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Effectiveness of the flipped classroom model on students' self-reported motivation and learning during the COVID-19 pandemic

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This study investigates the effects of the flipped classroom on Education students' perceptions of their learning and motivation during the current pandemic. The sample consisted of 179 student teachers from the Faculty of Education of the University of Murcia in the academic year 2020–2021, in which the flipped classroom model was implemented. Identical surveys were administered and examined through both descriptive statistics and non-parametric tests. Statistically significant differences were found between pre-tests and post-tests with experienced students scoring higher on average in the latter. Most students had a positive perception about the flipped classroom, noting the advantage of practical in-class activities, as well as increased self-autonomy in learning.

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Introduction

The increasing development of digital technologies and their application in education facilitates new learning ecologies that offer students new web-based learning opportunities and resources. This rapid spread of interactive technologies has facilitated the adoption of innovative approaches in higher education that help to promote collaborative learning, exploration, and research in online networked learning environments. It is in this context that alternative approaches to teacher-centered instruction have arisen and made a breakthrough in tertiary education.

In this line, the development of innovative student-centered approaches has encouraged teachers to rethink educational processes to shift the focus from them to the students, facilitate student participation, develop practical thinking, and improve digital skills (Wright, 2011).

Technology-driven models, such as the flipped classroom (FC), which provides students with direct access to video lectures, slides, and other teaching resources on online educational platforms, have gradually gained visibility and relevance (Bergmann and Sams, 2012). This discussion-oriented approach has accelerated well-structured independent learning, allowing teachers to provide feedback and assistance through innovative resources and learning management systems (LMS) in parallel with the implementation of collaborative problem-solving activities and group discussions in face-to-face lessons (López et al., 2016).

This is even more true at the present time due to the extreme circumstances. Undoubtedly, these technology-based approaches have become a greater priority during the COVID-19 pandemic as a consequence of the great disruption the virus is causing. In particular, the increasing restrictions recommended by the World Health Organization and other international institutions on disease control and prevention are profoundly affecting the ways in which we interact with each other, and the methods by which teachers teach and students learn and work (World Health Organization, 2020). Obviously, this completely changes the educational landscape, which includes not only teaching modes but also individual and collective practices on how to proceed (Dhawan, 2020; Fatani, 2020). This is particularly relevant for tertiary institutions such as universities or colleges, where a wide variety of classroom components, namely lectures, tutorials, or workshops, are being adapted to the global pandemic (Naw, 2020). In planning for the 2020-21 academic year, it was critical to consider certain constraints due to the evolution of the pandemic that has involved measures such as limiting classroom capacity and reducing face-to-face interactions. The restrictions introduced have even led to the suspension of classes and workshops in certain faculties or for specific groups of university students at some point during 2020 and 2021.

Regardless of the challenges, it is imperative that university programs continue to provide effective educational services (Tang et al., 2020). For this reason, a wide variety of mechanisms have been put in place to ensure that teaching is carried out on a regular basis. Academics in all areas of study have re-examined their teaching resources and found new options for engaging students in light of the current crisis. In these unfavorable conditions, innovative approaches based on distance conferencing technology and online tools play an important role at this time of great tension (Villa et al., 2020).

Several recent research papers have examined the intrinsic and extrinsic results of these teaching innovations, finding that these approaches can foster learning either in fully online or blended academic environments, even when it is mandatory to shift from one mode to another because of the present pandemic circumstances. Chick et al. (2020) offer several solutions to mitigate the risk of virus spread, including the FC model, teleconferencing, and online practice, with positive outcomes, as participants were satisfied with the format and were interested in continuing to learn without regularly attending face-to-face lectures. Comparative research was conducted by Latorre-Cosculluela et al. (2021), who concluded that participants were inclined to take a more active role in their own learning process by developing 21st-century skills (e.g., critical thinking or creativity) under the FC model rather than passively listening to direct instruction. In this regard, other studies highlighted the relevance of videos, recorded lectures, and group discussions, among other digital resources, to foster discussions, stimulate student learning and divert attention away from the current disruption caused by the pandemic (Agarwal and Kaushik, 2020; Guraya, 2020). As can be noted from the above-mentioned studies, the importance of increasing satisfaction and engagement during the unusual situation of COVID-19 is fundamental for educators to adopt strategic decisions to develop a culture of engagement among students. In this sense, Collado-Valero et al. (2021) identified a significant increase in the use of different online digital resources under the FC approach in a Spanish higher education context, mainly those related to video and audio resources, which provided a greater number of opportunities for students to share their learning experiences through a virtual space. Other research studies also confirm the distinctive rise of flipped learning, whereby students access information and have more opportunities to interact with each other, due to the wide range of possibilities for sharing opinions and ideas offered by these virtual scenarios. In particular, Colomo-Magaña et al. (2020) surveyed 123 trainee teachers who had been learning under the flipped-top classroom model during the 19/20 academic year. They concluded that the application of this flexible methodology promoted the development of oral skills and the improvement of learning abilities. They also highlighted time optimization as one of the benefits indicated by the participants in the survey. With the same purpose of contributing to the promotion of student learning achievement and engagement despite pandemic constraints, Smith and Boscak (2021) examined standard flipped classroom pedagogy, in which students were provided with self-learning educational resources, e.g., pre-class videos or case studies, together with interactive online lectures in which learning topics were revisited and discussed. They noted both the students' satisfaction with the approach invested by the flexible and engaging material used and their subsequent confidence in the skills developed during the course. In parallel, Monzonís et al. (2020) examined the perceptions of pedagogy students who followed a flipped methodology during the COVID-19 crisis and found that most of them had improved their digital skills and increased their motivation thanks to this methodology. Despite these clear benefits for skills development and active participation of students, there are still some challenges that need to be addressed in more detail and that may be mainly related to teachers, students, or technological requirements. Authors such as Agung et al. (2020) highlighted some technology-based problems when they found that most students surveyed were not enthusiastic about online learning mainly due to lack of access to the internet and other technological resources, which may be revealing the problem of the digital divide. The abrupt shift towards e-learning since spring 2020 has had other tangible web-based limits, which have been indicated by similar studies, namely over-reliance on the proper functioning of technology or lack of personal contact in video conferences due to the marked contrast caused by the teaching-learning environment switch (Goksu and Duran, 2020, Clark-Wilson et al., 2020). The challenges related to teachers may be related to their difficulties in dealing with emerging technology in such a short space of time. In this regard, ElSaheli-Elhage (2021) noted

that some educators admitted that they are not digitally literate enough to cope with regular online teaching activities during the pandemic. In this respect, Cevikbas and Kaiser (2020) pointed out another drawback related to digital teaching, which is closely linked to the subject-specific content needed for effective flipped teaching. They highlighted the problems for teachers in identifying adapted learning materials that successfully meet the specific needs of their students or in creating their own lecture videos, slides, infographics, and other learning resources via online platforms. Regarding student-related challenges during the current crisis, some authors have identified students' depressive symptoms and that signs of anxiety soar in online learning programs due to the perception of lagging behind academically under these unusual conditions (Islam et al., 2020). The influence of physical distance or the increase in response time when answering queries and providing academic assistance in asynchronous lessons may be other factors that cause these feelings of psychological unease (Ardan et al., 2020).

Therefore, further research and reflection are needed on the application of these innovative models and strategies in these new learning scenarios to improve understanding and adjust these web-based approaches according to the increasing and progressive demands and needs of the learners.

Objectives

The aim of this research is to analyze the effect that the FC model had on the students' perceptions of their learning process and progress and their levels of motivation. To achieve this aim, the following research objectives were defined:

RO1: To examine students' views on the effects that the FC model had on their motivation levels at the beginning and end of the core unit during the pandemic period, and in particular:

- To analyze their opinions on the impact this model had, as well as the variety of techniques and strategies used on their level of motivation according to the gender of the participants.
- To examine their impressions of the effects of this model, as well as the variety of techniques and strategies used on their level of motivation according to their experience under this approach.
- To analyze their impressions of the effects this model had, as well as the variety of techniques and strategies used on their level of motivation according to their level of digital competence under this approach.

RO2: To analyze their impressions of the learning achieved under a flipped methodology at the beginning and end of the core unit during the COVID-19 pandemic, and in particular:

- To examine their impressions of the learning developed, as well as the variety of techniques and strategies used in the core unit according to the gender of the participants.
- To analyze their impressions of the learning developed, as well as the variety of techniques and strategies used in the core unit according to their experience under this approach.
- To analyze their perspectives on the learning developed, as well as the variety of techniques and strategies used in the core unit according to their level of digital competence under this approach.

Methods

A quasi-experimental design was adopted through pre-test and post-test questionnaires, which were prepared ad hoc to measure the extent to which the objectives set out in this research had been achieved.

A quantitative methodology was applied to examine university students' perceptions of their learning process within this flipped model. Following the design of the pre-test and post-test, identical assessment measures were provided to participants before and after they had learned with this blended learning approach, to analyze comparative data, focusing on significant differences in learning perceptions at the end of the term.

Participants. The flipped experience was implemented in four groups in the core unit of Didactics of Social Sciences, which is compulsory for all second-year students of the Primary Education degree of the University of Murcia, Spain. In the study, the sample comprised 179 student teachers whose ages ranged from 19 to 39 years ($M = 20.02$ and $SD = 3.32$). Most of the participants were women, (43 men (24.02%) and 136 women (75.98%), and only one of them had repeated the year (0.56%). Informed consent was obtained from all participants to conduct this study.

The main objective of the core unit was for students to acquire relevant knowledge and mastery of the skills required to be effective social science teachers, with emphasis on cultivating meaningful learning and using accessible resources to encourage reflection on their own learning process.

Correspondingly, students had to plan, carry out and evaluate innovative proposals for the teaching of social science contents together with a rationale for the approach selected and a detailed description of how to assess this content in Primary Education.

The strategies used in the flipped approach were based on the learning management system as an effective technology that can support learning and make it trackable and motivating.

The core unit was taught for four months in the first term of the 2020/2021 academic year (September-December) using a blended teaching model that combined classroom experiences and online course delivery in both synchronous and asynchronous classes sessions.

Synchronous class sessions were held on Fridays using the Zoom video conferencing platform, in which students were asked to watch videos, visit educational sites or search for information on current social science issues. Each week, students were provided with a Zoom link that they could use by logging in beforehand with their university credentials, thus ensuring the most secure access to online learning. The instantaneous sharing capability of this type of video conferencing allowed educators to work on course content through real-time presentations or to record and store them on the e-learning campus, so making them available to students throughout the term.

Asynchronous learning was promoted using innovative and interactive learning materials such as prerecorded video lectures or multimedia activities. The contents were regularly uploaded after finishing the preceding teaching units. Despite the flexibility of time frames, students had weekly deadlines to access the previously uploaded content and they had to log into their accounts on the learning platform and check what they were regularly assigned via hyperlinks.

In-class sessions were held on Wednesdays and encompassed a wide variety of practical tasks aimed at promoting numerous and various interactions in which students cooperated together and accomplished shared goals to demonstrate competence in simulated skills practice. Groups were divided into three subgroups to avoid risks and maximize students' learning.

Subsequently, groups of university students were monitored until they finished the term, and information on their perceptions of the flipped experience was collected before and after applying

this methodological proposal to gauge the impact of this program at the end of the period.

Data collection tools. Participants' views on the adoption of this flipped approach were collected through an ad hoc questionnaire, the main purpose of which is to report on the implementation of a flipped approach by collecting data at two points in time from a sample of university students. Several advantages have been identified in the use of this technique in terms of reliability, objectivity, and representativeness (Cohen et al., 2017). Questionnaires are particularly valuable for data collection, as their quantifying nature and easy administration allow researchers to collect information from a large number of people. They are also considered quite reliable, as researchers do not need to be present when respondents fill it out, which means that if administered by different researchers, they should provide similar results. However, some limitations have been observed due to their impersonal nature, given the researcher's detachment, or differences in interpretation that may distort respondents' answers and undermine the validity of the information provided (Beiske, 2002; Waidi, 2016). The questionnaire was composed of thirty-six items divided into four main sections: self-perceived motivation, self-perceived acquisition of digital competencies, the effectiveness of this approach on students' learning processes, and reported views on students' learning of democratic education. The items were rated on a Likert scale of one to five points, where one is "very poor" and five is "excellent", to value the degree of respondents' agreement with the statements presented.

Procedure and data analysis. The data collected during the research were analyzed in Statistical Package for Social Sciences (SPSS) v.26.0. The degree of reliability and validity of the instrument was estimated prior to data analysis. The construct reliability was determined using Cronbach's Alpha to estimate whether the instrument consisting of a multiple-question Likert scale was reliable. A Cronbach's Alpha value equal to or higher than .70, which shows good internal consistency, is generally accepted in most social science research studies (González Alonso and Pazmiño Santacruz, 2015; Quansah, 2017). Regarding the questionnaire, positive results were obtained both overall ($\alpha = 0.89$) and in each of the sections: motivation, $\alpha = 0.86$; learning processes, $\alpha = 0.83$. The validity of the instrument was also tested using Bartlett's test of sphericity and a Principal Component Analysis (PCA) for each section of the questionnaire. In all the sections a significance level of 0.000 in Bartlett's test of sphericity was achieved. After running the PCA, we obtained distribution in the first block of 2 dimensions, explaining 58,47% of the total variance, with a KMO of 0.906. In the second block, we obtained 2 dimensions, explaining 53.24%, with a KMO of 0.861.

Results

As for the first objective, Table 1 shows descriptive statistics, consisting of two categories of measures: measures of central tendency (mean) and measures of variability (standard deviation).

In general, male students' extrinsic motivation is higher than intrinsic motivation, while female students scored similarly on both types of self-perceived motivation. When contrasting the results between the pre-tests and post-tests, it is observed that male students scored higher in the post-tests with respect to their intrinsic self-perceived motivation, while female students scored lower in the post-tests for both types of self-perceived motivation. No significant differences were identified between pretests and posttests in this section.

As we can see in Table 2, participants with previous experience with the FC model indicated higher self-perceived motivation than those with no experience. Also, student teachers with a high level of digital competence were more motivated to excel in class than those with a lower competence level. However, students with a lower level of digital competence showed more self-perceived intrinsic motivation to improve their future teaching practice than the other subgroups. Non-parametric tests were conducted to examine whether participants' perceptions of their self-perceived motivation in relation to Flipped-Classroom-based learning differed statistically. Wilcoxon tests showed no significant differences between pre-tests and post-tests. However, Mann–Whitney U tests revealed significant differences between participants with prior experience in this approach and those without, with the former feeling more motivated than the latter to learn new active methodologies, link them to their future teaching practice, improve their autonomy or interact socially more effectively.

As shown in Table 3, female students were more motivated by the resources and strategies implemented in the core unit compared to male students. Mann–Whitney U tests revealed significant differences between males and females in relation to small group activities, with female students rating this item significantly higher than the other subgroup.

Most of the items have a median between 3 and 4, which means that with these scores the participants indicated sufficient self-perceived motivation for this approach. The group with the lowest e-competence is the only group that gives a similar or higher score on all items in the post-test compared to the scores of the pre-test and the other groups (Table 4).

Regarding the second objective, the results in Table 5 show descriptive statistics, consisting of two categories of measures: measures of central tendency (mean) and measures of variability (standard deviation), as well as non-parametric results according to the gender of the participants.

With respect to the second objective, results indicate positive perceptions of their learning processes both before and after the implementation of this approach. However, male students scored lower in pre-tests but higher in posttests, particularly, with respect to learning interactions and self-evaluation. No significant differences were found between males and females in this objective.

As we can see in Table 6, participants with no prior experience assigned a lower score to the items related to planning, managing, and assessing processes. In fact, non-parametric tests revealed significant differences in these items between respondents with and without experience with this approach. No significant differences were found between subgroups with different levels of e-competence.

The table below indicates men's and women's perceptions of the learning strategies and resources used (Table 7).

The results indicate that both men's and women's views on their learning are lower in the post-tests, although male students rated the quizzes, points, prizes, and the student portal more positively after the core unit. No significant differences were identified between the two subgroups.

In terms of their participation and involvement in the strategies presented to support their learning in the core unit, respondents rated practical classroom activities, small group work, quizzes, and rewards higher than the other options, with medians around 4 or higher. Significant differences were identified between the subgroups with and without prior experience, with the former rating videos, practical activities, quizzes, and small group tasks significantly higher than the latter. Similar differences were found between subgroups with different levels of e-proficiency, with students with higher e-proficiency scoring higher on the small group activities and computer tools.

Table 1 Descriptive statistics for the variables referring to self-perceived motivation in this approach during the COVID-19 pandemic according to the gender of the participants.

	Male ($n = 51$)		Female ($n = 128$)		Mann–Whitney U	Z	p
	Pre-test M (SD)	Post-test M (SD)	Pre-test M (SD)	Post-test M (SD)			
Causes of self-perceived intrinsic motivation							
To excel in class	3.07 (1.09)	3.21 (0.91)	3.44 (1.01)	3.33 (1.09)	2406.00	−1.02	0.305
To learn new active methodologies	3.33 (1.03)	3.65 (0.89)	3.73 (1.00)	3.61 (0.96)	2589.50	−0.345	0.730
To improve my future teaching practice.	3.56 (1.02)	3.74 (1.11)	3.86 (1.02)	3.67 (1.05)	2486.50	−0.729	0.466
To improve my autonomy	3.41 (1.13)	3.34 (1.06)	3.46 (1.04)	3.36 (1.10)	2675.50	−0.017	0.987
To interact socially more effectively	3.19 (1.07)	3.37 (1.15)	3.33 (1.15)	3.22 (1.19)	2640.00	−0.149	0.881
To excel in online lessons	3.01 (1.14)	3.09 (1.12)	3.59 (0.99)	3.45 (1.06)	2527.50	−0.565	0.572
Overall/Total intrinsic motivation	3.26 (1.08)	3.4 (1.04)	3.56 (1.03)	3.44 (1.07)			
Causes of self-perceived extrinsic motivation							
To earn points and prizes	3.68 (1.08)	3.62 (1.01)	3.77 (0.96)	3.76 (0.92)	2577.00	−0.389	0.697
To get good grades	3.35 (1.01)	3.30 (1.08)	3.35 (0.92)	3.25 (1.12)	2548.00	−0.494	0.621
Overall/Total extrinsic motivation	3.51 (1.04)	3.46 (1.04)	3.56 (0.94)	3.50 (1.02)			

Table 2 Non-parametric results for the variables referring to self-perceived intrinsic and extrinsic motivation in this approach during the COVID-19 pandemic.

	Mdn E	Mdn NE	Mann–Whitney U	Z	p	Mdn H	Mdn M	Mdn L	Kruskal–Wallis H	gl	p
Causes of self-perceived intrinsic motivation											
To excel in class											
Pre	4	3	2573.0	−3.68	0.000*	4	3.5	3	9.176	2	0.010*
Post	4	3				4	3	3.5			
To learn new active methodologies											
Pre	4	4	2989.5	−2.41	0.016*	4	4	4	2.580	2	0.275
Post	4	4				4	4	4			
To improve my future teaching practice											
Pre	4	4	2997.5	−2.35	0.019*	4	4	3	10.582	2	0.005*
Post	4	4				4	4	5			
To improve my autonomy											
Pre	3	3	3179.5	−1.42	0.081	3.5	3	3	4.566	2	0.102
Post	3	3				4	3	3			
To interact socially more effectively											
Pre	4	3	3043.5	−2.18	0.029*	3	3.5	3	4.473	2	0.107
Post	4	3				4	3	4			
To excel in online classes											
Pre	4	3	2966.5	−2.42	0.015*	3	4	3	4.528	2	0.104
Post	4	3				4	3	3.5			
Causes of self-perceived extrinsic motivation											
To earn points and prizes											
Pre	4	4	3227.5	−1.62	0.104	4	4	3	1.568	2	0.457
Post	4	4				4	4	4.5			
To get good grades											
Pre	4	3	3255.5	−1.52	0.129	3	3	3	1.375	2	0.503
Post	4	3				4	3	3.5			

*$p < 0.05$.

Discussion and conclusions

This article examines student teachers' self-perceived motivation and learning under the FC model during the pandemic in the academic year 20/21. The data obtained in this study showed a positive evaluation of the approach, both in reported motivation and perception of learning.

According to the results, participants felt sufficiently motivated both intrinsically and extrinsically, throughout the core unit, to learn new active methodologies and to improve their future teaching practice. Thus, this new and unexpected situation did not especially affect their interest in the FC model, and they were willing to participate and collaborate to do better in the future. As the comparative research shows (Latorre-Cosculluela et al., 2021), respondents were more willing to actively participate in the FC model than to be passive recipients of the information.

In addition, as other studies show (Aşıksoy and Özdamlı, 2016; Wanner and Palmer, 2015), the impressions expressed by respondents on the relevance of various strategies and techniques on their self-perceived motivation were quite good, with the Kahoot! quizzes being one of the best-valued resources. In this sense, it should be noted that the effectiveness of gamification and some related ludic elements such as points, levels, or prizes can

Table 3 Descriptive statistics for the variables referring to the evaluation of the strategies used to foster students' motivation in this approach during the COVID-19 pandemic according to the gender of the participants.

Strategies used to foster motivation	Male ($n = 51$)		Female ($n = 128$)		Mann-Whitney U	Z	p
	Pre-test M (SD)	Post-test M (SD)	Pre-test M (SD)	Post-test M (SD)			
FC videos	3.33 (0.97)	3.06 (1.20)	3.48 (1.02)	3.26 (1.08)	2526.00	−0.575	0.565
Practical classroom activities	3.92 (1.07)	3.86 (1.12)	4.02 (1.00)	3.95 (1.01)	2656.00	−0.091	0.928
Kahoot! quizzes	3.88 (1.01)	3.88 (1.29)	4.07 (1.08)	4.05 (0.95)	2606.50	−0.279	0.780
Points and prizes	3.76 (1.06)	3.76 (1.34)	3.78 (1.20)	3.91 (1.13)	2594.50	−0.322	0.747
Small group activities	3.96 (0.91)	3.67 (1.10)	4.07 (1.03)	4.19 (0.88)	1916.00	−2.91	0.004*
Student portal and other IT tools	3.98 (0.92)	3.62 (1.13)	3.98 (0.97)	3.92 (0.92)	2297.50	−1.44	0.149
Total score	3.80 (0.99)	3.64 (1.19)	3.9 (1.05)	3.88 (0.99)			

*$p < 0.05$.

Table 4 Non-parametric results for the variables referring to the evaluation of the strategies used to foster students' motivation in this approach during the COVID-19 pandemic.

Causes of self-perceived intrinsic motivation	Mdn E	Mdn NE	Mann-Whitney U	Z	p	Mdn H	Mdn M	Mdn L	Kruskal-Wallis H	gl	p
FC videos											
Pre	4	3	3559.5	−0.554	0.580	4	4	2	0.622	2	0.733
Post	3	3				3	3	3			
Practical classroom activities											
Pre	4	4	3687.5	−0.151	0.880	4	4	4	2.032	2	0.362
Post	4	4				4	4	4			
Kahoot! quizzes											
Pre	4	4	3446.00	−0.928	0.353	4	4	4	5.640	2	0.060
Post	4	4				4	4	5			
Points and prizes											
Pre	4	4	3440.5	−0.939	0.348	4	4	4	1.128	2	0.544
Post	4	4				4	4	4.5			
Small group activities											
Pre	4	4	3435.0	−0.968	0.333	4	4	4	4.004	2	0.135
Post	4	4				4.5	4	4			
Student portal and other IT tools											
Pre	4	4	3492.5	−0.772	0.440	4	4	3	11.021	2	0.004*
Post	4	4				4	4	4			

*$p < 0.05$.

Table 5 Descriptive statistics for the variables referring to self-perceived learning in this approach during the COVID-19 pandemic according to the gender of the participants.

Causes of self-perceived learning	Male ($n = 51$)		Female ($n = 128$)		Mann-Whitney U	Z	p
	Pre-test M (SD)	Post-test M (SD)	Pre-test M (SD)	Post-test M (SD)			
To improve my learning planning process	3.62 (0.87)	3.55 (0.93)	3.85 (0.96)	3.56 (1.01)	2663.00	−0.64	0.949
To understand methodological shifts in SS teaching	3.68 (0.86)	3.62 (1.09)	3.85 (0.98)	3.71 (1.09)	2616.50	−0.239	0.811
To learn new active teaching methods	3.90 (0.80)	3.97 (0.98)	4.06 (0.89)	3.76 (1.07)	2252.50	−1.60	0.108
To make use of different resources	3.90 (1.01)	3.88 (0.90)	4.08 (0.87)	3.81 (0.97)	2474.00	−0.779	0.436
To increase interaction and manage knowledge and content	3.58 (0.89)	3.69 (0.81)	3.89 (0.91)	3.73 (0.99)	2623.00	−0.215	0.830
To develop self-evaluation methods	3.51 (0.78)	3.67 (0.83)	3.71 (0.96)	3.56 (1.07)	2559.50	−0.454	0.650
Total score	3.69 (0.86)	3.73 (0.92)	3.91 (0.92)	3.68 (1.03)			

Table 6 Non-parametric results for the variables referring to self-perceived learning in this approach during the COVID-19 pandemic.

Causes of self-perceived learning	Mdn E	Mdn NE	Mann-Whitney U	Z	p	Mdn H	Mdn M	Mdn L	Kruskal-Wallis H	gl	p
To improve my learning planning process											
Pre	4	4	2218.00	−4.85	0.000*	4	4	3	1.099	2	0.577
Post	4	3				4	4	3			
To understand methodological shifts in SS teaching											
Pre	4	4	2203.50	−4.84	0.000*	4	4	4	0.519	2	0.772
Post	4	3				4	4	3.5			
To learn new active teaching methods											
Pre	4	4	2440.00	−4.12	0.000*	4	4	4	1.601	2	0.449
Post	4	4				4	4	4			
To make use of different resources											
Pre	4	4	2443.50	−4.13	0.000*	4	4	4	3.034	2	0.219
Post	4	4				4	4	4			
To increase interaction and manage knowledge and content											
Pre	4	4	2286.00	−4.63	0.000*	4	4	3	1.126	2	0.569
Post	4	3				4	4	3.5			
To develop self-evaluation methods											
Pre	4	4	2398.50	−4.26	0.000*	4	4	3	2.036	2	0.361
Post	4	3				4	4	3.5			

*$p < 0.05$.

Table 7 Non-parametric results for the variables referring to the evaluation of the strategies used to foster their learning in this approach during the COVID-19 pandemic according to the gender of the participants.

Strategies used to foster flipped learning	Male ($n = 51$)		Female ($n = 128$)		Mann-Whitney U	Z	p
	Pre-test M (SD)	Post-test M (SD)	Pre-test M (SD)	Post-test M (SD)			
FC videos	3.62 (0.93)	3.46 (1.05)	3.88 (1.01)	3.43 (1.13)	2627.00	−0.197	0.844
Practical classroom activities	3.98 (0.86)	3.79 (1.01)	4.13 (0.91)	3.87 (0.97)	2610.00	−0.262	0.793
Kahoot! quizzes	3.68 (0.94)	3.79 (1.22)	3.96 (1.06)	3.92 (1.02)	2624.50	−0.209	0.834
Points and prizes	3.47 (0.98)	3.62 (1.30)	3.67 (1.21)	3.69 (1.24)	2647.50	−0.121	0.904
Small group activities	4.05 (0.91)	3.88 (1.02)	4.31 (0.91)	4.11 (0.88)	2439.50	−0.925	0.355
Student portal and other IT tools	3.86 (0.87)	4.04 (1.06)	4.07 (0.93)	3.91 (0.91)	2288.00	−1.48	0.138
Total score	3.78 (0.91)	3.76 (1.11)	4.01 (1.01)	3.82 (1.02)			

provide fun and interaction, and thus increase motivation and promote student participation. Furthermore, as Fontana (2020) and Park and Kim (2021) point out, gamification can enhance social relationships through which students can share information, learn from each other and entertain themselves through these online platforms, which are even more significant during the pandemic period associated with social distancing and the need to protect oneself and others. Notwithstanding, as suggested by Mekler et al. (2017) the underlying motivational mechanisms should be the subject of further empirical research.

Regarding student teachers' perceptions of their own learning, the data show their positive impressions, which are in line with other studies on the implementation of this approach (Foldness, 2016; Love et al., 2014). It seems obvious that participants were interested in understanding effective methodological shifts that support more flexible and active ways of learning under the current pandemic situation. According to the data, students' attitudes towards flipped education, which has shifted from prioritizing traditional lecture-based lessons to more student-centered and autonomous learning methods, were receptive to this technology-based active learning approach. Students valued most positively the use of a wider range of online resources, the development of more frequent interactions, not only teacher-student but also peer-to-peer, and new ways of managing knowledge and content. Other research studies also agreed on the appropriateness of these alternative approaches during coronavirus disease because of their great deal of flexibility, their free access to online academic resources, and their interactive learning environments, among other reasons (Chick et al., 2020; Lapitan et al., 2021). In this sense, the use of a full set of IT tools, such as a modern LMS with a user-friendly interface and effective collaboration tools, would allow for flexible resource management, which favors the search, sharing, and application of knowledge among students (Basilaia and Kvavadze, 2020; Zainuddin and Perera, 2018).

It is worth highlighting the statistically significant differences identified in the dimensions of the study, especially regarding previous experience and e-competence. In the first case, students with prior experience valued the effects of this approach in improving their future teaching practice more highly than the rest of their peers, which means that they saw this innovation as an opportunity to explore, expand their knowledge and update their potential as future teachers significantly more than those without prior experience. Therefore, these results encourage the further implementation of these actions, task-based initiatives in higher

Table 8 Non-parametric results for the variables referring to the evaluation of the strategies used to foster their learning in this approach during the COVID-19 pandemic.

Strategies used to foster flipped learning	Mdn E	Mdn NE	Mann–Whitney U	Z	p	Mdn H	Mdn M	Mdn L	Kruskal–Wallis H	gl	p
FC videos											
Pre	4	4	3061.00	−2.12	0.034*	4	4	3	0.687	2	0.709
Post	4	3				3	4	3			
Practical classroom activities											
Pre	4	4	2920.50	−2.59	0.009*	4	4	4	1.400	2	0.497
Post	4	4				4	4	4			
Kahoot! quizzes											
Pre	4	4	3104.00	−2.01	0.044*	4	4	5	2.619	2	0.270
Post	4	4				4	4	5			
Points and prizes											
Pre	4	4	3449.00	−0.899	0.369	4	4	3	1.327	2	0.515
Post	4	4				4	4	4.5			
Small group activities											
Pre	5	4	3055.00	−2.21	0.027*	5	4	4	8.871	2	0.012*
Post	4	4				4.5	4	4			
Student portal and other IT tools											
Pre	4	4	3436.50	−0.955	0.340	4	4	3	16.629	2	0.000*
Post	4	4				4	4	4			

*$p < 0.05$.

education, so that students can gain more experience of what an FC model consists of and thus improve their motivation and learn to manage cognitive knowledge more effectively (Abeysekera and Dawson, 2015).

Regarding the e-competence variable, results from non-parametric tests showed that students with a higher level of e-competence perceived active in-class tasks as more intrinsically motivating than the rest of their peers, while students with a lower e-competence found that taking an FC approach constituted a more motivating means of improving their future teaching practice. These different perceptions may give learners a more immediate sense of progress if they are sufficiently e-competent within this model or in the future once they intensify their acquisition of digital skills. In any case, the FC model has proved that it enables students to easily understand their progression in the learning and development of innovative methodological proposals (Blau and Shamir-Inbal, 2017).

However, despite the students' positive opinions, their impressions are not as optimistic as in other similar pre-pandemic studies conducted in the same context. The results in research conducted a year earlier (Gómez-Carrasco et al., 2020), in which students expressed more significant positive views on their self-perceived motivation, one point higher on average, may demonstrate that the consequences of pandemic-related restrictions are causing some unease among university students.

Furthermore, the findings of this research cannot be representative of current teaching and learning processes that drive student motivation, as the results are drawn from a single experience and it would be advisable for the analysis to be compared with actual learning outcomes and in more core units to gain a more complete understanding of the current outcomes and impacts of this model.

Therefore, there is a need for further study of these newly emerging e-learning scenarios due to the restrictions or lockdowns, as well as the complex set of interrelated factors affecting their implementation. In addition, further research is required to analyze the lower value items within this approach to customize them according to learners' specific interests and needs.

Data availability

The datasets generated during this study are not publicly available because the identities of some participants are visible, undermining privacy protection, but they are available from the corresponding author upon reasonable request.

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Competing interests

The authors declare no competing interests.

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