Flipped Classroom in the Educational System: Trend or Effective Pedagogical Model Compared to Other Methodologies?

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ABSTRACT: Flipped Classroom methodology is gaining relative importance as time goes by, in part due to the spreading and accessibility of technological resources in the educational field. Nonetheless, the effectiveness of this methodology is still being discussed. In this sense, the aim of this study is to analyse whether flipped classroom methodology is a more effective methodology than other methodologies. For this purpose, a systematic review was carried out, considering as valid studies those that had a pre-post and a control group. Based on a total of 61 studies (n = 5541 students) from 18 databases, results revealed that Flipped Classroom methodology is more effective than other methodologies in terms of learning achievement, in secondary and higher education, and it could be more beneficial than other methodologies in other constructs as motivation, self-efficacy, cooperativeness and engagement, among others. In primary education, findings revealed that Flipped Classroom could be as effective as other methodologies with regard to learning achievement, and other construct, such as self-concept and social climate. Depending on the educational stage, the effect size of differences was between 1.36 to 1.80 times larger in the case of Flipped Classroom group in comparison with control group. Based on these results, the Flipped Classroom could be more beneficial in comparison with traditional methodologies that are mainly used in higher education. However, it would not more beneficial in other educational stages where traditional approaches are not commonly used, such as in primary education.

Keywords: Flipped classroom, Primary education, Secondary education, Higher education, Effectiveness

1. Introduction

Flipped Classroom methodology is defined as a methodology in which the more practical part of the class (e.g., activities and problem solving), and traditionally done by students outside class, is moved into the classroom session; while what traditionally was done in class (e.g., presentation of information and information transmission teaching) is moved outside and prior to the class (Låg & Grøm, 2019). Flipped Classroom, correctly applied, could be considered as an active learning methodology as it is an instructional method that engages students in their learning process (Bishop & Verleger, 2013; Prince, 2004). The term Flipped Classroom is relatively new within the educational field (Berrett, 2012). However, it is not a novel teaching methodology since over the last decade analogous terms, such as inverted classroom (Lage, Platt & Treglia, 2000), just-in-time teaching (Novak, 2011) and inverted learning (Davis, 2013) have been studied in the literature to explain this approach, and which emphasize students' work before attending a class (Hung, 2015).

From previous systematic reviews it has seen how the quantity of Flipped Classroom studies was significantly higher in Higher Education than in other educational stages (Uzunboylu & Karagözlü, 2017). Furthermore, the quantity of studies based on Flipped Classroom and performed in Higher Education represent between the 52% and 79% of the total quantity of studies around Flipped Classroom, in comparison with studies carried out in Primary Education that represent around 6% to 7%, and in Secondary Education, it represents from 6% to 8% of the total quantity of studies around the Flipped Classroom (Cheng, Hwang, & Lai, 2020; Uzunboylu & Karagözlü, 2017).

From previous literature, the vast majority of Flipped Classroom interventions are done in the same way (Cheng et al., 2020). Firstly, out-of-class, students access through a learning platform or system, where all the resources are uploaded. This platform has the aim of fostering the learning process around these resources. Secondly, in-class, there are 3 main strategies used: issue discussions, practicing or performing exercises, and group projects (Cheng et al., 2020).

With regard to the matter studied, previous reviews revealed that the main aim of a great number of previous Flipped Classroom papers is to discover the effectiveness of this methodology in terms of academic performance, far from other affective constructs like motivation or satisfaction (Cheng et al., 2020; Galindo-Domínguez & Bezanilla, 2018; Galindo-Domínguez & Bezanilla, 2019).

Results are mostly in favour of Flipped Classroom methodology. In previous reviews, the vast majority of studies revealed positive or, at least, neutral direct or indirect effects, mainly on academic performance and satisfaction with the experience (Chen, Hwang & Lai, 2020; Galindo-Domínguez, 2018; Galindo-Domínguez & Bezanilla, 2019; Lag & Grøm, 2019; O'Flaherty & Phillips, 2015). However, this information has not been contrasted with other methodologies. Nevertheless, other meta-analysis has shown that, in spite of the large number of studies that revealed small positive effects when applying Flipped Classroom methodology, some also pointed out negative effect sizes for the flipped classroom condition (Chen, Ritzhaupt, & Antonenko, 2019).

Chen's et al. (2018) meta-analysis studied the impact of Flipped Classroom interventions on university students comparing their pre-post academic performance values. Their findings revealed how Flipped Classroom interventions had a statistical significant impact within university students ($n = 7$; $p < .005$), especially in those students enrolled in the health area. This conclusion was also reached by other meta-analysis such as Låg & Grøm's (2019) study, but, on the other hand, Gillete's et al. (2018) meta-analysis did not find significant differences between Flipped Classroom and traditional lecture methodology. This is the reason why some authors claim that there is a lack of evidence for the efficiency of Flipped Classroom methodology (e.g., Betihavas, Bridgman, Kornhaber, & Cross, 2016).

However, most of the previous studies which compare pre and post values with a control group, show the effectiveness of this methodology against traditional methodology in terms of different constructs in Higher Education (e.g., Kurt, 2017; Lin & Hwang, 2018; Chang, Kao & Hwang, 2020; Chyr et al., 2017), but some discrepancies appear in Secondary Education (e.g., Kumar, Chang & Chang, 2016; Wei et al., 2020; Gómez-García, Sellés, & Ferriz, 2019) and primary education (e.g., Galindo-Domínguez, 2019a; Galindo-Domínguez, 2019b; Ferriz, Sebastiá, & García, 2017; Cheung & Chen, 2020).

Although this review can make an approximation to the impact of this methodology, the results are still incomplete. Specifically, as the literature points out, there is a clear scarcity of previous evidence of meta-analyses and systematic reviews which compares the effectiveness of flipped classroom with other methodologies (Chen et al., 2019).

The justification for this study has its origin in that previous meta-analyses and systematic reviews are focused only on the impact of flipped classroom experiences, but they do not follow a specific selection of the research design of flipped classroom studies (Uzunboylu & Karagözlü, 2017; Cheng et al., 2020). Therefore, it is important, in order to go in depth, to select, analyse and compare studies of at least, pre and post phases, with a control group. This type of design could be the most beneficial one for having a closer and accurate sight of the effectiveness of the flipped classroom, in such a way that it permits to compare the effectiveness of an intervention with the passage of time and according to a specific group.

In addition, there is no previous evidence of meta-analysis or systematic reviews which compare the effectiveness of the flipped classroom depending of the educational stage. In this sense, previous meta-analyses and systematic reviews do not differentiate the educational stage of students, and in fact, this could be a critical factor to take into account when applying a Flipped Classroom intervention (e.g., Uzunboylu & Karagözlü, 2017; Cheng et al., 2020). Due to the fact that the psychosocial characteristics of students are different in each of the different stages, this differentiation may have consequences on the effectiveness of a certain methodology.

Furthermore, there is a significant gap on the constructs studied in previous meta-analyses and systematic reviews, in a way that the vast majority of them are focused on the effectiveness of the Flipped Classroom only considering students' learning achievement (Chen et al., 2018; Galindo-Domínguez, 2018; Gillete et al., 2018; Låg, & Grøm, 2019). In this sense, this study also analyses the impact of other cognitive, affective and social constructs. It is important to compare the effectiveness of educational methodologies in order to be able to provide teachers with as much information as possible, and thus, base their pedagogical practice on scientific evidence and make justified decisions. This does not necessarily mean that what they do will work, but it means that they already have prior scientific support on which to rely to try to select the best available option, and therefore, allow them to improve their pedagogical practice. It is important to take into account the integral development of the student as it is one of the objectives of the 21st century education, collected in the curricula and educational laws of several countries (for instance, Spain, France, and the United Kingdom). It is for this reason that it is necessary to study the potential of this methodology not only from its cognitive aspect, but also from emotional-affective and social aspects.

2. Methodology

2.1. Objective

The aim of this paper is to carry out a systematic review considering research that study the impact of Flipped Classroom methodology within the educational system. More specifically, this study analyses the effectiveness of Flipped Classroom interventions in comparison with control methodologies. For this purpose, this research will answer the following questions:

- Is the Flipped Classroom methodology as effective as other methodologies?
- Is the Flipped Classroom methodology as effective at the different educational system stages?
- If not, at what educational stages is the Flipped Classroom methodology most effective?

2.2. Documentary search

In order to achieve the objective of this study, certain national and international databases were used. In this case, an exhaustive search was performed in the databases of *Web of Science, Scopus, InCites, ProQuest, ScienceDirect, SpringerLink, Psyc, EBSCOHost, ACM, IEEE Xplore Digital Library, Emerald Insight, DOAJ, Google Scholar, PubMed, ResearchGate, SciELO* and *Dialnet*. Within these databases, the search for documents did not have a starting date but had a deadline of October 2020. These databases were selected because they are the databases that collect the scientific journals with the highest quality and impact at national and international levels. In this specific case, as it is a systematic review, the main interest in the selection of solid and quality studies justifies the usage of these databases.

The search looked into the, the possible crosses between the keywords *Flipped Classroom*, *Flipped Learning* and *Flipped*, with *control group* and *post* were done. All these keywords were also translated and used in the same way in Spanish.

2.3. Inclusion criteria

After this first search, a wide range of potential documents was obtained (n = 150). Nevertheless, some of them were rejected because they did not fit the inclusion criteria followed for this systematic review. The followed criterion was the next one:

- Accessibility: All results obtained from selected databases were taken into account. Those studies, regardless the format (paper, proceedings…), that were not accessible for the author had to be excluded (n = 5).
- Topic: With regard to the topic, only studies focused on Flipped Classroom methodology were taken into account. In this sense, 15 studies were not included in the analysis.
- Sample: It was a required condition that the Flipped Classroom was within the educational system. From this criterion 2, studies focused on the labour field were rejected.
- Construct studied: All cognitive, social and emotional constructs were studied. From this analysis, studies of satisfaction with the experience (n = 7) were excluded due to the fact that the focus was to analyse psychological constructs, which were widely studied and consolidated in the scientific literature, as they could provide higher quality and accurate information.
- Methodology: All included studies had to follow a quantitative methodology in order to permit comparisons and extract conclusions based on data. Consequently, 19 studies were rejected from this systematic review as they used qualitative methods or they were meta-analysis.
- Design: In order to permit solid comparisons, it was required to select studies with a control and experimental group, as well as studies with a pre and a post phase. Hence, those studies without a control group (n = 16) and/or without a pre and post phase (n = 22) were excluded from the analysis. Finally, there were some studies that mixed the methodology of the experimental and the control group, that is, what was at first the control group swapped to the experimental group, and vice versa. These studies (n = 2) were not included as they would significantly complicate drawing conclusions.
- Language: Studies that were not in Spanish or English were excluded.
- Once the studies passed through the explained criteria, a total of 61 research studies were selected, 58 in English and 3 in Spanish. The process of this analysis was performed by an adapted PRISMA flow diagram (Moher et al., 2009), as gathered in Figure 1. These studies analysed the impact of Flipped Classroom based on different constructs. 31 of them analysed the data by means of the repeated measures ANOVA, and 30 of them analysed the data by means of an analysis of covariance after observing that in the pre phase the

control and experimental groups did not show significant differences. The results of this study are based on these 61 research studies.

Noteworthy to mention that in those multidimensional constructs that did not provide an overall score, the arithmetic mean amongst the different dimensions were done.

Finally, as the countries in which the studies were carried out have different educational systems, and therefore, different ages for each educational group, the grouping mode for this analysis could be affected. That is why the studies were grouped with respect to educational stages as follows: (1) Primary Education: it was considered as primary education those students from 6 to 12 years old; (2) Secondary Education: It was considered as secondary education those students from 12 to 16; (3) It was considered as university education those students beyond 18 years old. No studies were found with the selected criteria for students aged 16 to 18 years. This post-high school stage is called differently depending on the country. To name a few, in Spain it is known as Baccalaureate, in the United Kingdom the A level of the General Certificate of Education (GCE), in Saudi Arabia Tawjahiya or in Belgium Higher Secondary Education.

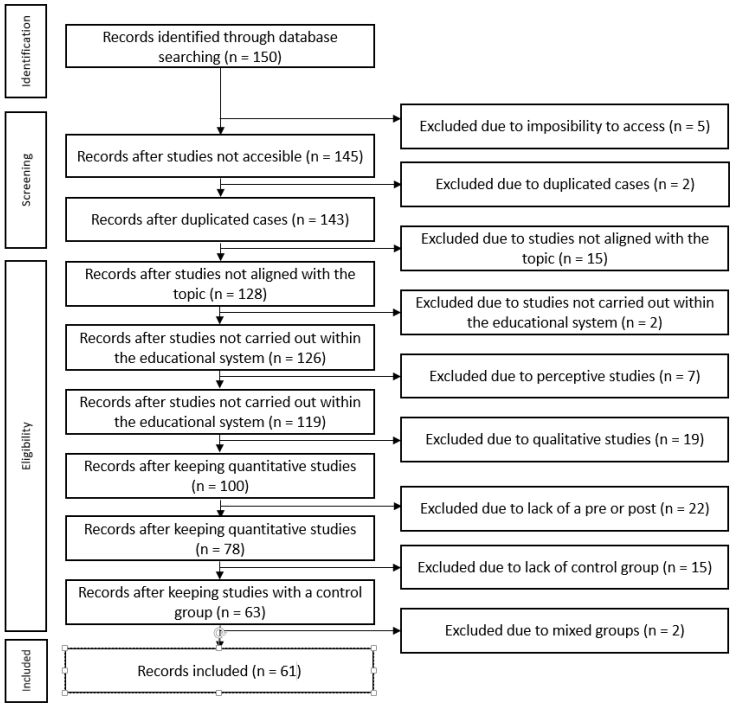

Figure 1. PRISMA Flow diagram of the inclusion criteria

2.4. Data analysis

After gathering the research studies in line with the initial criteria, their content was analysed. For this purpose, SPSS Statistics 23.0 was used. Through this software some interesting variables from all the selected studies were gathered (educational stage, intervention's duration, construct studied, sample of the control and experimental group, type of methodology followed in the control and experimental group, and means and standard deviations of the control and experimental group for the pre and post phase). To encode the constructs, the objective of each study was analysed, and in those studies in which more than one construct was analysed, more than 1 row was used in the database (1 row for each construct studied in the investigation). Finally, an inductive analysis according to the typology of the constructs studied was carried out, allowing to classify the total of constructs into: (1) cognitive constructs, those related to cognitive intelligence. Specifically, academic performance was found as the main cognitive construct; (2) affective-emotional constructs, that is, those constructs that are mainly related to the management and understanding of the individual's internal emotions, and which have an impact on their well-being and productivity. Specifically, self-concept, motivation, engagement, self-direction, metacognition, self-regulation and anxiety; (3) social constructs, namely, those internal or external constructs that have a high impact on the processes of interaction with other individuals. Specifically, competitiveness, cooperativeness and social climate.

An attempt was made to achieve the highest reliability in this data analysis process by establishing in advance a series of variables, which can be seen in Tables 1 and 2. In the case of Table 1, where the differences between the pre and post data for the control group and the experimental group are collected, the selected studies did not use an instrument with validated and reliable psychometric properties. In the case of Table 2, all the studies make use of instruments previously validated and consolidated by previous theories. It should be highlighted that in all cases the study was carried out with convenience samples.

After the database was consolidated, a descriptive analysis was carried out through the means and standard deviations of all selected studies. Then, Cohen's d was calculated by its formula $d = (M_2 - M_1) / SD_{pooled.}$

Finally, in order to perform a comparison between the control and the experimental group, the repeated measures ANOVA was carried out. Firstly, the repeated measures ANOVA was carried out considering pre and post phases of control group as within-subject factors and educational stage as between-subject factor. Then, the same procedure was carried out with the experimental group. In these analyses, the differences between pre and post, as well as the impact of the educational level along time were studied. This analysis provided 2 different plots, one for each group. That is the reason why an external graphic software was used to combine both plots in one in order to facilitate the interpretation between groups.

3. Results

Firstly, the impact of Flipped Classroom methodology on academic performance was studied. As gathered in Table 1, a total of 31 studies were included in this analysis: 3 studies focused on primary education, 9 studies focused on secondary education and 19 studies focused on university education. Other studies also analysed the impact of Flipped Classroom on academic performance, but used an analysis of Covariance, thus, making it impossible to introduce and compare the data with the information shown in Table 1. Nonetheless, these studies are used for justification or rejection of the findings.

It is important to highlight that all the control groups were grouped under the name of "control methodologies," which according to the authors of these studies, mainly used a traditional methodology. Nevertheless, in practice, it is likely that to a lesser degree, other types of methodologies not indicated in the "description of the intervention"section of the different studies were used.

The overall results from this analysis and confirmed through the repeated measures ANOVA showed that, regardless the educative stage, the post values were higher than the pre values for both: control group ($p = .013$) and experimental group ($p = .003$). The interaction between time and educational level resulted in non-significant differences in both groups, experimental group ($p = .680$) and control group ($p = .456$), stating that, regardless the educational stage of the sample, all of them improve their academic performance. Nonetheless, these results required further analysis, in order to detect possible significant differences amongst the different educational stages.

At this point, it is required to analyse and compare the impact of the group (experimental and control) at each educational stage.

As illustrated in Figure 2, it is shown that in Primary Education ($n = 3$), Flipped Classroom methodology is not more significant in the control group's methodology as experimental ($\bar{x}_{pre} = 6.51 \pm 2.92$; $\bar{x}_{Post} = 14.34 \pm 5.49$; $p = .147$) and the control group ($\bar{x}_{Pre} = 6.24 \pm 3.32$; $\bar{x}_{Post} = 12.80 \pm 5.55$; $p = .132$) obtained non-significant differences from pre phase to post phase. These results show that, regardless the methodology used, the impact on the academic performance is low. However, these results should be taken carefully as only 2 studies could be analysed. Some causes with regard this piece of information are discussed later on. This idea is supported by other primary education-focused studies which carried out a different methodology. More specifically, in Ferriz's et al. (2017) study it was shown how there was not a statistical significant difference between students who learnt through Flipped Classroom methodology and students who studied through the conventional methodology on their academic performance.

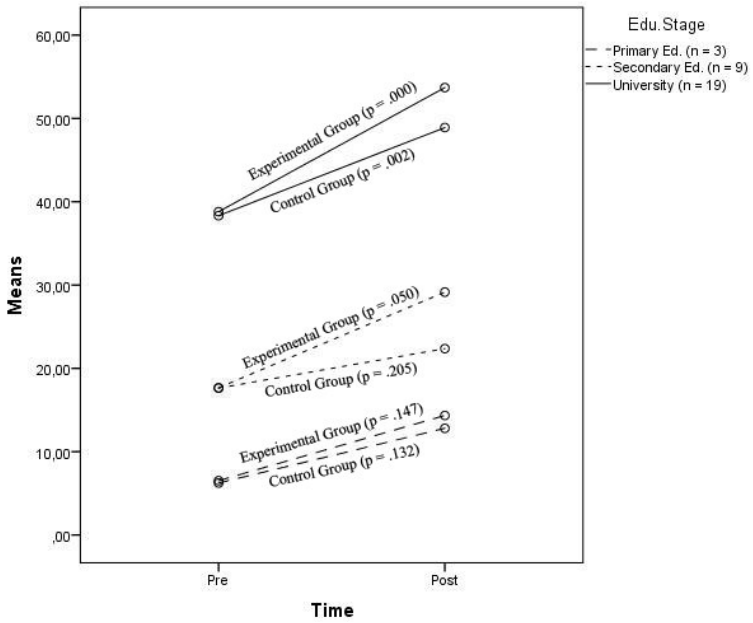

Figure 2. Impact of control and experimental groups' interventions on academic performance

With regard to secondary education (n = 9), the results reveal how the control group did not improve their academic performance significantly with their intervention (x̄pre = 17.62 ± 18.42; x̄Post = 22.36 ± 23.65; p = .205) in comparison with the students from the experimental group, who improved significantly their academic performance with their Flipped Classroom intervention (x̄pre = 17.67 ± 18.68; x̄Post = 29.16 ± 30.44; p = .050). This information matches with the conclusion of Djamàa's (2020) study, which revealed a significant benefit for secondary school students who learnt with Flipped Classroom approach in comparison with students who learnt with a more traditional approach.

Finally, concerning university education, the results reveal how both groups, control (x̄pre = 38.32 ± 24.62; x̄Post = 48.90 ± 27.98; p = .002) and experimental (x̄pre = 38.80 ± 24.96; x̄Post = 53.70 ± 30.32; p = .000), improved significantly their academic performance with their intervention. These results are also supported by other quantitative studies that could not be included in Table 1, as they used a different type of analysis (an ANCOVA, for instance). In this sense, Mattis (2015), Jian (2019), Wasserman et al. (2017), Chang et al. (2019), and Lai, Ting, and Yueh (2020) supported the idea that Flipped Classroom methodology could be even more beneficial than a more traditional approach to improve university students' academic performance. This does not mean that the control methodologies are not effective (which in fact, as can be seen in Figure 2, the control group students also show improvement), but that the Flipped Classroom methodology could be even better in higher education.

From these results, the Flipped Classroom could be potentially beneficial, especially from secondary education till university education, and equally beneficial than other methodologies used in primary education. If effect sizes between control and experimental group are compared (dividing the effect size of the experimental group by the control group), it can be seen how primary education students (n = 3) from experimental group obtained a 1.60 times larger effect size in comparison with students from the control group. Nonetheless, when removing excessive large effect size studies (Elian & Hamaidi; 2018) the experimental group showed 1.36 times larger effect sizes. In the case of secondary school students, the effect size was larger for experimental group students, in a way that the experimental group obtained a 3.67 times larger effect size in comparison with students from the control group. This information should be taken into account with care as there is a study from Mahmoud (2020) with a very large Cohen's d values. Withdrawing this study, the effect size is still larger (1.80 times) for the experimental group in comparison with the control group. Finally, in the case of university education, the effect size was 1.65 times larger (1.60 times if dismissing Sezer & Abay's study due to a very large Cohen's d) for the experimental group than for the control group.

Table 1. Main results of the different studies that had a pre-post and control and experimental group about academic performance ordered by effect size

Authors	Intervention	Control Group (CG)				Experimental Group (EG)				Results
		n	Pre	Post	d	*n*	Pre	Post	d	
Primary Education										
Elian & Hamaidi (2018) *	3 weeks	22	4.72 ± 2.18	16.27 ± 2.47	4.95	22	4.63 ± 2.12	19.09 ± 1.01	8.70	EG > CG
Jiménez & Domínguez (2018)	N / D	21	3.95 ± 1.50	6.40 ± 1.68	1.53	19	5.03 ± 1.28	8.33 ± 1.08	2.78	EG = CG
Cheung & Chen (2020)	4 weeks	95	10.05 ± 4.09	15.75 ± 2.82	1.62	94	9.89 ± 3.64	15.62 ± 3.84	1.53	EG = CG
Overall		46	6.24 ± 3.32	12.80 ± 5.55	2.7	45	6.51 ± 2.92	14.34 ± 5.49	4.33	
Overall [without outliers] *		58	7.00 ± 2.79	11.07 ± 2.25	1.57	56,5	7.46 ± 2.46	11.97 ± 2.46	2.15	
Secondary Education										
Mahmoud (2020)*	4 months	75	33.33 ± 1.72	34.17 ± 2.47	0.39	73	33.23 ± 1.80	69.98 ± 4.37	10.99	EG > CG
Schmeisser et al. (2018)	40 weeks	22	11.86 ± 5.42	39.45 ± 1.54	6.92	21	9.52 ± 6.63	36.76 ± 7.05	3.98	EG = CG
Eyitayo (2017)	3 weeks	33	5.73 ± 2.75	7.14 ± 2.54	0.53	33	5.12 ± 2.53	10.82 ± 2.44	2.29	EG > CG
Gómez-García et al. (2019)	3 weeks	26	4.52 ± 1.61	6.17 ± 1.55	1.04	30	5.43 ± 1.66	7.85 ± 1.37	1.59	EG = CG
Wei et al. (2020)	5 weeks	44	60.00 ± 23.82	75.52 ± 22.68	0.66	44	60.82 ± 22.93	88.95 ± 20.10	1.30	EG > CG
Namaziandost & Shafiee (2018)	N / D	25	12.40 ± 5.12	14.71 ± 5.70	0.42	25	13.38 ± 3.78	18.88 ± 6.72	1.00	EG > CG
Hamdani (2019)	3 months	39	2.26 ± 0.93	2.62 ± 1.03	0.36	38	2.65 ± 0.83	2.99 ± 0.78	0.42	EG > CG
Kumar et al. (2016)	6 weeks	41	9.12 ± 1.26	8.81 ± 2.00	-0.18	41	9.49 ± 1.90	9.97 ± 2.55	0.21	EG > CG
Mustapha (2020)	13 lessons	20	19.08 ± 0.24	12.72 ± 1.98	-4.50	20	19.40 ± 0.24	16.20 ± 3.58	-1.26	EG > CG
Overall		36,1	17.62 ± 18.42	22.36 ± 23.65	0.62	36,1	17.67 ± 18.68	29.16 ± 30.44	2.28	
Overall [without outliers] *		31,2	15.66 ± 18.66	20.89 ± 24.84	0.66	31,5	15.72 ± 18.97	24.05 ± 28.13	1.19	
Higher Education										
Sezer & Abay (2018)*	8 weeks	19	33.52 ± 3.62	61.00 ± 5.28	6.07	19	33.15 ± 4.01	82.10 ± 4.71	11.19	EG > CG
Robert et al. (2017)	25 hours	137	46.90 ± 9.80	86.10 ± 5.00	5.03	137	48.30 ± 10.40	86.00 ± 5.30	4.56	EG = CG
Penichet et al. (2017)	N / D	35	4.26 ± 1.60	6.31 ± 1.57	1.29	29	2.86 ± 1.46	8.31 ± 1.28	3.96	EG = CG
Zheng et al. (2018)	6 months	61	38.13 ± 13.01	76.32 ± 10.56	3.22	76	37.36 ± 13.23	82.30 ± 9.39	3.91	EG = CG
Wyk (2018)	6 months	162	58.30 ± 3.78	69.01 ± 6.71	1.96	209	58.77 ± 3.15	72.15 ± 4.21	3.59	EG = CG
Talan & Gulsecen (2019)	7 weeks	40	15.45 ± 4.95	30.45 ± 5.94	2.74	40	16.40 ± 5.27	33.95 ± 4.65	3.53	EG = CG
Haghighi et al. (2018)	7 lessons	30	27.30 ± 4.87	36.37 ± 5.22	1.79	30	27.80 ± 3.97	42.70 ± 4.85	3.36	EG > CG
Karabatak & Polat (2020)	8 weeks	31	30.42 ± 13.15	45.48 ± 9.55	1.31	35	30.80 ± 6.41	53.11 ± 7.87	3.10	EG > CG
Lin & Hwang (2018)	18 weeks	16	17.12 ± 1.89	19.62 ± 1.20	1.57	33	18.60 ± 1.69	22.12 ± 1.26	2.36	EG > CG
Alsancak & Özdemir (2018)	3 weeks	34	57.20 ± 11.40	72.04 ± 9.63	1.40	32	61.80 ± 10.40	79.41 ± 7.35	1.95	EG > CG
Kazanidis et al. (2018)	12	62	43.13	55.77	1.44	66	43.06	61.46	1.92	EG >

	weeks		± 5.66	± 11.02			± 5.57	± 12.33		CG
Sommer & Ritzhaupt (2018)	15 weeks	31	3.10 ± 1.51	6.55 ± 1.06	2.64	41	3.53 ± 1.87	6.51 ± 1.23	1.88	EG = CG
Zainuddin & Jacqueline (2017)	12 weeks	30	74.43 ± 8.29	79.77 ± 2.67	0.86	31	78.26 ± 9.45	89.64 ± 4.61	1.53	EG > CG
Chu et al. (2019)	5 hours	75	65.33 ± 18.55	75.07 ± 14.55	0.54	76	59.21 ± 18.85	80.92 ± 14.62	1.28	EG > CG
Fan et al. (2020)	6 months	198	5.38 ± 0.66	5.48 ± 0.63	0.15	287	5.39 ± 0.64	5.71 ± 0.56	0.53	EG > CG
Hava (2018)	5 weeks	33	81.45 ± 5.03	82.20 ± 4.84	0.15	26	80.15 ± 8.60	83.30 ± 5.03	0.44	EG = CG
Knežević et al. (2020)	8 weeks	30	11.26 ± 4.78	14.86 ± 2.51	0.94	30	11.03 ± 4.63	12.16 ± 4.35	0.25	EG > CG
Foldnes (2016)	6 months	142	60.70 ± 2.70	50.10 ± 3.90	-3.16	93	62.50 ± 2.70	63.20 ± 4.00	0.20	EG > CG
Cabi (2018)	4 weeks	31	54.84 ± 18.56	56.64 ± 14.79	-0.10	28	58.33 ± 18.98	55.29 ± 16.11	-0.17	EG = CG
Overall		63	38.32 ± 24.62	48.90 ± 27.98	1.57	69,3	38.80 ± 24.96	53.70 ± 30.32	2.59	
Overall [without outliers]*		65,4	38.59 ± 25.31	48.23 ± 28.63	1.32	72,1	39.11 ± 25.64	52.12 ± 30.39	2.12	

Apart from academic achievement, there is a large list of constructs that have also been considered in the literature and are analysed below.

Table 2. Main results of the different studies that had a pre-post and control and experimental group about different psychological constructs ordered by effect size

Construct	Authors	Inte.	Control Group (CG)				Experimental Group (EG)				Results
			n	Pre	Post	d	*n*	Pre	Post	d	
Primary Education											
Self-concept	Galindo-Domínguez (2019)	7 weeks	437	3.95 ± 0.64	3.99 ± 0.64	0.06	385	4.03 ± 0.63	4.06 ± 0.64	0.04	EG = CG
Social climate	Galindo-Domínguez (2019)	7 weeks	437	4.06 ± 0.57	4.04 ± 0.54	-0.03	385	4.10 ± 0.55	4.07 ± 0.50	-0.05	EG = CG
Secondary Education											
Motivation	Ruiz (2016)	4 months	23	45.64 ± 17.00	46.40 ± 17.02	0.04	25	43.00 ± 13.61	66.00 ± 17.95	1.44	EG > CG
Engagement	Ayçiçek, & Yanpar, (2018)	4 weeks	20	11.80 ± 5.56	13.74 ± 5.58	0.34	20	13.84 ± 5.90	16.72 ± 5.76	0.49	EG > CG
Higher Education											
Self-direction	Chyr et al. (2017)	6 months	35	3.16 ± 0.15	3.18 ± 0.22	0.10	34	3.14 ± 0.18	3.30 ± 0.25	0.73	EG > CG
	Hava (2018)	5 weeks	33	105.75 ± 10.69	108.60 ± 12.44	0.24	26	106.73 ± 11.29	110.34 ± 10.03	0.33	EG = CG
Self-efficacy	Kurt (2017)	14 weeks	30	136.07 ± 20.40	155.87 ± 19.13	1.00	32	125.22 ± 27.30	162.72 ± 21.03	1.53	EG > CG
	Chu et al. (2019)	5 hours	75	63.61 ± 16.39	82.15 ± 17.52	1.09	76	62.76 ± 21.66	89.03 ± 15.19	1.40	EG > CG
	Chyr et al. (2017).	6 months	35	3.95 ± 0.40	3.71 ± 0.67	-0.43	34	3.83 ± 0.50	4.39 ± 0.56	1.05	EG > CG
	Namaziandost & Çakmak (2020)	14 weeks	27	23.88 ± 3.86	23.40 ± 3.65	-0.12	31	24.77 ± 3.97	26.09 ± 3.52	0.35	EG > CG
Motivation	Karabatak &	8 weeks	31	3.63 ±	3.53 ±	0.16	35	3.34 ±	3.70 ±	0.62	EG >

	Polat (2020)			0.58	0.64			0.57	0.58		CG
Metacognition	Fan et al. (2020)	6 months	198	3.30 ± 0.49	3.52 ± 0.52	0.43	287	3.41 ± 0.51	3.59 ± 0.52	0.34	EG = CG
Competitiveness	Eon & Rok (2018)	6 months	76	3.73 ± 1.00	3.58 ± 0.99	-0.15	81	3.62 ± 0.89	3.07 ± 0.95	- 0.59	EG < CG
Cooperativeness	Eon & Rok (2018)	6 months	76	3.54 ± 0.79	3.63 ± 0.90	0.10	81	3.50 ± 0.82	4.04 ± 0.99	0.59	EG > CG
Self-regulation	Hava (2018)	5 weeks	33	62.36 ± 6.81	62.93 ± 6.23	0.08	26	63.61 ± 6.15	61.50 ± 8.35	- 0.28	EG = CG
Engagement	Chyr et al. (2017)	6 months	35	4.16 ± 0.44	4.11 ± 0.49	0.10	34	4.06 ± 0.32	4.31 ± 0.49	0.60	EG > CG
Anxiety	Chang & Koong (2019)	16 weeks	40	3.61 ± 0.84	3.01 ± 0.78	-0.74	45	3.71 ± 0.75	2.89 ± 0.67	- 1.15	EG < CG

Firstly, in relation to primary education, besides the information gathered in Table 2, Ferriz et al. (2017) revealed that both, students who applied Flipped Classroom methodology and students who applied a more traditional methodology significantly reduced their discouragement. Hence, based on these studies, the effectiveness of Flipped Classroom in comparison with other methodologies in primary education does not reveal striking findings. Nonetheless, this information should be taken carefully as only 4 pre-post with control group studies using an ANCOVA have been analysed.

Secondly, in relation to secondary education, besides the information gathered in Table 2, Gómez-García et al. (2019) affirm that the Flipped Classroom approach was not a more effective approach than a more traditional methodology in order to improve students' motivation. In this sense, further research about the impact of flipped classroom methodology on social and emotional constructs is required as only 3 studies pre-post with control group using an ANCOVA have been analysed in secondary education.

Thirdly, in relation to higher education, besides the information gathered in Table 2, Jian (2019) and Chang et al. (2019) demonstrated how Flipped Classroom methodology at university fosters students' learning motivation more significantly than traditional approaches. In addition, Beth et al. (2016) and Jdaitawi (2019) make evident that Flipped Classroom methodology could be more beneficial than traditional approaches in order to improve students' self-regulation.

Finally, there are a group of studies not included in table 1 or in table 2, which are not focused on comparing the effectiveness of Flipped Classroom methodology in contrast of other methodologies, but they compare the effectiveness of an adaptation of Flipped Classroom methodology against the conventional Flipped Classroom methodology.

Thus, there is some evidence that the Flipped Classroom methodology complemented with gamification (Aşıksoy, 2018), Reflective thinking-promoting mechanisms (Chen, 2019), RSI (Recognize, Summarize, Inquire) approach (Chang et al., 2020), KM (Knowledge Management) models (Thongkoo, Panjaburee, & Daungcharone, 2019) and Collective issue-quests systems (Chen & Hwang, 2019) could provide a significant improvement on university students' academic performance in comparison with the conventional Flipped Classroom methodology. The same happens in the case of motivation (Liu, Sands-Meyer, & Audran, 2019; Aşıksoy, 2018), self-regulation (Chen & Hwang, 2019), self-efficacy (Liu, Sands-Meyer, & Audran, 2019), and self-concept, critical thinking and problem-solving skills (Chang et al., 2020) improving more significantly these constructs on students applying the adaptation of Flipped Classroom in comparison with students applying a more conventional approach of Flipped Classroom.

4. Discussion

The main objective of this study has been to explore the effectiveness of Flipped Classroom methodologies in comparison with other teaching methodologies along the different stages of educational system.

As observed from the repeated measures and Figure 2, findings reveal that the Flipped Classroom could be more beneficial than control methodologies when applied to Secondary and Higher Education students, and equally beneficial than control methodologies when applying it to Primary Education students. These results are partially coherent and complementary with previous meta-analyses and systematic reviews (Chen et al, 2018; Galindo-Domínguez, 2018; Låg & Grøm, 2019) and contrary to other meta-analyses (Gillete et al., 2018). Based on this conclusion, some considerations should be taken into account.

Indeed, the main benefit often commented around the flipped classroom is that students who use this methodology are more prone to develop higher order skills under teacher guidance and peer support, due to the fact that in-time class is more focused on cooperative learning and practical tasks (Berrett, 2012). This change could permit teachers to develop in-class high order thinking skills, based on Bloom's (1984) taxonomy, and to establish a prior autonomous, but guided preparation before class working on low order thinking skills of Bloom's taxonomy (Hung, 2015). However, it is important to highlight other potential benefits over traditional teaching models cited in the literature, like a more personalized teaching and learning process (O'Flaherty & Phillips, 2015), a better management and organization of class time (Herreid, Schiller, Herreid, & Wright, 2014), and an improvement of the responsibility of students for their own learning process (O'Flaherty & Phillips, 2015). Nonetheless, critical reviews of the Flipped Classroom have revealed that there could be problems and future challenges related to this methodology. In this way, Lo and Hew (2017) highlight as negative points (1) that students could not be satisfied after using this methodology because they are not familiar with it and are not used to the routine or procedure it involves; (2) that students believe that the videos are very long and / or cannot pay enough attention when watching them. This may be due to the boredom and passivity that they can generate; (3) that certain students require clearer instructions from the teacher to work the practical part of the lesson in class; (4) that, like homework, activities before class take time and this makes students be overwhelmed by work at home; (5) that students cannot ask their doubts immediately during and after viewing the videos.

Firstly, it is thought that the effectiveness of the Flipped Classroom methodology is linked to the autonomy and responsibility of the student, as students are required to be autonomous for the preparation of the class. From teachers' view, it should be highlighted that, due to students' level of maturity and the disparity of the level of maturity amongst students, there are difficulties when giving primary school students a great deal of freedom of choice, and therefore, hand over to them the management of their learning process (Admiraal, Nieuwenhuis, Kooij, Dijkstra, & Cloosterman, 2019). This could be one of the main reasons why, despite the fact that primary education teachers foster students' autonomy, it is complex to develop a totally autonomous learning processes in children. In addition, in some cases, such as self-concept among others, it should be taken into account that these constructs are considered stable constructs and require large periods of time to modify them (Galindo-Domínguez, 2019b). It may be that for this reason, no significant differences have been found. Focusing on Higher Education, it is true that the literature has emphasized that having the responsibility of one's own learning is, in some cases, more demanding and more frustrating when there is an obvious lack of structure and direction (Boud, 1995; McKay & Emmison, 1995). However, one of the main aims university teachers attempt to foster in their students, differently from school pupils, is to actively pursue their own autonomy in their learning progress (Scoot, Furnell, Murphy, & Goulder, 2015; Thomas, Hockings, Ottaway, & Jones, 2015). In addition, data has shown how final-year university students tend to have higher levels of their own progression and learning than previous year students (Brown, 2007). In this sense, autonomy in students' learning process could be a clear factor that could have a significant impact on carrying out Flipped Classroom interventions, as students are required, among other activities, to read documents, watch videos, connect to the internet, pay attention to their tasks.

Secondly, it is though that the effectiveness of Flipped Classroom methodology is linked to the accessibility to digital resources and the presence of a medium-high digital competence. Research from last decade (Frederick, 2002) has shown how OECD countries were divided into two groups, based on the accessibility of children to ICT. The first group included highly developed OECD members. This group presents high ICT access rates for children, providing them with an Internet connection and digital resources in schools that facilitate their access to the net. Nevertheless, there was still a divided line in terms of accessibility to Internet at home caused, mainly by socioeconomic factors, such as parents' income. Previous literature has shown that this is the main dividing factor (UNICEF, 2017). The second group included the least developed countries. These groups had not yet provided ICT access to their children at school or through other means. The present context, however, has improved in such a way that from 2006 to 2015, the percentage of children from OECD countries who had access to the Internet at home had been significantly increased up to a 95%. Nonetheless, this situation is not equal for countries like Mexico and Peru, where only one out of two students have access to the Internet at home (OECD, 2017), and this figure is even worse in low-income countries, like Bangladesh and Zimbabwe, where only 1 out of 20 children under 15 year old has access to the internet (UNICEF, 2017). Based on these findings, this fact means a limitation to the Flipped Classroom's methodology as the resources require the need the internet for out-of-class preparation. The lack of access to these technological resources could be more notorious among younger students than among older students who, due to their autonomy and possibility to having a wage that permit them to buy these devices, while the former could have more difficulties in accessing the Internet and having a quality equipment.

Thirdly, it is thought that in Primary Education a wide variety of methodologies are commonly used, like projects or problem-solving in comparison with other educational stages, where the traditional lecture is still one

of the most common methodologies used. Furthermore, previous studies have revealed that at university, around 70% of the activities in which teachers are engaged consist of traditional lectures to students and the most common methodologies used are not active methodologies (Rutkiene, & Tandzegolskiene, 2015; Schmidt, 2010). Therefore, introducing an innovative methodology correctly, like Flipped Classroom, could lead to positive results. This has been previously discussed in the literature, pointing out the potential benefits of active methodologies, such as cooperative learning, experimental learning, and innovative usage of new technologies in education, against a more traditional and passive learning style (e.g., Khan, 2008; Pedró, 2007; Uddin & Khan, 2018). On the contrary, in primary education, despite the fact that Flipped Classroom studies have considered the control group as the group that based their intervention on a traditional methodology, against all odds, it is extremely difficult to find a traditional class in these stages. As a large number of studies have pointed out (Buljubašić & Petrović, 2014; Skutil, Havlíčková, & Matějíčková, 2015), in primary education and even, in secondary education, there is a wide variety of methodologies that are commonly used, such as cooperative learning, experiential learning, problem solving, presentations, mind maps, games and simulations, to name a few. In this sense, it is possible that Flipped Classroom methodology could not be as effective as other methodologies within primary education students, when other active learning methodologies are used. In addition, it should be taken into account what Låg and Grøm (2019) claim regarding the novelty of this methodology. In fact, as it is a recent teaching method, first-time usage of new methods may be more prone to unexpected obstacles due to teachers' and students' inexperience. Hence, it would be reasonable to expect possible significant improvements in comparison with other methodologies in the future.

Even so, these results have several theoretical and practical implications that should be highlighted. Concerning theoretical implications, these results reveal the theories and basis behind the Flipped Classroom methodology, as being, at least, equally effective as other teaching methodologies. This means that future studies could gradually improve this methodology, for example, unifying a series of indicators or models that would function as a reference to apply effective interventions in the Flipped Classroom. In addition, having shed some light on the effectiveness of this methodology, it could help teachers to justify their teaching processes based on more scientific evidence. Thus, it may be possible to create impact teaching programs based on this methodology and continue assessing its effectiveness with the passage of time.

Another important idea is that, the flipped classroom is generally compared with other control methodologies (mainly traditional methodologies). Nonetheless, it has been gradually seen how flipped classroom adaptations are being compared with a more traditional flipped classroom model. This could be an interesting future research line, as the results would allow the scientific community to know which complementary methodologies work in a better way than the conventional flipped classroom.

Finally, in spite of the fact that this systematic review has been performed to the best of our possibilities, this study has some limitations that should be taken into account when interpreting these results.

Firstly, due to the complexity of pedagogical practices, the interventions from the experimental group and the control group could have varied. In this sense, despite the fact that the data has been clustered under the Flipped Classroom methodology tag, in practice, teachers could have interpreted this methodology in a different way, and they could have implemented it in a different way. The same phenomenon happens in the case of the control group, which, in some cases, it is classified under the Control methodology tag, when in practice teachers could have developed different practical activities, which could bias the conclusions of this study. In this sense, it is important for future studies to try to provide a more in-depth description of the interventions carried out in the classroom, both for interventions based on the Flipped Classroom (duration of the intervention, methodologies used, sequencing followed, subjects in which it has been intervened, and so on), and those based on other methodologies, and thus, be able to make the strongest possible groupings. In the case of this research, there have been cases in which it has been impossible to know their duration, or that the duration provided has been so short that it would be difficult to show solid changes. In this sense, it would be interesting for future research to propose interventions of a longer duration in time (of some months or even of some years) that would allow to attribute a greater causal relationship of the results to the methodology used.

Secondly, there are some important variables that have not been considered as they are not described within the different studies. In this sense, personal variables like teacher's expertise in the Flipped Classroom or contextual variables, such as the impact of the socioeconomic context, could have a significant impact on the results. In this sense, future studies should try to provide more contextual information about the intervention, and which may allow the researcher to clearly analyse each study with as many significant variables as possible.

Thirdly, it should be highlighted how this study includes studies until October 2020. Recently, there is an important interest that this topic, and this is reflected in the scientific and educational field, having as a result an

exponential amount of research around the subject. In this sense, it is possible that from the new studies could have appeared before the publication of this article.

Fourthly, it should be taken into account that the conclusions of this study are based on a small number of studies available in the current literature. That is why, future studies could repeat the same study with the same methodology in order to compare and contrast the findings of those studies with the results of the present research.

Fifthly, it is necessary to take into account the sample selection procedure followed in the studies. It should be remembered that the sample selection method used is always a non-probabilistic method, and which on certain occasions can lead to certain limitations, such as the lack of representation of certain groups over the total population. It is a complex limitation to overcome, but it would be interesting if future studies could try to carry out research following completely random sampling system. However, despite these limitations, this study has some strengths. For instance, it has been the first systematic review that compares the effectiveness of Flipped Classroom methodology in comparison to other methodologies regarding numerous constructs beyond academic performance. In addition, the results have allowed to know how the effectiveness of this methodology could vary depending on the educational stage taken into account, and this could be a significant contribution to the scientific community.

Lastly, it is noteworthy to comment amongst the limitations how the content analysis process was performed solely by the author of the article. In order to avoid subjective biases, future studies could attempt to carry out this content analysis process with the presence of more than 1 researcher.

It is clearly important to continue investigating the effectiveness of active methodologies insofar teachers want to base their practice on scientific evidence, leaving aside educational fashions and trends without scientific basis, and thus, get to know which methodologies are those that work best in a specific context. Moreover, it is also necessary to continue providing and conducting in-depth comparative research to provide teachers with effective tools.

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Appendix: List of references from the systematic review

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