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Factors affecting students' perception of flipped learning over time in a teacher training program

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ABSTRACT

The flipped learning methodology could play a key role in teacher training, as it exposes future teachers to experience this active methodology as students. With the purpose of shedding light on how students' perceptions may vary over time and how they can be related to the improvement of the flipped learning methodology, our study explores different factors in an eight-year period. Specifically, we analyse teaching performance considering data on students' perceptions from the 2015–2016 academic year to 2022–2023 of a course embedded within a master s degree in teacher training in Spain. Once future teachers had experienced flipped learning as students, a sample of 338 completed a survey regarding their perceptions of the flipped classroom approach and the instructor role. In our study, the more experienced the instructor, the better perception the students showed on both the flipped learning methodology and the performance of their teacher. In particular, we found that future teachers had (i) a good or very good opinion about flipped learning, regardless of their gender (ii) a more positive perception about flipped learning, teaching performance and course development in the last five academic years, (iii) no remarkable differences between study specialisations in those last academic years, and (iv) a better opinion about the flipped learning model when they have best grades. We discuss our findings according to six factors that affect the flipped learning experience and, thus, students' perception of flipped learning over time: "student characteristics", "teacher characteristics", "implementation", "task characteristics", "out-of-class activities" and "in-class activities"—factors already unveiled by a recent state-of-the-art review to enhance the effectiveness of flipped classroom. We can conclude that the instructor's teaching experience is a key factor that affects the implementation of flipped learning, influencing students' perception and, consequently, the success of this active methodology.

1. Introduction

Flipped learning makes students take a central role in their learning process while educators become facilitators of learning along the whole process. It is an active methodology where students revise content prior to their classes, mainly in a video format [1–3], so that in-class time is dedicated to different activities and to work on tasks. As educators involve their students in doing things and reflecting on what they are doing [4], active methodologies promote students' engagement in their learning process [5]. Specifically,

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flipped learning has been found to contribute to students' attitudes toward their learning experience [6], better academic performance [6–8], satisfaction [9] and an increase in interactions, both student-teacher and student-student [8,10].

University students might perceive flipped classroom in both positive and negative ways. Strayer [11] concluded that students in the flipped classroom were less satisfied with the class structure, as they struggled more to orient themselves to the activities, compared with students in the "traditional" classroom, where the climate was more predictable. Similarly, other experiences in higher education have highlighted the students' lack of autonomy in time management and problem-solving, which led to some negative comments about flipped learning [12]. Negative comments might be related to active learning processes requiring higher student engagement [7], an extra effort that all students might not equally embrace. Students' initial interest and prior achievement also seem to influence their perception of this active methodology [13]. Hung [6] also identified this additional effort that students need to invest in a flipped learning model. Interestingly, a case study by Talbert [14] shows that once students learn in a flipped environment, they tend not to want to return to "traditional" learning environments, which might be linked to resistance to change as also mentioned by Martín Rodríguez & Santiago Campión [15]. Gardner [16] concluded that even students that do not like the flipped classroom format might agree on its positive impact on their learning. For its part, a systematic review of flipped classroom research on higher education found that an argument used by many highly cited publications is that the flipped classroom improves student learning, but the claim is mainly based on improved test results or self-reported motivation [17]. These authors, thus, warn that positive results on flipped learning might be under the effect of a bias of self-reported studies undertaken by educators influenced by the hype of the flipped classroom.

For flipped learning to be positively perceived, teacher training plays a key role as educators are responsible for its design and implementation in their classrooms. Teacher training offers educators increased assurance and knowledge [15], and may incentivize some to transition from traditional to active methodologies such as flipped learning by making them aware of its existence and functioning. Teacher training exposes future educators to flipped learning, which enables them to experience and learn the benefits of the model, and thus make better informed decisions on whether to apply it in their classrooms. Besides, it can play a key role to disseminate this active methodology among future educators.

Previous studies in the field of teacher training and secondary education report rather positive students' perceptions about flipped learning, although the research that focuses on this educational level is limited. With the term "secondary education" we refer to both secondary education and vocational training stages. Studies among trainee teachers in elementary and secondary education show that these students identify the possibility to study in their own time with video lessons as a benefit of flipped learning [18]. A case study in teacher training reported positive perceptions from students and concluded that the model should be embedded in the master's in teacher training [15]. Beyond higher education but linked to teacher training, González et al. [19] found that most Primary Education bachelor's degree students had a favourable perception of flipped classroom and highlighted a statistically significant difference in the flipped classroom setting, with students performing higher on average than in the "traditional" setting. Other studies confirm the better teaching-learning environment flipped learning allows for pre-service teachers and the positive influence it may have on their future students [20].

Students' performance seems to be a variable potentially influencing students' perception of the flipped model, although surprisingly, it is not easy to find studies analysing such relationship. On the contrary, performance is mainly taken only as a dependent variable. De la Fuente et al. [21], with a focus on different instructional models in higher education, confirm that performance is interdependent with the perception of the learning-teaching process. High-performing students have a better perception of the process. They also pose that lower-performing students rather value a more externally regulated process, while higher-performing students, and therefore more self-regulated, prefer an autonomous instructional context. Hence, it is important to acknowledge that active methodologies, such as flipped learning may negatively affect less autonomous and competent students.

Gender may also be another variable affecting perception on flipped learning and student's performance. Chiquito et al. [22] found that females obtained higher grades with the flipped model in an engineering subject. The same results were obtained by Gross et al. [23]. However, Chen et al. [24] found that gender was not a determining factor for first-year university students' perceptions and learning performance regarding flipped learning. Same results were reported by Mengual et al. [25]. And the study by Colomo et al. [26] with future primary teachers, showed that men had a better perception of the flipped methodology than women. Hence, as Chiquito et al. [22] claim, more studies objectively measuring the impact of the flipped model on student performance and perception, and focused on gender differences are clearly needed, especially in STEM areas.

In secondary education, where students of the master in teacher training will act as future teachers and be able to implement flipped learning, students' perceptions of flipped learning appear more favourable than in higher education. This validates our hope of contributing to implementing more flipped learning in this educational level as a methodology that improves various aspects of learning. Galindo et al. [27] explored the use of flipped classrooms through a voluntary two-week workshop and pointed to positive opinions. Johnson [28] studied the perceptions of flipped classrooms in maths courses, concluding that most students enjoyed the experience and its self-paced nature. Particularly, students in Johnson's study valued the greater opportunities to communicate with their classmates and teacher and engage in meaningful classroom activities. Lozano Fernández et al. [29] analysed in 2021 informants' responses to a case study in secondary education, who reported an efficient model given that the experience is adequately planned and implemented, along with appropriate ICT. Also in 2021, the findings from Fornons et al. [8] warned about a relevant nuance: students' perceptions of the flipped classroom vary with their learning style.

In addition to analysing students' perceptions, several studies have reported the effects of using flipped classroom on university students' performance, either showing a positive relationship [30–33] or showing no significant differences [34]. As Luo et al. [34] pose, this lack of conclusive evidence can be related to different designs and implementations of flipped model by educators, so they claim the need for studies to go beyond the flipped versus traditional comparison and deepen the analysis of potential influencing variables and their impact on learning.

Hence, the effectiveness of flipped learning requires careful design and implementation by educators. The role of the instructor in flipped learning is essential and even more demanding than in a traditional format [35]. Indeed, what is called a "Professional Educator" is defined as one of the four pillars of F-L-I-P™ [36]. Factors such as "teacher characteristics", "implementation", "task characteristics", "out-of-class activities", and "in-class activities" have been identified by Oudbier et al. [37] as main factors that impact effectiveness of flipped learning in higher education students (the other factor being "student characteristics"). In addition, the term "educator" has been identified as a latent topic associated with experience in flipped learning, with a text mining approach by Park & Bang [35]. Oudbier et al. [37] revealed specific factors in their state-of-the-art review of flipped classroom with the aim of investigating the factors that play a role in the effectiveness of flipped classroom and interventions to positively stimulate them. Even though their study is framed in the health science education domain, previous studies have confirmed that students learn more from teachers with certain characteristics [38], so we hypothesise that these factors might be relevant in our case. Specifically referring to "teacher characteristics", Oudbier et al. [37] suggested that future studies should be conducted, as little research has been carried out. Our study focuses on this factor, "teacher characteristics", conceptualised as proposed by Oudbier et al. [37]; this is, the skills, knowledge, attitude, and traits of the teacher, and we consider that this factor in turn indirectly affects "implementation", "task characteristics", "out-of-class activities", and "in-class activities". Ideally, apart from creating a flexible environment (a pillar of F-L-I-P™), the need of educators incorporating fun and exciting elements to classroom activities has been found by Park & Bang [35], as students expect these elements in a flipped learning setting. This relates with the pillar "Learning Culture" by F-L-I-P™, to which the authors referred to as "fun and exciting culture". Interestingly, the intervention that Oudbier et al. [37] propose for "teacher characteristics" is "pay attention to relevant dimensions of flipped classroom in teacher training", an intervention that is at the core of our study as it exposes future teachers to flipped learning with the hope that they bring this methodology to their future classrooms. Educators in flipped learning can positively impact student's favourable perceptions on flipped classrooms [35].

With the purpose of contributing to students' learning with active methodologies such as the flipped classroom both in secondary and higher education, our study explores the factors affecting students' perception of flipped learning over time. Specifically, and in accordance with previous findings, the research question is: Are students' perceptions on flipped learning affected by their gender, academic achievement, studies itinerary or their teacher's teaching performance? To answer it, we analysed data collected along eight academic years from secondary education future teachers, on their perceptions on flipped learning, their opinion about the course and the teaching characteristics and their performance (grades). This research is framed in a master's degree program directed to future secondary education teachers at Universidad Politécnica de Madrid in Spain. Our study intends to bring closer higher education to previous educational levels in the field of flipped learning.

2. Methodology

2.1. Context of the course and teaching characteristics

Our study was conducted in the master's degree program in Teacher Training for Secondary and Vocational Training Education at Universidad Politécnica de Madrid (Spain) [Máster Universitario en Formación del Profesorado de Educación Secundaria Obligatoria, Bachillerato y Formación Profesional], specifically in the "Learning and Personality Development [Aprendizaje y Desarrollo de la Personalidad]" master's course. The course was taught within a flipped learning model since the 2014–2015 academic year, but this paper analyses data starting in the 2015–2016 academic year, as the instructor whose teaching is considered started then teaching the course with this active methodology. The course was organised along ten weeks during which students had to attend each week a 100-min class. It has to be noted that in the academic year 2020–2021 a hybrid model was temporarily established due to the COVID-19 pandemic, in which half of the students attended face-to-face class, while the other half was online (with a rotative system that enabled all students to experience both class models) [39]. Every week students were asked to watch several video lessons before class, following Sams and Bergmann [1] recommendations. These were recorded by their instructors and required a weekly dedication of 30–40 min (each video-lesson was under 15 min). In order to highlight the most relevant contents, thus, controlling students' level of understanding, video-lessons contained quiz-like questions. Students' answers to these questions along with their actual comments and doubts laid out at the beginning of each class, permitted professors to guarantee that the key points were properly understood, and no doubts were left unsolved. This part was usually structured as a reflective discussion, where students solved their classmates' questions, and all were encouraged to reflect on the content. The next phase of each lesson was directed at consolidating the necessary

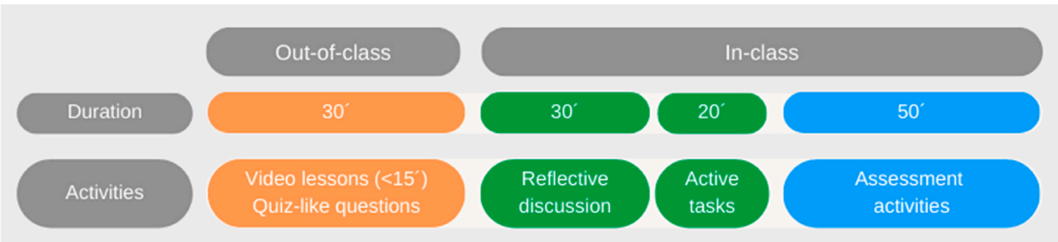

Fig. 1. Weekly course flow with the distribution of students' dedication within the designed flipped learning model.

theoretical contents through active tasks that included manipulative activities, gamification activities, case studies or role-play. The remaining time in each lessons was dedicated to students' work in pre-established groups where they addressed the different assessment activities of the course. The instructor was available in the classroom during this phase, so that she could guide students in their work and contribute to solve emerging doubts or problems. The weekly course flow is shown in Fig. 1. The data were collected between 2015 and 2022. The students were informed that all the requested information was anonymous and the study was approved by the Ethical Committee of the Universidad Politécnica de Madrid.

2.2. Participants

An incidental sample of 338 future secondary education teachers in eight cohorts that englobe from the 2015–2016 to the 2022–2023 academic year participated in this study.

According to their graduate education and their focus as future teachers, students were organised in different specialisations (Table 1). This master's program offered three specialisations (Physical Education, Technology and Graphic Expression) from 2015 to 2016 to 2017–2018. Two new specialisations (Mathematics and Physics & Chemistry) were included in 2018–2019. That same academic year, the Physical Education specialisation ceased to be offered, limiting all study itineraries in the STEM area. Table 1 shows that participants' gender was evenly distributed. Their grades may also be consulted, taking into account that the minimum to pass the course is 5.0 on a 0 to 10 scale. A vast majority of students (84 %) reported that this was their first experience with flipped learning. The COVID pandemic did not substantially affect this course, as the same methodology and contents could be implemented and the percentage of students answering the survey about their perception on flipped learning remained similar to other years.

2.3. Instruments

On one hand, a survey was designed ad-hoc by academics with experience in educational research and active methodologies to explore students' perceptions of flipped learning. First, students reported demographic data such as age, specialisation or gender. Next, they expressed their opinion comparing the flipped learning model to a non-flipped (hereinafter referred as to traditional) class setting through 5-point Likert scale items—from 1 (completely disagree) to 5 (completely agree). These items explored issues such as the usefulness of the flipped model for their learning, in-class interactions, students' satisfaction or the different assessments activities. The survey was composed of 20 items and shows a high reliability with Cronbach $\alpha = 0.941$.

On the other hand, students filled out, at the end of the semester, a survey concerning different aspects of the course and the instructor's teaching with a total of 20 questions (Q). This survey's content is facilitated by the UPM Quality Vice-Chancellor's office and used to assess teaching performance throughout all the university's courses. For the purposes of this work, nine specific items of

Table 1
Students' characteristics.

Variable	Categories	Frequency	%
Cohort/Academic year	2015–2016	30	8.9
	2016–2017	47	13.9
	2017–2018	40	11.8
	2018–2019	47	13.9
	2019–2020	39	11.5
	2020–2021	75	22.2
	2021–2022	38	11.2
	2022–2023	22	6.5
Gender	Female	165	48.8
	Male	170	50.3
	Missing data	3	0.9
Age	18–24 years	72	21.3
	25–34 years	107	31.7
	35 and older	69	20.4
	Missing data	90	26.6
Previous experience with flipped learning	Yes	24	7.1
	No	284	84.0
	Missing data	31	8.9
Specialisation	Physical education	31	9.2
	Technology	82	24.3
	Graphic Expression	77	22.8
	Physics & Chemistry	53	15.7
	Mathematics	65	19.2
	Missing data	30	8.9
Academic achievement/Grades	5.0–5.9	1	0.3
	6.0–6.9	8	2.4
	7.0–7.9	62	18.3
	8.0–8.9	181	53.6
	9.0–9.9	56	16.6
	Missing data	30	8.9

this survey, that addressed factors related to the teaching characteristics, are considered. Namely, the ones related to the course's activities (Q1) and assessment tasks (Q6) and their contribution to the students' learning (Q7 and Q16), others related to the professor's teaching skills such as her organisation of the activities (Q9), the clarity of her explanations (Q10) or the interest she triggers in students (Q15), so as her ability to solve doubts (Q11) or encourage student participation (Q14). Cronbach α (0.888) of this instrument may be considered high.

2.4. Procedure and analyses

Approximately two weeks after the course ended, students were notified their final grade. Simultaneously, they received the petition to fill out an online survey about their perception of the flipped learning model. To ensure the maximal number of responses, the instructor sent several reminders.

The other survey concerning students' opinion about the course and the instructor's performance had to be filled out anonymously in class at the end of the semester through an online platform. The response rate was subsequently very high. At this moment, students did not know their grade in the course.

The analyses of the quantitative data were carried out with SPSS Statistics Software and with Microsoft Excel using parametric tests (ANOVA) when data allowed it and non-parametric tests (Kruskall-Wallis H, Mann-Whitney U) when data did not show a normal distribution.

In order to explore differences related to the flipped learning consolidation due to the educator's expertise with the model, students' data were classified into two different phases. Phase I) comprises the 2015–16, 2016–17 and 2017-18 academic years, which were the first experience with flipped learning for the professor, who invested a great effort in creating video-lessons with limited technical knowledge to the detriment of in-class and assessment activities. During this phase the master offered three specialisations, namely, Physical Education, Technology and Graphic Expression. On the other hand, phase II) ranges from the 2018-19 academic year to 2022–23, when the instructor included improvements in the model. Video-lessons were improved, both technically and regarding the content, but also in-class activities and assessment tasks were adapted to better suit students' needs. Additionally, during these years the professor stopped teaching in the physical education specialisation, but two new STEM specialisations were included: Mathematics and Physics & Chemistry.

3. Results

Results are organised in four sections. First, descriptive results are presented in Section 3.1. Then, sections 3.2. to 3.4 show differences concerning academic year (organised in two different phases), specialisation and academic achievement.

3.1. Descriptive analysis

As may be seen in Table 2, participants have a good or very good opinion about flipped learning: nearly half of the data show means around 4 in a 5-point scale and all items' means are above 3 (see Table 2).

In general, results showed a positive perception in favour of the flipped model (means all above 3.5). When students compared a traditional class setting with a flipped learning model, they showed a clear preference for the active methodology (with means above 3.5) regarding their active role in learning (item 9), their involvement in the course (item 12), their learning achievement (item 14)

Table 2
Future teachers' perception on the analysed items concerning flipped learning.

Item	N	$\bar{x}$	SD
1. There are more frequent in-class interactions with professors.	337	3.96	0.964
2. The in-class interactions with professors helped my learning.	308	4.08	0.965
3. There are more frequent in-class interactions with classmates.	308	3.96	1.081
4. The in-class interactions with classmates helped my learning.	308	3.89	1.109
5. I have better access to learning materials and contents.	338	3.86	1.064
6. I have the possibility to choose the type of materials that better fit my learning.	338	3.35	1.175
7. I can work at my own pace.	338	3.99	1.172
8. I have more opportunities to show what I have learned to professors or classmates.	338	3.51	1.171
9. Learning is more active and experiential.	338	3.86	1.177
10. Professors take my strengths, my interests and my weaknesses more into account.	338	3.12	1.146
11. Time investment has been greater than in a traditional model.	338	3.25	1.235
12. This model got me more involved in the course.	308	3.62	1.170
13. I have improved my learning process.	338	3.79	1.013
14. I have learned more.	337	3.72	1.037
15. The assessment activities have helped me in my learning. Specifically: Videos.	308	4.07	1.057
16. The assessment activities have helped me in my learning. Specifically: Webquest.	248	3.42	1.135
17. The assessment activities have helped me in my learning. Specifically: Poster.	308	3.37	1.158
18. The assessment activities have helped me in my learning. Specifically: Individual exercise.	248	3.65	1.016
19. I am satisfied with my grades.	308	4.10	0.947
20. I liked this model more than the "traditional" one.	338	3.93	1.093

and their satisfaction (item 20). On the other hand, students perceived that they needed a moderately bigger time investment in the flipped learning setting, when compared to a traditional model (item 11).

Items 1 to 4 show students' perceptions about the in-class interactions, both student-student and instructor-student, in the flipped learning model. Student perceive more frequent interactions with their professor (item1, $\overline{x} = 3.96$; SD = 0.964) and with their peers (item 3, $\overline{x} = 3.96$; SD = 1.081) in the flipped learning model. Furthermore, these interactions seem to facilitate their learning, especially those with the instructor (item 2, $\overline{x} = 4.08$; SD = 0.965), but also with fellow students (item 4, $\overline{x} = 3.89$; SD = 1.109).

Assessment activities were rated above 3 in terms of their contribution to students learning. The most valued activity were the video-lessons (item 15), followed by the individual exercise (item 18), the WebQuest (item 16) and in the last place, although also with means above 3, the poster (item 17).

When regarding issues related to personalized learning, students value very high the chance to work at their own pace (item 7, $\overline{x} = 3.99$; SD = 1.172). Having better access to materials and learning contents is also among the high valued aspects of flipped learning (item 5, $\overline{x} = 3.86$; SD = 1.064). Other items addressing personalized learning include the option to choose the type of materials that best suit their learning style (item 6, $\overline{x} = 3.35$; SD = 1.175), the possibilities of showing their learning achievements to professors and students (item 8, $\overline{x} = 3.51$; SD = 1.171) and the perception of the professors taking into account their strengths, interests, and weaknesses (item 10, $\overline{x} = 3.12$; SD = 1.146). These three items' results are still high but not as notable as others.

To finish, item 13 about students' perception of their improvement in the learning process ($\overline{x} = 3.79$; SD = 1.013), and item 19 regarding their satisfaction with their grades ($\overline{x} = 4.10$; SD = 0.947) show a strong support of the flipped learning model.

3.1.1. Differences concerning demographic aspects: gender and age

The ANOVA-test showed no differences in students' perception about the flipped learning model, comparing gender. In our study, men and women showed similar means concerning all the items in the survey. Furthermore, the sample in this study is very balanced in this issue, as 49 % are women and 50 % men, which is uncommon in education related studies in Spain [40].

Table 3

Mann-Whitney *U*-test comparing future teachers' perception by academic year (organised in two phases).

Item		N	Average ranks	U	p-value
1. There are more frequent in-class interactions with professors.	Phase I	116	127,3	7981	**0.000**
	Phase II	221	190,89		
2. The in-class interactions with professors helped my learning.	Phase I	87	106,29	5419.5	**0.000**
	Phase II	221	173,48		
3. There are more frequent in-class interactions with classmates.	Phase I	87	133,66	7800.5	**0.007**
	Phase II	221	162,7		
4. The in-class interactions with classmates helped my learning.	Phase I	87	125,7	7107.5	**0.000**
	Phase II	221	165,84		
5. I have better access to learning materials and contents.	Phase I	117	143,57	9895	**0.000**
	Phase II	221	183,23		
6. I have the possibility to choose the type of materials that better fit my learning.	Phase I	117	147,2	10,319	**0.002**
	Phase II	221	181,31		
7. I can work at my own pace.	Phase I	117	137,74	9212	**0.000**
	Phase II	221	186,32		
8. I have more opportunities to show what I have learned to professors or classmates.	Phase I	117	145,65	10137.5	**0.001**
	Phase II	221	182,13		
9. Learning is more active and experiential.	Phase I	117	143,79	9920	**0.000**
	Phase II	221	183,11		
10. Professors take my strengths, my interests and my weaknesses more into account.	Phase I	117	144,53	10006.5	**0.000**
	Phase II	221	182,72		
11. Time investment has been greater than in a traditional model.	Phase I	117	173,29	12,485	0.594
	Phase II	221	167,49		
12. This model got me more involved in the course.	Phase I	87	108,15	5581	**0.000**
	Phase II	221	172,75		
13. I have improved my learning process.	Phase I	117	140,12	9491	**0.000**
	Phase II	221	185,05		
14. I have learned more.	Phase I	116	134,78	8849	**0.000**
	Phase II	221	186,96		
15. The assessment activities have helped me in my learning. Specifically: Videos.	Phase I	87	116,39	6297,5	**0.000**
	Phase II	221	169,5		
16. The assessment activities have helped me in my learning. Specifically: Webquest.	Phase I	87	115,22	6196	0.122
	Phase II	161	129,52		
17. The assessment activities have helped me in my learning. Specifically: Poster.	Phase I	87	128,72	7371	**0.001**
	Phase II	221	164,65		
18. The assessment activities have helped me in my learning. Specifically: Individual exercise.	Phase I	87	98,98	4783.5	**0.000**
	Phase II	161	138,29		
19. I am satisfied with my grades.	Phase I	87	131,7	7629.5	**0.003**
	Phase II	221	163,48		
20. I liked this model more than the "traditional" one.	Phase I	117	137,74	9212.5	**0.000**
	Phase II	221	186,31		

p-value less than 0.05 (indicates significant difference) is reported in bold font.

Dissimilarities concerning students' age were also explored and some items showed significant differences in the ANOVA-test. Participants stated their age according to three groups: i) 18–24 years, ii) 25–34 years and iii) 35 years or older. In six items of the survey the younger students (ages 18 to 24) had the best opinion, followed by their oldest classmates (age 35 and older). Hence, the students between 25 and 34 years had a lower opinion in comparison. The specific items which showed these differences were item 2 "The in-class interactions with professors helped my learning." ($F_{2,\ 247} = 7.051$, $p = 0.001$), item 8 "I have more opportunities to show what I have learned to professors or classmates." ($F_{2,\ 247} = 4.632$, $p = 0.011$), item 10 "Professors take my strengths, my interests and my weaknesses more into account." ($F_{2,\ 247} = 3.926$, $p = 0.021$), item 15 "The assessment activities have helped me in my learning. Specifically: Videos." ($F_{2,\ 247} = 4.641$, $p = 0.011$), item 17 which also asked about a specific assessment activity, namely, "Poster." ($F_{2,\ 247} = 3.305$, $p = 0.038$) and item 20 "I liked this model more than the "traditional" one." ($F_{2,\ 247} = 5.746$, $p = 0.004$). A different tendency is observed for item 19 "I am satisfied with my grades", where the older students are the most satisfied with their grade ($F_{2,\ 247} = 3.399$, $p = 0.035$).

3.2. Differences in students' perceptions by academic year organised in two phases

3.2.1. Perceptions about the flipped learning model

In order to explore differences related to flipped learning over time, and as stated in the methodology, data were organised in two phases. Phase I (years 2015–2016 to 2017–2018) with inexperienced educators for the flipped learning model teaching the course and phase II (years 2018–2019 to 2022–2023) where the more experienced professor implemented subsequent improvements in the course and her teaching with a flipped learning model.

Due to lack of homogeneity of variances (Levene-test <0.05), the exploration of differences between the two phases of academic years concerning students' perception of the flipped learning model was carried out using the Mann-Whitney *U*-test (see Table 3).

As it may be seen (Table 3), all items, except the ones about time investment (item 11) and a specific assessment task (Webquest, item 16), showed differences when comparing the two phases. In all cases, students show a more positive perception in recent years (phase II) when compared to the first years the professors implemented this teaching model (phase I).

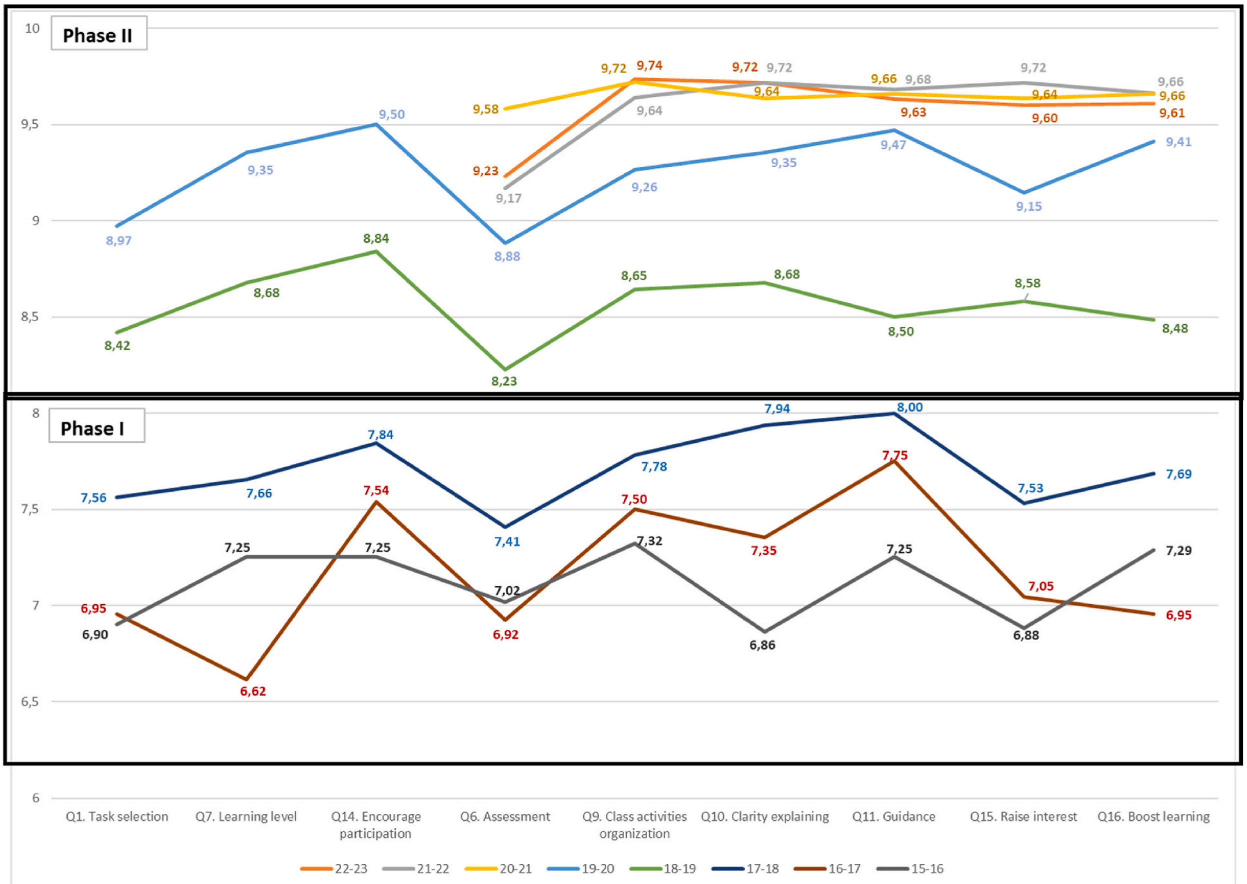

Fig. 2. Means for perception about the course and teaching by academic year. Note: From the academic year 20–21 onwards, Q1, Q7 and Q14 were no longer included in the institutional questionnaire.

3.2.2. *Perceptions about the course development and the teaching performance*

As stated before, students fill out at the end of every academic year, a survey about the course and the professor's teaching. As explained in the 2.2 section and in order to explore the evolution of students' responses and their relation to the perception of the flipped learning model implemented during these years, data of nine specific questions of this survey are analysed. Fig. 2 shows the means in these selected questions (Q) by academic year. In the 2020–2021 academic year, some changes were introduced in the questionnaire. Therefore, Q1 about the task selection by the instructor, Q7 concerning students' perception of their learning level in the course and Q14 which asks about the professor's ability to encourage students' participation, are only present from 2015 to 2016 to 2019–2020. The rest of the questions addresses issues such as the course's assessment tasks (Q6), the professor's organisation of in-class activities (Q9), her clarity when explaining (Q10), her ability to solve doubts and guide students (Q11), if she raises interest in the contents (Q15) and her ability to encourage students' learning (Q16).

A simple view of Fig. 2 shows a clear upward tendency in the data. Students' perception of the course and the teaching in the first two years the analysed professor started teaching with a flipped learning model (2015–2016 and 2016–2017) show the lowest means with data from 6.62 to 7.75 in a 10-point scale. In the next three years, means in all analysed items rise, with the lowest mean being 7.41 and the highest 8.00 in 2017–2018, the lowest mean 8.23 and the highest 8.84 in 2018–2019 and means between 8.88 and 9.50 in 2019–2020. In the last three years (2020–2021, 2021–2022 and 2022–2023) all means are extraordinarily high (data between 9.17 and 9.74), showing students pronounced positive perception of the course and the professor's teaching abilities.

ANOVA-tests reveal significant differences in all questions when the academic years are separated, as in prior analyses, in phase I (years 2015–2016 to 2017–2018) and phase II (2018–2019 to 2022–2023). In all cases, students in more recent years (phase II) have a better opinion of the course and the different activities for enhancing their learning, as well as about the teaching activity developed by their professor (see Table 4). Data also show a higher standard deviation in phase I, indicating more variability in students' perception during the first years where the analysed instructor implemented the flipped learning model.

3.3. *Differences in students' perceptions by specialisation*

Master specialisations (studies' itinerary) were also explored with the phase I and II classification, as Physical Education (PE) was only present in the first phase, while Mathematics (MA) and Physics & Chemistry (PC) only in the second one.

In phase I the data did not follow a normal distribution, so that Kruskall-Wallis H-tests were carried out. Results showed significant differences for only two of the survey's items and for the final grade (see Table 5).

Data show that Physical Education students' perception about the frequency of interactions with professors in class (item 1) was lower than those of the Technology specialisation and TC students, in turn, showed lower scores than students from the Graphic Expression specialisation. Post-hoc analyses with Mann-Whitney U-tests confirm significant differences between PE and GE students'

Table 4
ANOVA-test comparing perceptions about the course and the teaching activity by phase.

Item		N	$\bar{x}$	SD	F	p-value
Q1. Activities (theoretical, practical, individual, teamwork, etc.) are related to what I should learn in this course.	Phase I	189	7,14	2,00	55,77	**0.000**
	Phase II	130	8,70	1,57		
Q6. Assessment methods (exams, reports, individual or teamwork, etc.) are related to the activities developed during the course (theoretical, practical, individual, teamwork, etc.).	Phase I	188	7.11	2,09	158,64	**0.000**
	Phase II	357	9.02	1,41		
Q7. Concerning the competences of the course, I have improved my base level.	Phase I	188	7,17	2,37	64,06	**0.000**
	Phase II	130	9,03	1,44		
Q9. The teacher prepares, organises and structures the activities or tasks to be carried out in class.	Phase I	187	7,40	2,24	173,91	**0.000**
	Phase II	357	9,43	1,11		
Q10. The teacher clearly explains the content and emphasises the most important concepts.	Phase I	187	7,40	2,13	204,71	**0.000**
	Phase II	358	9,44	1,19		
Q11. The teacher solves students' doubts and guides them while they work on their tasks.	Phase I	187	7,68	2,03	149,03	**0.000**
	Phase II	356	9,39	1,24		
Q14. The teacher encourages students' participation during class (he/she encourages them to express their opinions, includes individual and group activities, etc.).	Phase I	188	7,55	2,06	63,62	**0.000**
	Phase II	130	9,18	1.31		
Q15. The teacher raises students' interest in this course.	Phase I	188	7,16	2,31	204,19	**0.000**
	Phase II	358	9,37	1,30		
Q16. The teacher boosts my learning and due to his/her help I have improved my knowledge and abilities.	Phase I	188	7,31	2,30	194,18	**0.000**
	Phase II	358	9,40	1,21		

p-value less than 0.05 (indicates significant difference) is reported in bold font.

Table 5
Significant results for Kruskall-Wallis H-test comparing specialisation in phase I (2015–16, 2016–17 and 2017-18 academic years).

Item	Specialisation[a]	N	Average ranks	H	p-value
1. There are more frequent in-class interactions with professors.	PE	31	35.48	7.373	**0.025**
	TC	32	42.25		
	GE	24	53.33		
10. Professors take my strengths, my interests and my weaknesses more into account.	PE	31	34.19	7.817	**0.020**
	TC	32	49.83		
	GE	24	48.90		
Final grade	PE	31	35.16	7.427	**0.024**
	TC	32	48.19		
	GE	24	49.83		

p-value less than 0.05 (indicates significant difference) is reported in bold font.
[a] PE: Physical Education; TC: Technology; GE: Graphic Expression.

perception about the frequency of interactions with the instructor in class ($U_{PE\text{-}GE} = 224$, $p = 0.010$). No differences are found between Technology students and the other specialisations ($U_{TC\text{-}PE} = 380$, $p = 0.100$; $U_{TC\text{-}GE} = 308$, $p = 0.187$).

Regarding whether professors take their interests and weaknesses more into account in the flipped learning model (item 10), Physical Education students' perception is lower both than Technology and Graphic Expression students. Mann-Whitney U-tests confirm this tendency, as this item presents significant differences between PE and TC students ($U_{PE\text{-}TC} = 307.5$, $p = 0.007$), as well as between PE and GE ($U_{PE\text{-}GE} = 256.5$, $p = 0.043$). On the contrary, no differences may be observed regarding the Technology and Graphic Expression specialisations $U_{TC\text{-}GE} = 382$, $p = 0.972$).

This same difference between Physical Education students and the rest is observed regarding the final grade in the course. U-tests clearly show these differences both between PE students and TC students, and PE and GE ($U_{PE\text{-}TC} = 342.5$, $p = 0.018$; $U_{PE\text{-}GE} = 251.5$, $p = 0.026$), while Technology and Graphic Expression students show no difference regarding their final grade ($U_{TC\text{-}GE} = 364.5$, $p = 0.712$).

On the contrary, no differences between specialisations could be observed for phase II. Therefore, it may be stated that Technology, Graphic Expression, Mathematics and Physics & Chemistry students had a similar perception of the flipped learning model since the 2018-19 academic year.

3.4. *Differences in students' perceptions by academic achievement*

In order to explore differences in students' perceptions by their academic achievement more accurately, grades have been grouped under specific categories: A (grades 9.0 and higher in a 10-point scale), B+ (grades 8.0 to 8.9), B- (grades 7.0 to 7.9), C (grades 5.0 to 6.9) and D (grades 4.9 and lower). Note that there were no D grades in the course.

When comparing the results according to these grades, ANOVA-tests were carried out as the Levene-test permitted it ($p > 0.05$). Results show significant differences for nearly all items (see Table 6). The only exceptions are the time investment (item 11) and two specific assessment tasks, namely, the WebQuest (item 16) and the individual exercise (item 18), where no significant differences according to academic achievement were found.

Post-hoc analyses reveal that in most cases, students with the best grades (A) have a better opinion about the flipped learning model, than their classmates (see Table 6). Interestingly, looking at the means of the grades, they do not show a gradual increase. Instead, students with good grades (B-) are the ones who present the lowest results when asked about the flipped learning model. Students with moderate grades (C) and with very good grades (B+) have an intermediate position, although the differences between C and B- are seldom significant.

4. Discussion

We have analysed data collected from secondary education future teachers, on their perceptions of flipped learning and teaching performance, along eight academic years organised in two phases. The study was embedded in the "Learning and Personality Development [Aprendizaje y Desarrollo de la Personalidad]" master's course directed to future secondary education teachers at Universidad Politécnica de Madrid (Spain). The two phases compared a first period—when the professor started teaching with the flipped model and the students came from three specialisations (Physical Education, Technology and Graphic Expression)— and a second one—in which the professor had gained experience in flipped learning and taught in four specialisations (Technology, Graphic Expression, Mathematics and Physics & Chemistry). The majority of students in this study (84 %) did not have previous experience with the flipped learning model, confirming that educators or people with educational experience (as many of these students may not have teaching experience as actual teachers, but as private tutors or auxiliary teachers) might be completely unaware of flipped learning as a possible active methodology, thus, preventing to reach more students. Our study shows a positive increase in future teachers' perceptions over time about flipped learning. However, we have not compared this flipped model with a traditional format, as previous research has already reported [41], and instead we focus on factors that may influence flipped learning in teacher training to be positively accepted. Our hope is that future educators are exposed to this method and thus can be motivated in the future to flip their classrooms. Consistent with this, for an effective flipped learning Oudbier [37] recommends paying attention to flipped classroom

Table 6
ANOVA-test comparing students' perception by academic achievement.

Item	Grade	N	$\overline{X}$	SD	F	p-value	Post-hoc analyses results
1. There are more frequent in-class interactions with professors.	C	9	4,11	0,928	4.236	**0.006**	B- < (B+ = C= A)
	B-	62	3,63	1044			
	B+	181	4,01	0,957			
	A	56	4,25	0,939			
2. The in-class interactions with professors helped my learning.	C	9	3,89	1167	3.672	**0.013**	A > (B+ = C]B-)
	B-	62	3,87	0,983			
	B+	181	4,05	0,950			
	A	56	4,43	0,892			
3. There are more frequent in-class interactions with classmates.	C	9	3,78	1202	2.745	**0.043**	A > (B+ = C]B-)
	B-	62	3,68	1052			
	B+	181	3,98	1090			
	A	56	4,23	1009			
4. The in-class interactions with classmates helped my learning.	C	9	4,00	1323	7.643	**0.000**	A > (C]B+ = B-)
	B-	62	3,52	1052			
	B+	181	3,85	1120			
	A	56	4,45	0,893			
5. I have better access to learning materials and contents.	C	9	3,89	1054	3.308	**0.021**	(B-= C) < (B+ = A)
	B-	62	3,47	1127			
	B+	181	3,93	1060			
	A	56	4,00	1062			
6. I have the possibility to choose the type of materials that better fit my learning.	C	9	3,56	0,726	4.778	**0.003**	B- < (B+= C= A)
	B-	62	2,85	1226			
	B+	181	3,37	1136			
	A	56	3,63	1259			
7. I can work at my own pace.	C	9	3,44	1333	3.004	**0.031**	(C]B-) < (B+ = A)
	B-	62	3,66	1305			
	B+	181	4,06	1124			
	A	56	4,20	1182			
8. I have more opportunities to show what I have learned to professors or classmates.	C	9	3,22	1202	5.290	**0.001**	(B- = C) < (B+ = A)
	B-	62	3,02	1138			
	B+	181	3,55	1181			
	A	56	3,84	1203			
9. Learning is more active and experiential.	C	9	4,00	1323	3.639	**0.013**	B- < (B+= C= A)
	B-	62	3,42	1287			
	B+	181	3,82	1136			
	A	56	4,13	1207			
10. Professors take my strengths, my interests and my weaknesses more into account.	C	9	3,11	1167	4.277	**0.006**	A > (B+ = C]B-)
	B-	62	2,69	1095			
	B+	181	3,12	1170			
	A	56	3,45	1143			
11. Time investment has been greater than in a traditional model.	C	9	2,89	1453	1.653	0.177	–
	B-	62	2,98	1324			
	B+	181	3,36	1224			
	A	56	3,30	1264			
12. This model got me more involved in the course.	C	9	3,33	1414	4.505	**0.004**	(B- = C) < (B+ = A)
	B-	62	3,18	1167			
	B+	181	3,71	1109			
	A	56	3,88	1222			
13. I have improved my learning process.	C	9	3,22	1093	4.506	**0.004**	(C]B-) < (B+ = A)
	B-	62	3,44	1034			
	B+	181	3,82	1001			
	A	56	4,04	1061			
14. I have learned more.	C	9	3,44	1130	4.639	**0.003**	(B- = C) < (B+ = A)
	B-	62	3,31	1182			
	B+	181	3,75	0,999			
	A	56	3,98	1000			
15. The assessment activities have helped me in my learning. Specifically: Videos.	C	9	3,78	1202	4.304	**0.005**	(B- = C) < (B+ = A)
	B-	62	3,68	1198			
	B+	181	4,17	0,954			
	A	56	4,25	1100			
16. The assessment activities have helped me in my learning. Specifically: Webquest.	C	6	3,17	1169	1.057	0.368	–
	B-	57	3,23	1180			
	B+	148	3,45	1102			
	A	37	3,62	1187			
17. The assessment activities have helped me in my learning. Specifically: Poster.	C	9	2,67	1323	3.683	**0.012**	(C]B-) < (B+ = A)
	B-	62	3,06	1199			
	B+	181	3,43	1106			

(*continued on next page*)

Table 6 (*continued*)

Item	Grade	N	$\overline{X}$	SD	F	p-value	Post-hoc analyses results
	A	56	3,63	1169			
18. The assessment activities have helped me in my learning. Specifically: Individual exercise.	C	6	2,83	1602	2.415	0.067	–
	B-	57	3,46	1019			
	B+	148	3,72	0,953			
	A	37	3,76	1090			
19. I am satisfied with my grades.	C	9	3,33	0,866	27.929	**0.000**	(C]B-) < (B+ = A)
	B-	62	3,44	0,985			
	B+	181	4,15	0,833			
	A	56	4,79	0,680			
20. I liked this model more than the "traditional" one.	C	9	4,11	0,782	2.002	0.114	–
	B-	62	3,63	1134			
	B+	181	3,91	1112			
	A	56	4,11	1107			

p-value less than 0.05 (indicates significant difference) is reported in bold font.
Note: non-parametric Kruskall-Wallis test used.

in teacher training, which we support.

Based on student perceptions, our results indicated that to enhance flipped learning teaching experience is required. In our study, the more experienced the instructor, the more positive perception the students showed on both flipped learning (the methodology) and the performance of the professor. This finding relates to flipped learning experts who emphasize the relevant role instructors play in these kind of active methodologies (see, for example [42] or [43]) In addition, students who performed better (measured by their grades) have a higher perception of flipped learning. Surprisingly, the lowest-performing group of students (C) also perceive flipped learning rather positively, generally together with B+ students, while B- students present the lowest means for 15 out of 20 items. This might signify that those students motivated toward the flipped methodology ended up with higher learning outcomes, but what factors might have come into play to achieve such motivation is unknown. For instance, knowing the students' learning style (a relevant element for the perception of flipped learning, as pointed out by Fornons [8] could have helped us to identify patterns on how students' learning style affects motivation and, thus, grades. Self-regulated learning strategies might also help some students to achieve better grades, as self-directed learners are able to self-regulate their motivation [21,44]. Also, in this study students had received their grades before having completed the survey about their perception of flipped learning; and this could have led to students with a higher mark in the subject being biased towards the learning methodology. Our results presented no differences due to gender, in accordance with those of Chen et al. [24] and Mengual et al. [25], but differently to other studies, such as Chiquito et al. [22] or Gross et al. [23].

What we refer to as "teaching experience" is closely linked to the main factors identified by Oudbier et al. [37] impacting effectiveness of flipped learning in higher education students. In particular, factors outlined by the authors in their state-of-the-art review on flipped learning include "student characteristics", "teacher characteristics", "implementation", "task characteristics", "out-of-class activities", and "in-class activities".

Concerning the factor "student characteristics", we have studied "the learner's level of self-regulated learning" and "learning attitude" sub-factors via five items in our surveys. Specifically, about the mediating factor "the learner's level of self-regulated learning", our study found that future teachers valued having better access to learning materials and contents (item 5), having the possibility to choose the type of materials that better fit their learning (item 6) and working at their own pace (item 7) (see Table 2). In addition, students in phase II had an even better perception of these items (see Table 3), which is consistent with improvements made by the course's instructor. However, this mediating factor presents differences for different students' profiles, specifically regarding performance. In this study, A and B+ students value self-regulating opportunities more than C and B- students (item 5 and 7). This result can be explained, as De la Fuente et al. [21] claim, by high learner's level of self-regulated learning being linked to high-performing students and to better perceptions of autonomous instructional methods. In what concerns the "learning attitude" sub-factor, future teachers moderately agreed that this model got them more involved in the course (item 12) and highly agreed about liking this model more than the traditional one (item 20). Significant differences have been found in both items when comparing phase I and phase II students. Also in item 12, significant differences have been found regarding performance. High-performing students feel more involved with this model than lower-performing students. As Oudbider et al. [37] already noted, not all students prefer flipped learning, and our results show that students scoring B+ and B- liked the flipped model less (when compared with the traditional one) than the rest of students (A and C), even though significant differences could not be found (item 20, Table 6). Also related to learning attitudes are the items on activities future teachers consider related to what they should learn in the course (Q1) and the relationship between assessment methods and activities (Q6). Both items resulted in phase II students being more satisfied with significant differences (Table 4 and Fig. 2), which could be mainly due to the confidence with flipped learning developed by the course's instructor.

Another factor that aligns with "teaching experience" is "teacher characteristics''. In our study, the instructor has been characterized by giving guidance, for example, solving students' doubts while they work on their tasks (Q11), encouraging students' participation during class (Q14), raising students' interest in this course (Q15) and boosting students' learning (Q16). In the four cases significant differences resulted when comparing phase I and phase II students, with more positive perceptions in phase II students. With the accumulated experience, it seems that this course's instructor managed to perform more as a "coach, facilitator or mentor that supports student's learning process" [37] than as a lecturer, as is particularly evident in the last three academic courses (22–23, 21–22 and 20–21) in phase II (Fig. 2).

An additional factor which can be mastered through "teaching experience" on flipped learning, "implementation", requires time and resources (invested by students and teachers), plus the use of technology [37]. In our flipped classroom model, students moderately agreed that time invested had been greater than in a traditional model (item 11), without significant differences between phase I and phase II students nor between different performance profiles. This might mean that regardless of the experience of the teacher with flipped learning, students need to invest more time in flipped than with traditional models. A study by Hung already identified this extra effort that students invest in a flipped classroom [6]. In our view, flipped learning requires more students' effort throughout the whole learning process instead of effort concentrated just before the final test., A good implementation by the course's instructor also implies using activities that relate to what students should learn (Q1) and the professor preparing, organising and structuring the activities or tasks to be carried out in class (Q9). Significant differences were found in our study in both items when comparing phase I and phase II students' perceptions (Fig. 2 and Table 4).

Finally, three factors on tasks and activities conform the picture of an effective flipped learning [37]: "task characteristics", "out-of-class activities" and "in-class activities", all of them under the influence of "teaching experience". "Task characteristics" for flipped learning should put a variety of competences to work. In our flipped classroom model, students considered that they had improved their base level of competences of the course (Q7), with significant differences in students' perception between phases I and II (Table 4) and remarkable differences, improving year by year, when analysing the individual cohorts (Fig. 2). The assessment tasks of the analysed flipped course have been modified over the years, which could have contributed to enhancing future teachers' perception on flipped learning. One of the functions of tasks is to put into play the metacognition, and in our study, students agree ($\bar{x}$ = 3.79) that they have improved their learning process (item 13) with flipped learning and that they have learned more ($\bar{x}$ = 3.72, item 14). This supports previous observations [11,30] stating that flipped learning generally contributes to higher learning outcomes. Satisfaction with the grades has also increased from phase I to II (item 19) and it also enhances from lower to higher-performing students. Flipped learning was valued by future teachers as more active and experiential than traditional learning (item 9). Phase II students showed significantly increased higher scores. This students' acknowledgment of the interactivity of the flipped setting confirms the own active nature of the flipped learning model. This finding aligns with the study by Roach that resulted in 94 % of students agreeing with the fact that the flipped class was more interactive than other courses they had taken [45].

In what concerns "out-of-class activities", our students highly agree on pointing to videos as the assessment activities that have helped them more in their learning ($\bar{x}$ = 4.07), compared to individual exercise ($\bar{x}$ = 3.65), webquest ($\bar{x}$ = 3.42) and poster ($\bar{x}$ = 3.37). This is related to the professors' effort and expertise in creating over the years high quality-video lessons that address the course's most relevant contents, showing the importance of carefully designing and implementing active methodologies. Yoshida's sample of students also highlighted the usefulness of the flipped approach because they could watch videos again and again, at their pace and on their own time [18]. As Sletten stated [44], video lectures have a relevant role in flipped learning, but students need self-regulated learning behaviour to effectively learn from them. As Bordes et al. [46] pointed out, video creation is a daunting task by educators. However, time and effort invested by the instructor in this course compensates with the more positive feedback received by students. Besides, students agreed on the better access to learning materials and contents ($\bar{x}$ = 3.86, item 5). Significant differences were also found between phase I and II students (Table 3).

Regarding "in-class activities", the increased in-class interactions that the flipped model allows were acknowledged and positively perceived by the future teachers. On the one hand, students confirmed our expected increased student-professor (item 1) and student-student (item 3) frequency of interactions. On the other hand, they highly agreed ($\bar{x}$ = 4.08) that such interactions with professors had helped their learning (item 2) and moderately agreed that interactions with classmates had helped their learning (item 4, $\bar{x}$ = 3.89). This is congruent with other studies that highlight the increased in-class interactions in a flipped learning setting [45]. Significant differences between phases have also been found (Table 3), with higher positive perceptions on the interactions in phase II. In our flipped course, the usefulness of face-to-face classes is enhanced by the improvements implemented for the in-class activities, contributing this way to the success of the flipped learning model. Previous authors have found similar perceptions, and an example is a study by Fornons et al. [8] in which students perceived their interactions (both with the teacher and classmates) to be more frequent and positive. Interestingly, such increased interactions might affect students in different ways (e.g., stress and anxiety) regarding their personality or other circumstances. For example, this study shows that students' specialisation influences their perception of such interactions. Specifically, Physical Education students (present in phase I) valued lower than Technology and Graphic Expression students flipped learning as promoting more frequent in-class interactions with professors. But no differences were found between Technology, Graphic Expression, Mathematics and Physics & Chemistry students in phase II. Hence active learning should be carefully planned to minimise potential issues.

In summary and answering our research question, we found academic achievement and teaching performance to be relevant factors that affect students' perception of the flipped classroom. On the contrary, we did not find influence of gender on the perception of this active methodology. In the case of studies' itinerary, the results were not clear; some items showed differences in favour of STEM specialisations when compared to Physical Education, but in overall, students' perception of the flipped classroom were similar among specialisations. Educators' experience, involvement, expertise and their focus on students are issues that need to be considered and enhanced in order to facilitate an optimal implementation of a flipped learning model. We consider teaching performance especially relevant as it may be addressed more directly with teacher training.

Our findings are subject to some study limitations. Potential biases in the research might derive from the fact that one of the researchers is the educator teaching the analysed course [11]. The incorporation of additional co-authors who had no teaching responsibility in the course and the use of statistical analyses may have contributed to reduce these possible biases [11]. Another limitation is the use of students' perceptions (collected through a survey) instead of direct measures of learning [47]. Finally, apart from the improvement of the quality of videos, other factors such as the possible changes in the charisma of the instructor have not been considered within this study, which might affect the engagement of students [46].

5. Conclusions

Active methodologies require time to be successful and positively impact students' learning process. In this sense, we can conclude that the instructor's experience is a key factor that influences students' perception, both, about the flipped learning and the teaching performance and, consequently, the success of this active methodology.

Based on student perceptions, we have argued that teaching experience is key to enhance flipped learning. Teaching experience has been discussed considering "student characteristics", "teacher characteristics", "implementation", "task characteristics", "out-of-class activities", and "in-class activities". We have found no differences due to gender.

This study contributes to the research about flipped learning in an interesting group, namely, future secondary education teachers, who could be able to replicate this active methodology as future teachers. Our study shows a positive increase over time in their perceptions about flipped learning and also about the performance of the professor teaching the course. Hence, the more experienced the instructor, students showed a more positive perception on both the methodology and her performance. Additionally, students with better academic performance (measured by their grades) also show a better opinion about the flipped learning model. Consequently, new and improved teacher training programs should involve experienced instructors in active methodologies to positively impact the way future educators perceive and later bring the methodology to their classrooms, contributing to a more innovative, but effective, educational system. The factors discussed in this paper can also be useful beyond teacher training and academic research, as individual educators in any field can benefit from considering these factors when designing their flipped classrooms to enhance its effectiveness.

In future research, it would be useful to incorporate more questions to deepen the knowledge in other possible factors affecting students' perceptions, to register more students' characteristics that may be interesting to incorporate when designing flipped learning (for instance, to address the needs of diversity or to include students' learning style [8]). It could also be completed with educators' perceptions regarding flipped learning and self-assessment of their teaching skills [48]. Furthermore, an interesting research line would be to explore how many active teachers—exposed to flipped learning as students—have actually implemented flipped learning models in their classrooms. Educators must first be aware of active methodologies, then implement them to successfully engage their students and thus help to foster quality education. In addition, what self-regulated learning strategies future teachers apply in flipped learning and whether such strategies affect the student's academic achievement might be worth exploring in future studies.

6. Data availability statement

Data associated to this study have been stored in an open source web application and can be accessed through the following link: https://osf.io/p8xtf/.

CRediT authorship contribution statement

Iciar Pablo-Lerchundi: Writing – review & editing, Writing – original draft, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **Cristina Núñez-del-Río:** Writing – review & editing, Writing – original draft, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **Ana Jiménez-Rivero:** Writing – review & editing, Methodology, Conceptualization. **Susana Sastre-Merino:** Writing – review & editing, Methodology, Formal analysis, Conceptualization. **Alexandra Míguez-Souto:** Writing – review & editing, Methodology, Conceptualization. **José Luis Martín-Núñez:** Writing – review & editing, Supervision, Project administration, Methodology, Conceptualization.

Declaration of competing interest

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