-grade values. Generally, DD students outperformed SD students across the three methodologies, except for OG scores in FFL group. Within TL methodology, both SD and DD groups achieved their best scores in TEST and lowest in PIC. OFL methodology yielded superior POC results for both SD and DD groups, but DD students showed lower scores in PIC, while SD students scored lower in TEST. In FFL group, DD students excelled in PIC, while SD students scored higher in POC and OG. However, lower values were observed in TEST for both groups. Notably, OFL led to higher scores compared to TL methodology, except for TEST in SD group.

Similarly, within FFL methodology group, superior scores were evident when compared to measurements taken within TL methodology group, particularly in PIC, POC, and OG, the latter being applicable to SD group. However, this superiority did not extend to TEST scores in both SD and DD groups, nor did it apply to the OG score in DD group. When contrasting values between OFL and FFL methodologies, OFL yielded higher scores in POC, TEST, and OG within DD group. Conversely, for SD group, FFL exhibited better results in POC, TEST

Table 2. Analysis of differences between academic results of OFL & traditional methodologies

Variable	OFL (n=63)	Traditional (n=94)	Z	U	p	g Hedges
	Median (range)	Median (range)				
PIC	8.04 (9.6)	8.38 (10.0)	-.389	2,852.500	.697	-0.41
POC	9.06 (10.0)	7.60 (9.7)	-4.155	1,801.500	<.001	-0.48
TEST	7.03 (6.0)	7.70 (6.2)	-1825	2,451.500	.068	0.25
OG	7.81 (5.7)	7.70 (8.1)	-1.142	2,642.000	.253	-0.23

Note. n: Sample size; U: Mann-Whitney U; & g Hedges: Effect size

Table 3. Analysis of differences between academic results of FFL & traditional methodologies

Variable	FFL (n=63)	Traditional (n=94)	Z	U	p	g Hedges
	Median (range)	Median (range)				
PIC	10.0 (10.0)	8.38 (10.0)	-3.857	2,007.500	<.001	-0.31
POC	9.03 (9.2)	7.60 (9.7)	-4.579	1,782.500	<.001	-0.48
TEST	7.46 (6.3)	7.70 (6.2)	-2.016	2,520.500	.044	0.36
OG	7.91 (8.0)	7.70 (8.1)	-0.700	2,900.000	.484	0.04

Note. n: Sample size; U: Mann-Whitney U; & g Hedges: Effect size

and OG, while PIC performed less favorably. The standard deviation, in most of the scores, shows that there is dispersion across most scores (Jöreskog, 2001).

Analysis of Differences Between Academic Results of FL (Online & Face-To-Face) & Traditional Methodologies

Table 2 shows that significant differences with medium-large effect (g Hedges=-0.48) in POC are observed between OFL and TL methodology. This indicates that the variability in the grades of the asynchronous pre- and post-class activities could be attributed with a medium-large effect to the type of FL methodology and online modality. However, the differences found between PIC (medium effect), TEST and OG (small effect) are not significant. This partially supports hypothesis H1a, which states that the academic performance of students using OFL methodology outperforms that of students using TL methodology. This observation is particularly valid for the POC tests.

Table 3 shows that significant differences are observed in the evaluative tests–PIC, POC, and TEST–between FFL and TL methodology. For PIC (g Hedges=-0.31) and TEST (g Hedges=0.36) with medium effect and POC (g Hedges=-0.48) with medium-large effect. However, the differences found for OG (g Hedges=0.04) with very small effect are not significant. All this suggests that the variability of the–PIC, POC, and TEST–scores could be attributed to the type of FL methodology and the face-to-face modality. Consequently, the results allow us to partially accept hypothesis H1b, which states that the academic performance of students using FFL methodology outperforms that of students using TL methodology. This observation is particularly valid for the tests–PIC, POC, and TEST.

Analysis of Differences in Academic Results Between Single- & Double-Degrees With Different Learning Methodologies & Modalities

Upon analyzing the three applied methodologies–TL, OFL, and FFL–**Table 4** illustrates significant differences in academic results based on degree type, methodology, and learning modality. The coefficient ($\eta^2 \geq 0.14$) indicates that the proportion of variability in POC, TEST, and OG scores can be attributed to degree type, methodology and learning mode (large effect). Conversely, the coefficient ($\eta^2 = 0.102$) points a moderate effect, attributing a significant portion of variability in PIC scores to the interplay of degree type, methodology, and learning mode.

Following this, post hoc analyses were conducted to evaluate whether OFL and FFL methodologies yield superior academic results compared to TL methodology. Additionally, we assessed whether the scores of DD students using OFL and FFL were superior to those of SD students using TL.

The scores of DD students using OFL methodology were compared with those of SD students employing TL methodology. Post-hoc analyses, conducted using the Games Howell statistic, revealed that the PIC (Mdn=8.96), POC (Mdn=10.00), and OG (Mdn=9.46) of DD students using OFL methodology demonstrated superior outcomes compare to SD students employing TL methodology in the specific evaluation tests: PIC

Table 4. Differences in academic performance based on degree type, methodology, & learning modality

Learning methodology		SD		DD		H	η^2
		n	Median (range)	n	Median (range)		
PIC	TL	81	8.31 (10.0)	13	8.46 (10.0)	22.580***	0.102
	OFL	52	7.83 (9.2)	11	8.96 (2.5)		
	FFL	59	10.0 (10.0)	7	10.00 (4.8)		
POC	TL	81	7.57 (9.5)	13	8.21 (8.3)	42.126***	0.190
	OFL	52	8.90 (10.0)	11	10.00 (6.0)		
	FFL	59	9.03 (9.2)	7	9.58 (2.1)		
TEST	TL	81	7.51 (5.8)	13	8.75 (2.9)	39.139***	0.176
	OFL	52	6.76 (5.4)	11	9.30 (4.5)		
	FFL	59	7.42 (5.8)	7	8.20 (6.3)		
OG	TL	81	7.50 (8.1)	13	8.71 (3.0)	34.088***	0.154
	OFL	52	7.67 (4.9)	11	9.46 (2.7)		
	FFL	59	7.87 (7.6)	7	9.02 (8.0)		

Note. *p<.05; **p<.01; ***p<.001; TL: Traditional learning (pre-COVID-19 group); OFL: Online flipped learning (COVID-19 group); FFL: Face-to-face flipped learning (post-COVID-19 group); n: Sample size; H: Kruskal-Wallis H; & η^2: Eta squared coefficient (effect size)

Table 5. Analysis of differences in academic results between SD & DD with TL methodology

Variable	SD (n=81)	DD (n=13)	Z	U	g Hedges
	Median (range)	Median (range)			
PIC	8.31 (10.0)	8.46 (10.0)	-.595	472.500	0.001
POC	7.57 (9.5)	8.21 (8.3)	-1.607	380.000	0.030
TEST	7.51 (5.8)	8.75 (2.9)	-4.173	145.500***	0.120
OG	7.50 (8.1)	8.71 (3.0)	-3.817	178.000***	0.100

Note. *p<.05; **p<.01; ***p<.001; n: Sample size; U: Mann-Whitney U; & g Hedges: Effect size

(Mdn=8.31, p<.001) 95% CI [1.14, 3.51], POC (Mdn=7.57, p=.008) 95% CI [0.58, 4.49], and OG (Mdn=7.50, p<.001) 95% CI [0.82, 2.83]. Nevertheless, the observed distinctions between the TEST scores (Mdn=9.30) of DD students using OFL and the TEST scores (Mdn=7.51, p=.076) 95% CI [-0.11,2.93] of SD students employing TL were not statistically significant. Consequently, these findings partially lend support to hypothesis H2a, asserting that the academic results of DD students using OFL methodology surpass those of SD students employing TL methodology, when considering the academic results of PIC, POC, and OG.

The grades of DD students are compared using FFL methodology, and those of SD students are evaluated through TL. Post hoc analyses conducted with the Games Howell statistic indicated that the PIC (Mdn=10.00) and POC (Mdn=9.58) of DD students with FFL methodology were better to those of SD students with TL methodology. Specifically, PIC (Mdn=8.31, p=.041) 95% CI [0.098, 5.48] and POC (Mdn=7.57, p<.001) 95% CI [0.91, 3.62]. However, differences in the TEST (Mdn=8.20) and OG (Mdn=9.02) scores between DD students using FFL and SD students using TL were not statistically significant, with TEST scores (Mdn=7.51, p=1.00) 95% CI [-3.15, 3.64] and OG (Mdn=7.50, p=.99) 95% CI [-3.68, 4.85]. These findings partially support Hypothesis H2b, suggesting that the academic results of DD students using FFL methodology outperforms that of SD students using TL methodology, particularly concerning the academic results of PIC and POC.

Finally, the results partially substantiate Hypothesis H2, asserting that within OFL and FFL methodologies, the academic results of DD students are better than those of SD students using TL method.

Analysis of Differences in Academic Results Between Single- & Double-Degrees With Same Methodologies & Learning Modalities

Table 5 indicates noteworthy findings within the traditional methodology (TL). Significant differences emerge in the TEST and OG grades based on whether a student is pursuing an SD or DD. The effect size coefficients for TEST (g Hedges=0.12) and OG (g Hedges=0.10) indicate that the proportion of variability in these grades could be attributed to the type of degree (small effect). Conversely, no significant differences are observed in PIC and POC grades, with the effect size coefficients of (g Hedges=0.001) for PIC and (g Hedges=0.03) for POC signifying a minor effect. Notably, academic results for DD participants show higher. This provides partial support for H3a, which posits better academic results for DD students following TL methodology compared to SD students. This observation particularly holds true for the TEST and OG tests.

Table 6. Analysis of differences in academic results between SD & DD using OFL methodology

Variable	SD (n=52) Median (range)	DD (n=11) Median (range)	Z	U	g Hedges
PIC	7.83 (9.2)	8.96 (2.5)	-3.657	84.000***	0.010
POC	8.90 (10.0)	10.0 (6.0)	-3.686	83.000***	0.070
TEST	6.76 (5.4)	9.30 (4.5)	-3.541	90.500***	0.150
OG	7.67 (4.9)	9.46 (2.7)	-3.929	69.000***	0.160

Note. *p<.05; **p<.01; ***p<.001; n: Sample size; U: Mann-Whitney U; & g Hedges: Effect size

Table 7. Analysis of differences in academic results between SD & DD using FFL methodology

Variable	SD (n=59) Median (range)	DD (n=7) Median (range)	Z	U	g Hedges
PIC	10.0 (10.0)	10.0 (4.8)	-1.445	146.000	0.060
POC	9.03 (9.2)	9.58 (2.1)	-0.822	167.500	0.050
TEST	7.42 (5.8)	8.2 (6.3)	-1.573	131.000	0.040
OG	7.87 (7.6)	9.02 (8.0)	-1.697	125.000	0.030

Note. *p<.05; **p<.01; ***p<.001; n: Sample size; U: Mann-Whitney U; & g Hedges: Effect size

Table 8. Differences between dimensions of FL assessment according to type of modality: online or face-to-face

Variable	Online (n=40) Median (range)	Face-to-face (n=39) Median (range)	Z	U	p	g Hedges
FLA	4.50 (2.7)	4.25 (2.0)	-.210	759.000	.834	-0.020
FLP	4.00 (2.7)	4.50 (5.0)	-.868	692.500	.386	-0.157
FLI	4.00 (2.7)	4.00 (2.5)	-1.510	627.500	.131	0.278
FLR	4.25 (3.5)	4.00 (5.0)	-.772	702.000	.440	0.137
FLS	4.33 (2.7)	4.00 (5.0)	-1.004	679.000	.315	0.335

Note. n: Sample size; U: Mann-Whitney U; & g Hedges: Effect size

Table 6 reveals notably findings within OFL methodology group. There are significant differences in academic results based on whether a student is pursuing an SD or DD. Effect size coefficients for PIC (g Hedges=0.1), TEST (g Hedges=0.15), and for OG (g Hedges=0.16) suggest a modest impact of the degree type on these grades (small effect). Conversely, for POC scores, the coefficient (g Hedges=0.07) indicates an even smaller effect. Like the traditional methodology, DD participants achieve higher academic scores in OG and TEST. Nevertheless, using OFL methodology, DD participants achieve higher academic scores also in PIC and TEST, while SD participants attain lower scores. These results, with a small effect, lend support to H3b, asserting better academic outcomes for DD students following OFL methodology compared to SD students.

Table 7 shows the results obtained in FFL methodology group. Notably, no significant differences in academic results are observed based on the type of SD or DD. The effect size coefficient (g Hedges<0.1) for PIC, POC, TEST, and OG indicates an almost negligible effect, suggesting that academic results, achieved through FFL methodology do not vary significantly between SD and DD. Therefore, the results provide sufficient evidence to refute hypothesis H3c, which posits better academic results for DD students using FFL methodology compared to SD students.

Hence, the outcomes partially support hypothesis H3, affirming that the academic results of DD students surpass those of SD students when identical methodologies and learning modalities are employed within the same class.

Analysis of Differences Between Dimensions of FL Assessment Based on Type of Modality: Online or Face-To-Face

Table 8 shows no significant differences in FL methodology between the online and face-to-face groups in relation to the dimensions: attitude (FLA) with very small effect (g Hedges=-0.030), perception (FLP) with small effect (g Hedges=-0.157), interaction (FLI) with medium effect (g Hedges=-0.378), results (FLR) with small effect (g Hedges=0.137) and satisfaction (FLS) with medium effect (g Hedges=0.335). This indicates that the variability in these dimensions cannot be attributed to the type of online or face-to-face modality when FL methodology is used. Hence, the results do not allow us to accept hypothesis H4 and its corresponding sub-

Table 9. Differences between dimensions of OFL assessment based on type of degree

Variable	SD (n=31) Median (range)	DD (n=9) Median (range)	Z	U	p	g Hedges
FLA	4.00 (2.7)	5.00 (0.25)	-3.704	27.500	<.001	-1.340
FLP	4.00 (2.7)	5.00 (0.50)	-4.045	16.500	<.001	-1.780
FLI	4.00 (2.7)	5.00 (0.50)	-4.220	10.500	<.001	-1.720
FLR	4.25 (3.2)	5.00 (0.75)	-3.727	25.500	<.001	-1.230
FLS	4.00 (2.7)	5.00 (0.33)	-3.602	30.000	<.001	-1.400

Note. n: Sample size; U: Mann-Whitney U; & g Hedges: Effect size

Table 10. Differences between dimensions of FFL assessment based on type of degree

Variable	SD (n=32) Median (range)	DD (n=7) Median (range)	Z	U	p	g Hedges
FLA	4.00 (2.0)	5.00 (1.00)	-2.719	39.000	.007	-1.104
FLP	4.00 (5.0)	5.00 (0.25)	-3.748	11.000	<.001	-1.068
FLI	4.00 (5.0)	4.67 (1.00)	-1.969	59.000	.049	-0.668
FLR	3.75 (2.0)	5.00 (0.50)	-4.111	1.000	<.001	-3.071
FLS	4.00 (5.0)	5.00 (1.00)	-2.470	45.500	.014	-0.868

Note. n: Sample size; U: Mann-Whitney U; & g Hedges: Effect size

hypotheses, which state that the attitudes (H4a), perceptions (H4b), interactions (H4c), results (H4d) and satisfaction (H4e) perceived by students with FL methodology and online modality are different from those perceived by students with FL methodology and face-to-face modality.

Analysis of Differences Between Dimensions of OFL Assessment Based on Type of Degree: Single or Double

Table 9 shows significant differences within OFL methodology group in relation to several dimensions: attitude (FLA), perception (FLP), interaction (FLI), results (FLR) and perceived satisfaction (FLS) with OFL methodology according to degree type. All dimensions showed differences with large effect, indicating that the variability in these dimensions can be attributed to the type of SD or DD. Consequently, within OFL methodology group, DD students scored higher on all dimensions compared to SD students. Therefore, the results affirm hypothesis H5 and its corresponding sub-hypotheses, corroborating that the attitudes (H5a), perceptions (H5b), interactions (H5c), outcomes (H5d) and satisfaction (H5e) perceived by DD students through OFL methodology are better than those of SD students.

Analysis of Differences Between Dimensions of FFL Assessment Based on Type of Degree: Single or Double

Table 10 demonstrates noteworthy differences within FFL methodology group in relation to various dimensions: attitude (FLA), perception (FLP), interaction (FLI), results (FLR), and satisfaction (FLS) perceived with FFL methodology according to the type of degree. For the dimensions FLA, FLP, FLR, and FLS with FFL methodology, the differences are significant. The coefficients (g Hedges=-1.104) for FLA, (g Hedges=-1.068) for FLP, (g Hedges=-3.071) for FLR, and (g Hedges=-0.868) for FLS denote a substantial effect size, indicating that a considerable portion of the variability in these dimensions can be attributed to SD or DD type (large effect). Conversely, differences in FFL interaction dimension (FLI) linked to degree type were statistically significant, albeit at the borderline level (p=0.049), with a coefficient value (g Hedges=-0.668) signifying a large effect size.

Therefore, within FFL methodology group, DD students attained higher scores across all dimensions compared to SD students. Consequently, the results affirm Hypothesis H6 and its corresponding sub-hypotheses, substantiating that the attitudes (H6a), perceptions (H6b), interactions (H6c), outcomes (H6d), and satisfaction (H6e) perceived by DD students through FFL methodology are better than those of SD students.

DISCUSSION & CONCLUSIONS

This research assesses the impact of FFL and OFL on the academic performance of students in SD and DD, compared to that achieved in the traditional methodology (TL). Additionally, perceptions of OFL and FFL

methodologies among SD and DD students are compared. Aspects that have not been previously analyzed jointly and are demanded (Senali et al., 2022; Strelan et al., 2020).

In the literature review, studies have been found regarding FL in various HE contexts. However, first, there are few that delve into the comparison between TL and the different modalities of FL (online and face-to-face) in terms of performance through grades (Lapitan et al., 2021; Strelan et al., 2020), as they limit their works to students' perception of FL (Aidoo et al., 2022; Buil-Fabregá et al., 2019; Murillo-Zamorano et al., 2019). This research extends the analysis of students' perception of FL by contextualizing it within an OFL and FFL instructional modality.

Second, although comparisons are found regarding various educational methodologies and their influence on academic performance, once again, differentiation between FL modalities (online and face-to-face) is not evident. For instance, Stratton et al. (2020) study FFL and TL; Drozdikova-Zaripova & Sabirova (2020) consider blended learning (not exclusively OFL); Durrani et al. (2022) explores FFL, gamification, and TL; García-Alonso et al. (2019) study project-oriented learning vs. service-learning and FFL; Lapitan et al. (2021) research FFL and OFL but do not compare with TL. These aspects are jointly examined in this investigation.

Third, despite academic performance in terms of grades being a well-covered area in the literature (Strelan et al., 2020), there is also a lack of comprehensive analysis of grades disaggregated by synchronous and asynchronous activities. This study differs from Lapitan et al. (2021) and Stratton et al. (2020), who assess overall grades but do not distinguish between synchronous activities (in-class) and asynchronous activities (pre- and post-class); Förster et al. (2022), evaluates the influence of pre-class videos on exams and Strelan et al. (2020), although reports differences in types of assessment by the empirical studies, their findings span various disciplines and not specifically marketing and communication. Finally, it has been less common to find studies of FL based on degree types, even though DDs have been among the fastest-growing academic programs in European and Spanish universities in recent years (European Commission/EACEA/Eurydice, 2020; Ministerio de Universidades, 2022). In summary, this research refines the application and analysis of FL methodology, contributing a greater data segmentation to the research field.

The results show similar evidence to Guevara-Otero, Diaz-Iglesias, et al. (2023) who find that asynchronous pre- and post-class activity scores are higher with large effect, when both online and face-to-face FL methodology is employed. In addition, the scores of the synchronous activities (in-class) and exam also improve with medium effect when OFL methodology is implemented. These results are in line with Xu et al. (2021) and Lapitan et al. (2021), who obtain better academic performance when OFL method is applied.

In addition, the results reveal that DD students achieve better academic performance with a small effect, compared to SD students. Specifically, in the exam and overall grades of the subject using TL. However, this performance improvement is extended with a small effect to in-class synchronous activities, pre- and post-class asynchronous activities, exam, and overall grades using OFL. In contrast, with FFL the academic performance of SD and DD students is quite similar.

The previous findings are in line with Orenes Lucas and Sánchez Martín (2021), who find that DD students achieve a higher average grade than SD students when TL is applied. Likewise, Xu et al. (2021) and Lapitan et al. (2021) posit that academic performance improves when OFL methodology is employed. On the other hand, Durrani et al. (2022), Price and Walker (2021), and Stratton et al. (2020) did not find evidence of performance improvement with FFL. Others suggest that FL might work better in disciplines such as humanities rather than in social sciences, mathematics, or technologies (Strelan et al., 2020).

Comparing FL with TL, the analysis reveals that regardless of the modality used, online or face-to-face, DD students achieve better grades in synchronous activities (in-class) and asynchronous activities (pre- and post-class) than SD students with TL. These results align with the studies conducted by Guevara-Otero, Diaz-Iglesias, et al. (2023), El-Banna et al. (2017), and Lapitan et al. (2021) who demonstrated that the learning and academic performance of students using FL is superior in asynchronous and synchronous activities compared to those using TL. Naturally, the methodology enables students to perform tasks in various stages and timings (Salas-Rueda, 2021). It also facilitates online or face-to-face interaction between students and teachers (Lapitan et al., 2021; Lin et al., 2022). Furthermore, several studies provide evidence that overall grades improve with OFL (Lapitan et al., 2021; Xu et al., 2021). These data correspond to this investigation, where it

was found that the overall grades of DD students attending OFL were superior to those of SD students using TL.

Additionally, while no differences in student ratings were found between OFL and FFL, significant differences were found between SD and DD students. Specifically, the students' learning experiences under OFL and FFL reported more positively attitudes, perceptions, interactions, academic results, and perceived satisfaction in DD students than in SD students. Prior research agrees that students' perceptions and attitudes about their learning improve when FL is applied (Guevara-Otero, Cuevas-Molano, et al., 2023; Ruiz-Jiménez et al., 2022; Saglam & Arslan, 2018). This is consistent with the outcomes of this work. Some indicate that they achieve a more committed attitude in students of SD and DD (Murillo-Zamorano et al., 2019), even towards sustainable development (Buil-Fabregá et al., 2019). Others point out that it enhances motivation and enjoyment (Ruiz-Jiménez et al., 2022), as well as satisfaction, interaction, and perception of the instructional mode (Chen et al., 2008; Fornell et al., 1996; Ruiz-Jiménez et al., 2022; Wu et al., 2010; Zhai et al., 2017). Furthermore, in comparison to TL, FL enhances attitude towards e-learning, subsequently to improved academic results for students (Chen et al., 2008; Tsai et al., 2012).

This study extends the empirical investigations into FL by exploring diverse modalities and TL. It evaluates whether the adoption of FL model affects students' performance in contexts encompassing both SD and DD in marketing and communication. These contextual studies have been demanded by literature reviews (Senali et al., 2022).

However, this research has certain limitations: First, the sample used in this study consisted of a non-probabilistic selection of SD and DD students in three different courses at a Spanish university. Therefore, caution should be exercised with the results obtained. Empirical research should be extended to multiple degrees, diverse disciplines, other subjects (Strelan et al., 2020), and across countries. Secondly, while segmenting student profiles by degrees provides new insights, it is essential to study the skills inherent in different types of degrees and their correlation with the assessment-activity formats. This involves redesigning materials and activities, and further examining cooperative learning comparations. Thirdly, it would be fruitful to analyze how the performance, attitudes, perceptions, interactions, results, and satisfaction are affected by FL method from the teacher's perspective, incorporating qualitative research methods that reflect positive attitudes and barriers towards the flipped classroom methodology. Finally, it would be of great interest to the academy community to investigate whether attitude, formative assessment and perceived interactions with FL method influence students' perceptions, improved academic outcomes, and increased satisfaction with FL learning method.

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Data availability: Data generated or analyzed during this study are available from the authors on request.

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APPENDIX A

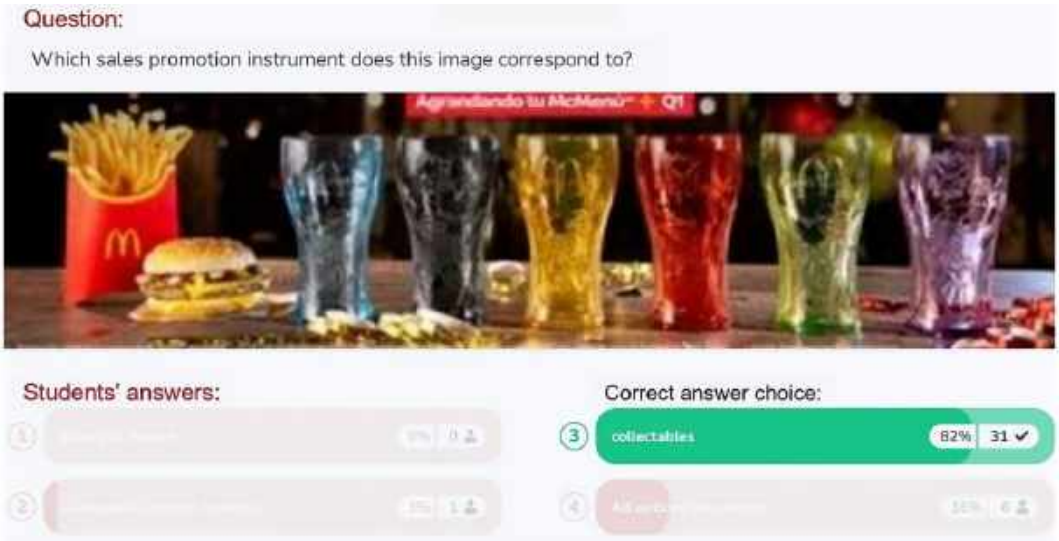

Figure A1. Example of an activity during OFL & FFL class session (Source: Authors)

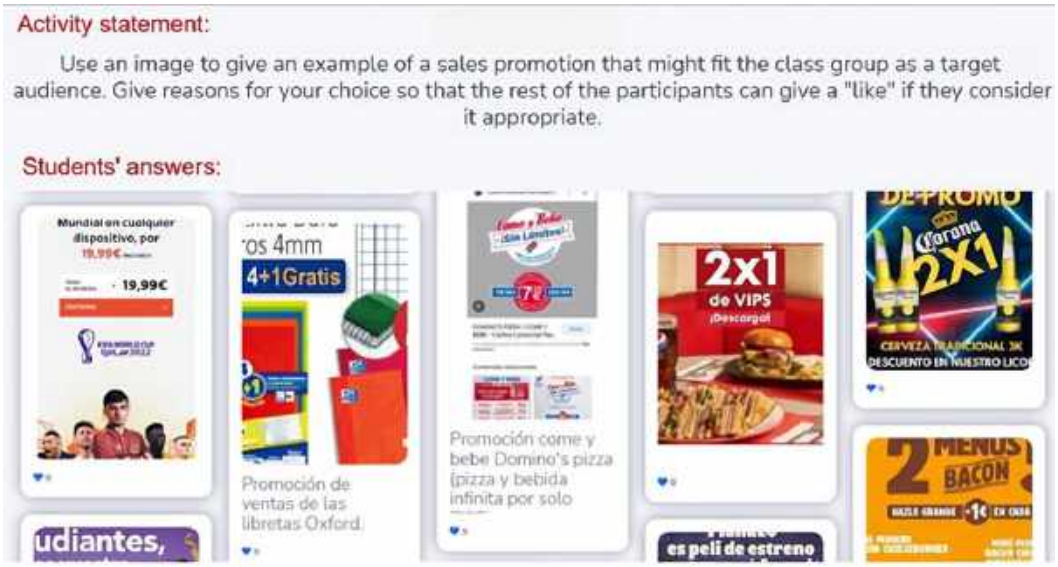

Figure A2. Example of a post-class session activity in OFL & FFL (Source: Authors)

APPENDIX B

Table B1. Instrument for OFL & FFL methodologies

Dimensions/items		Source
FL ATTITUDE (FLA)		
FLA 1	The FL experience has been enjoyable and stimulating for me.	Ruiz-Jiménez et al. (2022) & Saglam and Arslan (2018)
FLA 2	I liked the FL experience.	
FLA 3	The FL experience has motivated me in my studies more than the TL methodology.	
FLA 4	Overall, I found learning process with FL methodology enjoyable.	
FL PERCEPTION (FLP)		
FLP 1	The use of FL helped me to better understand theoretical concepts of the lessons.	Ruiz-Jiménez et al. (2022)
FLP 2	Thanks to the use of FL, I learned more and better.	
FLP 3	The FL methodology allowed me to learn the study' materials more efficiently.	
FLP 4	FL methodology helped me to workday by day continuously, instead of studying only a couple of days before the exam.	
IN-CLASS FL INTERACTION (FLI)		
FLI 1	I can exchange information effectively in the physical classroom with the FL.	Paechter and Maier (2010) & Ruiz-Jiménez et al. (2022)
FLI 2	I can get support from cooperative learning and group work with other participants in the FL physical class.	
FLI 3	I can easily get advice and support from the tutor in the physical class with the FL.	
FL RESULTS (FLR)		
FLR 1	Compared to TL learning approach, I spend less time learning a certain knowledge point with the use of FL.	Fornell et al. (1996), Ruiz-Jiménez et al. (2022), & Zhai et al. (2017)
FLR 2	Compared to TL learning approach, I can learn more at a certain point in time in FL context.	
FLR 3	Compared to TL learning approach, learning with FL enabled me to perform self-assessment of my learning process.	
FLR 4	Compared to TL learning approach, I think that with FL learning I will achieve better grades.	
FL STATISTICS (FLS)		
FLS 1	Overall, I am satisfied with the FL methodology.	Chen et al. (2008), Tsai et al. (2012), Wu et al. (2010), & Zhai et al. (2017)
FLS 2	I am satisfied that the FL methodology meets my needs in terms of learning.	
FLS 3	I am willing to use FL methodology in other subjects to support my learning.	
FLS 4	I am more willing to use FL than before.	

APPENDIX C

Table C1. Questionnaire reliability of OFL's & FFL's methodologies by groups

Dimensions	OFL		FFL		Items
	Cronbach's alpha	McDonald's omega	Cronbach's alpha	McDonald's omega	
Overall	.928	.925	.874	.836	19
FLA	.907	.911	.843	.842	4
FLP	.837	.842	.908	.904	4
FLI	.635	.665	.917	.918	3
FLR	.858	.861	.798	.801	4
FLS	.856	.849	.933	.935	4

Table C2. KMO & Bartlett's questionnaire test by groups with OFL & FFL methodologies

KMO & Bartlett's test		OFL	FFL
KMO measure of sampling adequacy		.706	.645
Barlett's test of sphericity	Approximate Chi-square	593.469	598.746
	gl	171	171
	Sig.	<.001	<.001