RIEM

REVISTA INQUIETUD EMPRESARIAL
ISSN 0121-1048, E-ISSN 2422-3220
2026 VOL. 26 N.1, 1–27
HTTPS://DOI.ORG/ 10.19053/UPTC.01211048.19271

A BIBLIOMETRIC ANALYSIS OF FLIPPED CLASSROOM, SKILL, AND PERFORMANCE

JESÚS ABRAHAM ZAZUETA-CASTILLO[1]* ✉, CARLOS JESÚS HINOJOSA-RODRÍGUEZ[2], ALBERTO GALVÁN-CORRAL[3]

Citation: Zazueta-Castillo, J. A., Hinojosa-Rodríguez, C. J. & Galván-Corral, A. (2026). A bibliometric analysis of flipped classroom, skill, and performance. *Inquietud Empresarial*, *26*(1), 1-27. https://doi.org/10.19053/uptc.01211048.19271

Editor: Blanco-Mesa, Fabio

Received: 14/04/2025.
Accepted: 30/02/2026.
Published: 15/04/2026.

JEL codes: I21, I23, C10, O30.

Type of article: Bibliometrics and Scientometrics

Abstract: This bibliometric study examines the flipped classroom methodology in relation to the development of competencies and performance, based on articles obtained from the Scopus database. To this end, keywords such as Flip*, Class*, Skill* and Performance* were used, which allowed us to analyze how this strategy influences the teaching-learning process, based on the interaction between teachers, students and the educational environment. Likewise, the crucial importance of information and communication technologies in the integration of new generations in active methodologies, which use different technological resources and learning experiences throughout the different educational levels, is underlined. Relevance is the potential to optimize students' preparation for the demands of the labor market, promoting the development of the knowledge and skills essential for their professional performance. In addition, it stands out in the training of talent that meets the requirements of the business sector and in addressing the challenges of globalization. The study was developed through a quantitative bibliometric approach using descriptive and relational indicators to identify publication trends, most cited authors, collaboration networks and emerging topics. The results show a significant increase in scientific production from 1971 to 2024, although citations remain limited. It is concluded that the flipped classroom represents a transformative model that requires greater empirical support and its adaptation to higher education to strengthen academic performance and competency-based learning.

Keywords: Flip*, Class*, Skill*, Performance*.

[1]PhD student in Education; Instituto Tecnológico de Sonora, Aguascalientes y Ramón Corona S/N, Colonia ITSON, Navojoa, Mexico; jesus.zazueta99610@potros.itson.edu.mx; https://orcid.org/0009-0004-7407-4114*Corresponding Author
[2]Research Professor; Instituto Tecnológico de Sonora, Aguascalientes y Ramón Corona S/N, Colonia ITSON, Navojoa, México; carlos.hinojosa@itson.edu.mx; https://orcid.org/0000-0002-7576-9338
[3]Research Professor; Instituto Tecnológico de Sonora, Aguascalientes y Ramón Corona S/N, Colonia ITSON, Navojoa, México; alberto.galvan@itson.edu.mx; https://orcid.org/0000-0002-9625-0324

Un análisis bibliométrico del aula invertida, las habilidades y el desempeño

Resumen: Este estudio bibliométrico examina la metodología del aula invertida en relación con el desarrollo de competencias y el desempeño, a partir de artículos obtenidos de la base de datos Scopus. Para ello, se utilizaron palabras clave como Flip*, Class*, Skill* y Performance*, lo que permitió analizar cómo esta estrategia influye en el proceso de enseñanza-aprendizaje, basado en la interacción entre docentes, estudiantes y el entorno educativo. Asimismo, se subraya la importancia crucial de las tecnologías de la información y la comunicación en la integración de las nuevas generaciones en metodologías activas, que emplean diversos recursos tecnológicos y experiencias de aprendizaje en los distintos niveles educativos. Su relevancia radica en el potencial para optimizar la preparación de los estudiantes frente a las demandas del mercado laboral, promoviendo el desarrollo de los conocimientos y habilidades esenciales para su desempeño profesional. Además, destaca en la formación de talento que responda a los requerimientos del sector empresarial y en la atención a los desafíos de la globalización. El estudio se desarrolló mediante un enfoque bibliométrico cuantitativo utilizando indicadores descriptivos y relacionales para identificar tendencias de publicación, autores más citados, redes de colaboración y temas emergentes. Los resultados muestran un incremento significativo en la producción científica de 1971 a 2024, aunque las citas siguen siendo limitadas. Se concluye que el aula invertida representa un modelo transformador que requiere un mayor respaldo empírico y su adaptación a la educación superior para fortalecer el rendimiento académico y el aprendizaje basado en competencias.

Palabras clave: Aula invertida *, Clase*, Habilidad*, Rendimiento*.

1 INTRODUCTION

The adoption of the flipped classroom has gained importance in the last ten years as an innovative strategy that modifies the conventional dynamics of the educational process. Its importance is due to its ability to stimulate student motivation, commitment and active participation, fundamental aspects in current educational environments that require student-centred approaches (Chen et al., 2017). Several studies have recorded its effectiveness in enhancing academic performance and conceptual understanding, particularly in the postgraduate setting (Tune et al., 2013), although there are still controversies about its direct impact on skill development (Betihavas et al., 2016; Thai et al., 2017).

Despite the benefits mentioned, authors such as Love et al., (2014) They point to the lack of solid empirical research that systematically analyzes its effects, which highlights the importance of further research. Similarly, Wilson (2013) underlines the relevance of transforming traditional pedagogical structures to foster more participatory environments, in which the classroom is transformed into a dynamic space for the creation of knowledge. The originality of this study lies in its bibliometric approach, which allows examining the scientific production related to the flipped classroom, skills and performance from a quantitative perspective; in this regard, the study, supported by the Scopus scientific information database, facilitates the identification of trends (Lapitan et al., 2021).

The flipped classroom has been enhanced by additional methods such as augmented reality, which encourages critical thinking and self-efficacy within the group (Chang & Hwang, 2018), as well as gamification, which promotes autonomy and social interaction (Ryan & Reid, 2016 ;Zainuddin, 2018;). A beneficial effect has been observed in specific groups, such as women and students with poor past performance (Bhagat et al.,2016; Gross et al., 2015). In addition, a relationship has been established between this approach and employability in the digital age (Murillo-Zamorano et al., 2019). The use of artificial intelligence to adapt teaching resources has shown encouraging results (Huang et al., 2023).

In view of this situation, the current article is based on the need to organize and clearly present the current state of research on the flipped classroom, paying special attention to its connection with the development of competencies and academic performance. Therefore, the main objective of this study is to analyze, through a bibliometric approach, the scientific production on the flipped classroom and its relationship with skills and performance, identifying publication trends, influential authors, thematic evolution, and research gaps between 1971 and 2024. This analysis seeks to provide an updated and evidence-based overview that contributes to understanding how the flipped classroom influences competency development and educational performance in different academic contexts.

This methodological perspective facilitates valuable contributions to the rethinking of educational models that adjust to the demands of a global, digital environment focused on autonomous and active learning (González-Gómez et al., 2016; Kong, 2014; McLaughlin

et al., 2013; Ramnanan & Pound, 2017; Strelan et al. 2020; Turan & Akdag-Cimen, 2020). The text is structured in six sections: the theoretical framework presents the fundamental concepts; the methodology explains the analysis process; The results present discoveries about publications, citations, authors and collaboration networks; the discussion examines trends and gaps; and the conclusion assesses the impact and importance of the study.

2 THEORETICAL FRAMEWORK

This section presents the conceptual foundations that support the analysis of the flipped classroom, emphasizing its pedagogical principles, its relationship with competency development, and the empirical evidence of its effects on student performance. The flipped classroom derives its theoretical basis from constructivist and active learning perspectives, which propose that knowledge is best built through interaction, reflection, and problem-solving rather than passive reception. It also draws from self-regulated learning theory, highlighting the learner's autonomy, metacognition, and motivation as central factors for meaningful learning.

The Flipped Classroom has been presented as an innovative educational methodology that redefines the conventional roles of the teacher and the student, focusing on active learning, autonomy, and participation (Akçayır & Akçayır, 2018; O'Flaherty & Phillips, 2015). In the first implementations, an improvement in academic performance was observed thanks to prior access to content and the use of practical activities in the classroom (Pierce & Fox, 2012). In the same direction, Missildine et al., (2013) indicated that the use of interactive technologies improves learning, although not necessarily student satisfaction (Fautch, 2015;Ferreri & O'Connor, 2013; Moraros et al., 2015).

This approach has proven to be particularly beneficial in the field of engineering, as it facilitates more effective content coverage and produces superior learning outcomes (Mason et al., 2013). Likewise, McLaughlin et al., (2014) linked it to problem-centered learning and educational reform, emphasizing its capacity to maximize classroom time and promote active participation (Al-Samarraie et al., 2020; Foldnes, 2016; Kerr, 2015; Khanova et al., 2015; Long et al., 2017; Morton & Colbert-Getz, 2017; Tang et al., 2017; Velegol et al., 2015). From a structural perspective, Hung, (2015) suggested that semi-structured lessons require greater planning effort but yield more positive academic outcomes, underscoring the need for further research into their application in disciplines such as health sciences, engineering education, and teacher training.

The flipped classroom model has demonstrated several benefits in diverse educational contexts. Studies highlight that, when properly implemented, it promotes self-efficacy, reflection, and autonomous learning (He et al., 2016; Hew et al., 2020; Lai and Hwang, 2016; Schultz et al., 2014 ; Shyr & Chen, 2018; Stöhr et al., 2020). In the area of social sciences, Akçayır & Akçayır (2018) confirmed improvements in both academic performance and student satisfaction (Lin & Hwa, 2018) while Iglesias-Pradas et al., (2021) found that, in engineering, organizational factors play a decisive role, although group size and teaching modality show no significant differences. Despite these advantages, the effectiveness of the model still depends largely on course planning, the quality of assessment, and student attitudes (Davies et al., 2013). Furthermore, O'Flaherty

and Phillips, (2015) stressed the need for stronger empirical evidence regarding its long-term impact in higher education and lifelong learning (Brewer & Movahedazarhouligh, 2018).

Furthermore, from a bibliometric approach, Tsai & Wu (2020) carried out an analysis of the scientific production related to the flipped classroom during the period 2000–2019, identifying 645 articles. The United States, China, and Taiwan were found to be the top countries in terms of publications, and the authors underscored the need for further research that systematically examines the model's effectiveness, particularly in areas such as curriculum design and autonomous learning. At last del Arco et al. (2022) , a significant increase in research on the flipped classroom was observed since 2013, highlighting its potential to enhance motivation, independence and understanding in different areas of knowledge. They also highlighted the importance of further investigating their impact on academic performance and the development of transversal skills.

In addition, the role of Information and Communication Technologies (ICT) is fundamental in sustaining the flipped model, as they enable the creation, distribution, and personalization of digital learning materials that support student autonomy and interaction. ICT tools, when properly integrated, expand the possibilities for active and collaborative learning beyond the classroom and connect the flipped approach with current digital and competency-based education paradigms. In summary, the theoretical framework shows that the flipped classroom has evolved from an instructional technique into a comprehensive pedagogical model that integrates technology, self-regulation, and active learning. The reviewed literature supports its positive influence on academic achievement and competency development, yet also reveals persistent research gaps concerning assessment design, teacher training, and long-term skill acquisition. These theoretical foundations justify the present bibliometric study, which seeks to map the global evolution of this field and identify the main thematic and methodological trends that explain its educational impact.

3 METHODOLOGY

First, the Scopus database was used exclusively, analyzing publications from 1971 to 2024. The objective was to examine its relationship with skills development and academic performance. The search strategy combined, using the Boolean operator AND, the terms: "Flip*", "Class*", "Soft*" and "Performance*", applied in the title, abstract and author keywords fields. The use of the asterisk allowed variations such as "flipped", "classroom", "soft skills", etc. The search, carried out on February 5, 2025, yielded 4792 documents, from which the 30 most cited articles were selected, excluding those not directly related to education (del Arco et al., 2022 and Tsai & Wu, 2020). For the analysis, indicators such as the number of publications per country, the H-index of authors, the quartile of journals, the level of citation per article, and the evolution of publications over time were used. In addition, networks of co-authorship, co-occurrence of keywords and co-citation of authors were explored, in order to detect thematic and collaborative patterns. Visualization and analysis were performed with the Bibliometrix package in R, using the Biblioshiny interface (Aria & Cuccurullo, 2017), supplemented with Microsoft Excel for descriptive

analysis. The documentary review identified 2924 research articles, 1393 reference documents, 176 book chapters, 133 reviews, 102 conference proceedings and 29 books. Although the exclusive use of Scopus limits the inclusion of studies indexed only in Web of Science or Google Scholar, the methodology applied guarantees an objective, clear and replicable review, useful to support future research on the flipped classroom and its impact on the development of competencies in higher education.

4 RESULTS

This section presents the results of the analysis of the data collected. These results are divided into some aspects related to the evolution and structure of citations, TOP-30 of the most cited articles, the 30 most cited authors, the leading countries in the field, the most relevant journals, the leading universities and keyword analysis, among others.

4.1 Annual number of publications

The analysis in Figure 1 reveals that interest in the flipped classroom model, linked to skills and performance, has increased steadily since 1971, when the first article on the subject was published. Although in past decades publications were infrequent, since 2013 there has been a steady increase, with most studies concentrated between 2013 and 2024. In 2016, 17 publications were registered, while in 2024 the figure reached 696, which shows a clear upward trend. Between 2004 and 2024, a total of 4792 documents were counted, with a significant increase from 2015, when 164 articles were registered. This increase indicates the growing interest in the flipped classroom model and its effect on the educational field.

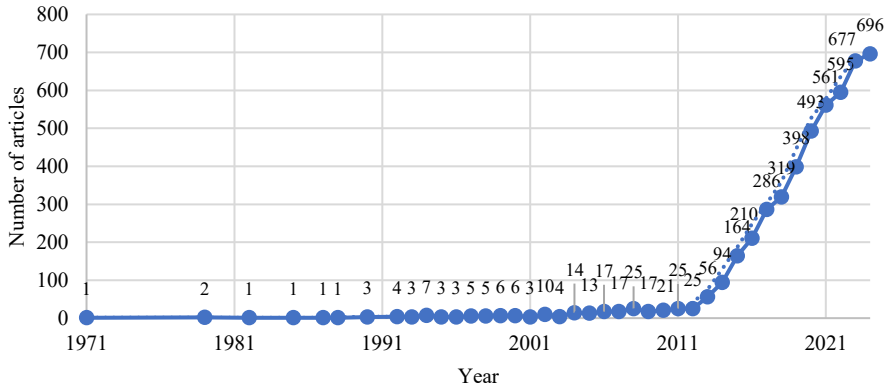

Figure 1. Annual number of publications in Scopus

Source: Authors

4.2 Number of citations out of the total number of articles

This growth in scientific output is accompanied by a particular pattern in citations: although there are almost 4800 publications, most have few or no citations, indicating that the field is still young and expanding. According to Table 1, only two articles exceed 1000 citations, while the vast majority (4644) have not been cited. The most cited publications are concentrated in ranges of 200 to 400 citations, with 7 articles in the latter group (23%) and 9 in the first (30%). This distribution suggests that, although interest has grown, few studies have achieved a high impact, which opens opportunities for new relevant and widely referenced research, which can be seen in Table 1.

Table 1. Number of citations out of total articles

C	S	P	A
≥ 1000	2	0.04%	0.04%
800	3	0.06%	0.10%
700	2	0.04%	0.15%
600	1	0.02%	0.17%
500	3	0.06%	0.23%
400	7	0.15%	0.38%
300	5	0.10%	0.48%
200	17	0.36%	0.84%
100	88	1.84%	2.68%
0	4644	97.32%	100.00%

Note: Abbreviations: C: Citations; S: Scopus; P: Proportionality. A: Acumulative.

Source: Authors.

4.3 Number of publications by country

In relation to the number of publications on the subject, it can be seen in Figure 2 that the most important countries of the total are the United States with 1182, China with 735, India with 314, Spain with 237, Taiwan with 221, the United Kingdom, with 200, Indonesia with 146, Germany and Australia with 142, Malaysia with 119, Hong Kong with 113, Canada with 111, Turkey with 103, South Korea with 95, Japan with 89, Thailand and Iran with 83, Saudi Arabia with 81, Italy with 69, France with 68, the Netherlands with 60, Brazil with 49, Pakistan with 44, the Russian Federation with 43 and Mexico with 38.

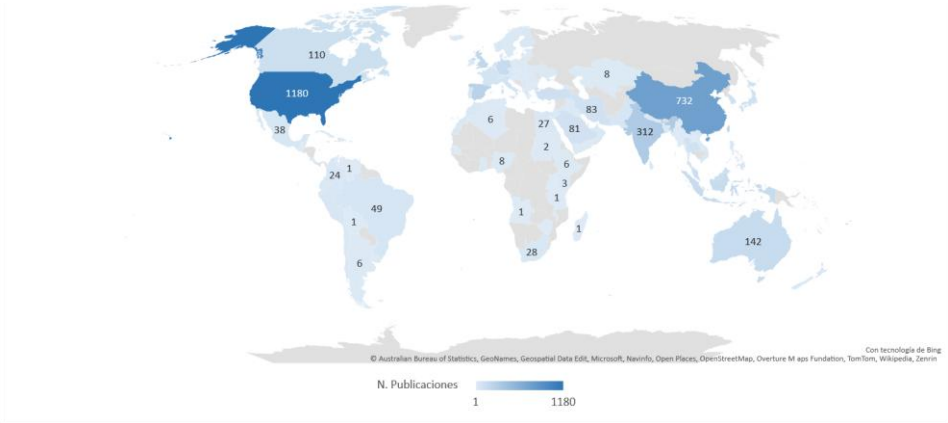

Figure 2. Number of publications by country

Source: Authors

4.4 The 30 most important articles

Identifying the most referenced articles, as shown in Table 2. The most cited study is that of O'Flaherty & Phillips (2015) , which has 1397 references, and was published on the Internet and Higher Education (Q1). This work is considered fundamental to understand its application in the field of higher education. Below is McLaughlin et al., (2014). In 2014, a study was published in Academic Medicine (Q1) that has received 854 citations and examines the implementation of the model in the field of health sciences, highlighting its impact on active participation and professional learning. Finally, the research of Akçayır & Akçayır, (2018), which has 785 citations in Computers and Education (Q1), presents a balanced analysis of the advantages and disadvantages of the flipped classroom, providing a critical perspective from pedagogy and the application of educational technologies. These publications constitute the most relevant conceptual foundations in this field.

In the technical and health fields, several studies have shown the benefits of the flipped classroom. First of all Mason et al., (2013), a study with 735 citations was published in IEEE Transactions on Education (Q1) that compares this methodology with traditional teaching, and shows improvements in the performance of engineering students. In a complementary approach, Lai & Hwang, (2016), who have been cited 529 times in Computers and Education (Q1), emphasize that self-regulation in the model contributes to mathematics learning by enhancing students' autonomy and self-efficacy. Despite having a smaller number of references, other studies are also important, such as those by Missildine et al., (2013) , research with 465 citations was published in the Journal of Nursing Education (Q2), which underscores the advantages in nursing students' performance and perception. On the other hand Pierce and Fox, (2012), with 451 citations in the American Journal of Pharmaceutical Education (Q1), showed that the use of vodcasts and active learning in pharmacotherapy improve content comprehension. These studies highlight the adaptability of the flipped classroom in different academic contexts.

Table 2. Top 30 articles

No.	T	AU	J	CT_SC	Q_SC	H_SC	Y
1	The Use of Flipped Classrooms in Higher Education: An Exploratory Review	O'Flaherty, Jacqueline y Phillips, Craig	Internet and Higher Education	1397	Q 1	117	2015
2	The flipped classroom: a course redesign to encourage learning and participation in a health professions school	McLaughin, Jacqueline E. ; Roth, María T; Glatt, Dylan M.; Gharkholonarehe, Nastaran; Davidson, Cristóbal A.; Griffin, Latoya M.; Esserman, Denise A.; Mumper, Russell J.	Academic Medicine	854	Q 1	188	2014
3	The flipped classroom: a review of its advantages and challenges	Akçayır, Gokce; Akçayır, Murat	Computer Science and Education	785	Q 1	232	2018
4	Comparing the effectiveness of a flipped classroom to a traditional classroom in an upper-division engineering course	Mason, Gregorio S.; Schumann, Teodora Rutter; Cook, Kathleen A.	IEEE Educational Transactions	735	Q 1	76	2013
5	Flipping the classroom and integrating educational technology into a university-level information systems spreadsheet course	Davies, Randall S.; el decano Douglas L.; Pelota, Nick	Educational Technology Research and Development	618	Q1	109	2013
6	A self-regulated flipped classroom approach to improving student learning performance in a math course	Lai, Chiu-Lin; Hwang, Gwo-Jen	Computer Science and Education	529	Q 1	232	2016
7	Changing the classroom for English language learners to encourage active learning	Colgado, Hsiu-Ting	Computer-assisted language learning	473	Q1	75	2015
8	Flipping the classroom to improve student performance and satisfaction	Missildine, Kathy; Fuente, Rebeca; Summers, Lynn; Gosselin, Kevin	Journal of Nursing Education	465	Q2	75	2013
9	Vodcasts and active learning exercises in a "flipped classroom" model of a renal pharmacotherapy module	Pierce, Ricardo; Zorro, Jeremy	American Journal of Pharmacy Education	451	Q1	78	2012
10	Emergency Remote Teaching and Student Academic Performance in Higher Education During the COVID-19 Pandemic: A Case Study	Iglesias-Pradas, Santiago; Hernández-García, Ángel; Chaparro-Peláez, Julian; Prieto, José Luis.	Computers in human behavior	446	Q1	251	2021
11	A systematic review of the effectiveness of flipped classrooms in medical education	Chen, Fei; He, Ángela M; Martinelli, Susan M.	Medical Education	437	Q1	162	2017

12	The flipped classroom model improves graduate students' performance in cardiovascular, respiratory, and renal physiology	Melodía, Johnathan D.; Sturek, Miguel; Basile, David P.	American Journal of Physiology - Advances in Physiology Education	408	Q2	73	2013
13	The Evidence for 'Flipping Out': A Systematic Review of the Flipped Classroom in Nursing Education	Bethihavas, Vasiliki; Bridgman, Heather; Kornhaber, Raquel; Cruz, Merylin	The training of nurses today	4022	Q1	101	2016
14	The Impact of a Flipped Classroom Design on Learning Performance in Higher Education: Finding the Best "Mix" of Lectures and Guiding Questions with Feedback	Thai, Ngoc Thuy Thi; De Wever, Bram; Valcke, Martín	Computer Science and Education	338	Q1	232	2017
15	Developing Information Literacy and Critical Thinking Skills Through Learning Domain Knowledge in Digital Classrooms: A Hands-On Experience of Flipped Classroom Strategy	Kong, Siu Cheung	Computer Science and Education	327	Q1	232	2014
16	Student Learning and Perceptions in an Inverted Linear Algebra Course	Con amor, Betty; Hodge, Angie; Grandgenett, Neal; Swift, Andrew W.	International Journal of Mathematics Education in Science and Technology	289	Q2	42	2014
17	The flipped classroom: a method for addressing the challenges of an undergraduate statistics course	Wilson, Stephanie Gray	Didactics of Psychology	287	Q2	56	2013
18	An Effective Blended Online Teaching and Learning Strategy During the COVID-19 Pandemic	Lapitan, Lorico DS; Tiangco, Cristina E.; Sumalinog, Divina Ángela G.; Sabarillo, Noel S.; by Joey Mark	Education for Chemical Engineers	278	Q1	30	2021
19	The flipped classroom: a meta-analysis of the effects on student achievement across disciplines and educational levels	Strelan, Pedro; Osborn, Amanda; Palmer, Edward	Journal of Educational Research	281	Q1	100	2020
20	Pharmacy Student Engagement, Performance, and Perception in a Flipped Satellite Classroom	McLaughlin, Jacqueline E.; Griffin, LaToya M.; Esserman, Denise A.; Davidson, Cristóbal A.; Glatt, Dylan M.; Roth, María T.; Gharkholonarehe, Nastaran; Mumper, Russell J.	American Journal of Pharmacy Education	278	Q1	78	2013
21	Impacts of an augmented reality-based flipped learning guide approach on student performance and perceptions of science projects	Chang, Sao-chen; Huang, Go-jen	Computer Science and Education	268	Q1	232	2018

22	Advances in Medical Education and Practice: Students' Perceptions of the Flipped Classroom	Ramnanan, Cristóbal J.; Libra, Lynley	Advances in medical education and practice	212	Q2	42	2017
23	Flipped classroom in English language teaching: a systematic review	Turan, Zeynep; Akdag-çimen, Birgul	Computer-assisted language learning	208	Q1	75	2020
24	Student Learning Performance and Perceived Motivation in Gamified Flipped Instruction	Zainuddin, Zamzami	Computer Science and Education	200	Q1	232	2018
25	Performance and perception in the flipped learning model: a first approach to evaluate the effectiveness of a new teaching methodology in a general science classroom	González-Gómez, David; Jeong, Jin Su; Airado Rodríguez, Diego; Cañada-Cañada, Florentina	Journal of Science Education and Technology	197	Q1	80	2016
26	Impact of the flipped classroom on student performance and retention: a controlled parallel study in general chemistry	Ryan, Michael D.; Reid, Scott A.	Journal of Chemical Education	199	Q1	102	2016
27	The Impact of the Flipped Classroom on Learning Math Concepts in High School	Bhagat, Kaushal Kumar; Chang, Cheng-non; Chang, Chun-Yen	Educational Technology and Society	194	Q1	111	2016
28	Increased pre-class preparation underlies improved student outcomes in the flipped classroom	Gross, David; Pietri, Evava S.; Anderson, Gordon; Moyano-Camihort, Karin; Graham, Mark J.	CBE Life Sciences Education	193	Q1	90	2015
29	How the flipped classroom affects knowledge, skills, and participation in higher education: effects on student satisfaction	Murillo-Zamorano, Luis R.; López Sánchez, José Ángel; Godoy-Caballero, Ana Luisa	Computer Science and Education	189	Q1	232	2019
30	Effects of AI-enabled personalized recommendations on student learning engagement, motivation, and outcomes in a flipped classroom	Huang, Anna Y.Q.; Lu, Owen H.T.; Yang, Stephen J.H.	Computer Science and Education	191	Q1	232	2023

Note. Abbreviations: No: Number; T: Title; AU: Authors; J: Magazine; CT_SC: Scopus Total Citations; Q_SC: Scopus Quartile; H_SC: Scopus H-Index;Y: Year of publication.

Source: Authors.

4.5 The 30 most important magazines

Table 4 analyzes the journals with the highest scientific production on flipped classrooms, revealing that a high number of publications does not always imply high academic impact. Although conferences such as ASEE, ACM, and FIE generate many articles, they do not have a quartile in Scopus, which limits their visibility. On the other hand, journals indexed in Q1 quartile such as BMC Medical Education, Computers and Education, Education and Information Technologies and IEEE Access stand out for their influence and are consolidated as key spaces in the dissemination of knowledge in education, technology and medical sciences. And the other hand, Q2 journals, such as MedEdPORTAL and Frontiers in Psychology, also make relevant contributions, although with a smaller scope. Some, such as the International Journal of Information Technology and Education (Q3), reflect less impact. Overall, the table shows that research on the flipped classroom is supported by high-quality publications, which reinforces its position as a topic with growing academic and multidisciplinary value.

Table 3. Journals with the most publications in the field

No	J	Q	C
1	ASEE Annual Conference & Exhibition Proceedings	180	Nd
2	Lecture notes on computer science, including the subseries Lecture notes on artificial intelligence and Lecture notes on bioinformatics	84	Nd
3	ACM International Conference Proceedings Series	71	Nd
4	BMC Medical Education	69	Q 1
5	Proceedings of the Conference on the Frontiers of Education	57	Nd
6	Lecture notes on networks and systems	38	Nd
7	Education and Information Technology	37	Q 1
8	Mededportal The Teaching and Learning Resources Journal	35	Q 2
9	Education Sciences	32	Nd
10	Sustainability Switzerland	31	Q 2
11	Computer Science and Education	29	Q1
12	Journal of Transformations of Engineering Education	29	Nd
13	Interactive Learning Environments	28	Q 2
14	IEEE Access	27	Q 1
15	Journal of Chemical Education	27	Q 2
16	Communications in Computer Science and Information Science	26	Nd
17	Frontiers of Psychology	26	Q 2
18	Plos Uno	26	Q 2
19	Journal of Physics Lecture Series	25	Nd
20	Medical Science Educator	24	Q 1
21	Proceedings of SPIE, the International Society for Optical Engineering	24	Nd
22	Journal of Computer-Assisted Learning	23	Q 1
23	AIP Conference Proceedings	21	Nd
24	American Journal of Pharmacy Education	20	Q 1
25	Nongye Gongcheng Xuebao Transactions of China Society of Agricultural Engineering	20	Q 2
26	Computer applications in engineering education	18	Q 2
27	British Journal of Educational Technology	17	Q 1
28	Image and Graphic Magazine	17	Nd
29	Electrical Engineering Instruction Notes	17	Nd
30	International Journal of Information Technology and Education	16	Q 3

Note: Abbreviations: No: Number; J: Journal; Q: Publications; C: Quartile

Source: Authors.

4.6 Three-course plot

Figure 3 presents a three-field graph that allows a clear visualization of the relationship between authors, key topics and sources of publication in flipped classroom studies. On the left are researchers with high production, such as Wang X, Wang J and Li Y; in the center, the most addressed topics, including "flipped classroom", "active learning" and "blended learning"; and on the right, the main sources of dissemination, such as BMC Medical Education and ACM conference proceedings. This representation reveals how certain authors actively participate in multiple thematic lines and platforms, highlighting the interdisciplinary nature of the flipped classroom, especially in areas such as medical education. In addition, the thickness of the lines between fields indicates the strength of these relationships, which helps identify both the most influential researchers and the most relevant journals.

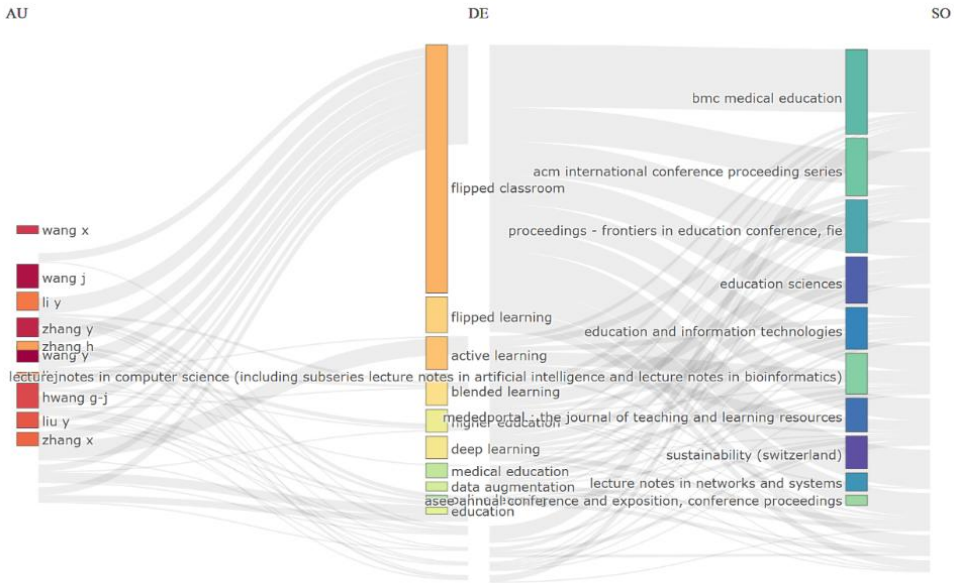

Figure 3. Three-field plot

Source. Generated by the authors via Biblioshiny

4.7 Authors' production over time

Figure 4 illustrates the development of the scientific production of several authors from 2008 to 2024. In the graph, each point corresponds to an article published in a given year; The size of the dot reflects the number of papers that author published in that year, while the color indicates the number of citations received: the darker the color, the greater the impact.

This visual resource facilitates the identification of the most active researchers with the highest number of citations. Since 2015, there has been a significant increase in the number of publications and their impact. Several authors, such as Wang Y., Wang J., Zhang Y. and Wang X. Hwang G.J. and their collaborators stand out for their constant production and for receiving a considerable number of citations, indicating their importance in the field of the flipped classroom and active learning.

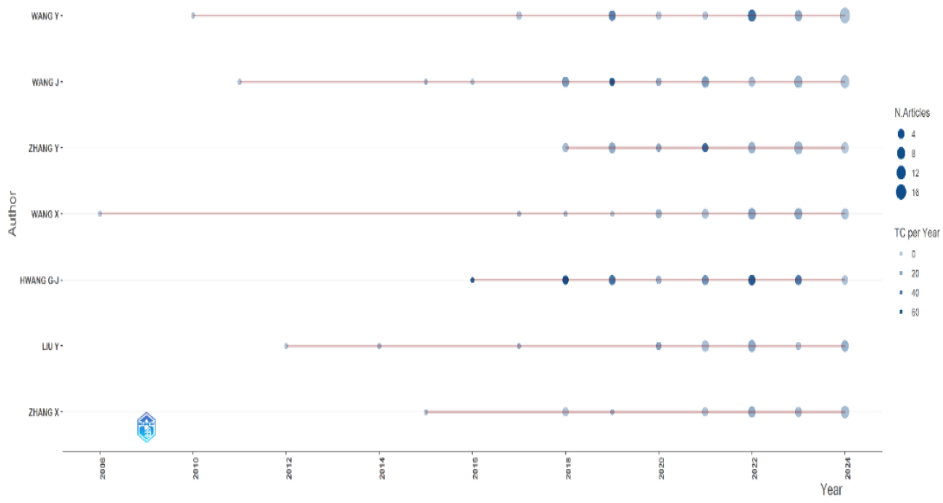

Figure 4. The authors' production over time

Source. Generated by the authors via Biblioshiny

4.8 Most relevant words.

Figure 5, prepared with Bibliometrix, presents a graph illustrating the most frequent keywords used by the authors in the documents analyzed. This chart, which is based on the most commonly used author keywords, makes it easy to identify the top topics covered in flipped classroom research. The vertical axis indicates the frequency with which they appear in the texts.

The most notable expression is "flipped classroom", which appears 1407 times, which validates its importance in the literature analyzed. This is followed by concepts such as "active learning", "flipped learning", "hybrid learning" and "higher education", suggesting a close relationship with innovative teaching approaches. Likewise, terms such as "e-learning", "machine learning" and "covid-19" are incorporated, which show the influence of technology and the pandemic in the educational field. Finally, terms such as "problem-based learning," "self-regulation," and "collaboration" reflect the growing interest in student-centered approaches to optimizing the educational process.

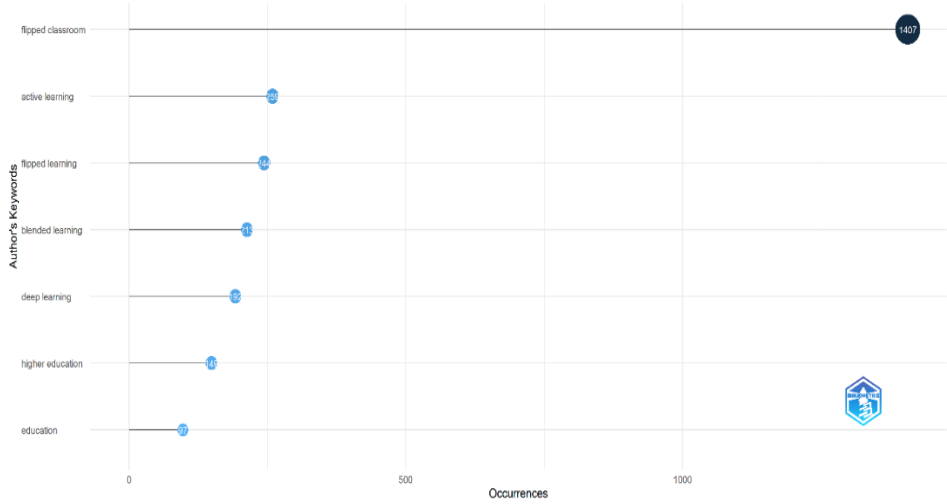

Figure 5. Most relevant words

Source. Generated by the authors via Biblioshiny

4.9 Trends in the subject

Figure 6 illustrates the evolution of the keywords used by the authors in studies on education from 2014 to 2024. The vertical axis lists keywords such as "flipped classroom", "active learning", "online learning", "e-learning" and more recent concepts such as "federated learning" and "deep neural networks". A timeline is shown on the horizontal axis that makes it easy to see when they started using them or when they reached their peak popularity.

Each dot symbolizes a keyword, and its size indicates the number of times it has been cited in the documents: large dots (more than 1000 mentions) indicate highly relevant topics, while smaller dots (around 500) reflect a lower frequency. The graph shows that, in recent years, there has been an increase in interest in concepts related to artificial intelligence and educational technology, such as federated learning and neural networks. In previous stages, topics such as linear algebra or low power were addressed, although with a lesser impact. In summary, the image shows how trends have evolved, favoring more and more innovative and digital methods in the education sector.

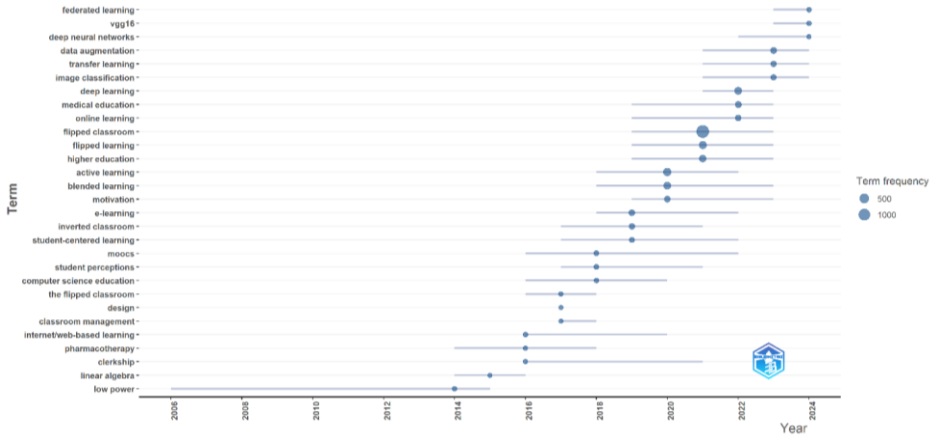

Figure 6. Trends in the topic

Source. Generated by the authors via Biblioshiny

4.10 Keyword co-occurrence network

Figure 7 illustrates the connection between the most common keywords in flipped classroom studies, with "flipped classroom" standing out as the main term. Terms such as "collaboration in learning", "school performance" and "self-learning" emerge around this concept, suggesting that research focuses on how this methodology favors student participation and performance. Likewise, the incorporation of expressions such as "deep learning" and "image classification", characteristics of the technological field, is noted, which indicates an increase in interest in integrating artificial intelligence in education. Consequently, the image indicates that current research integrates classical pedagogical methods with new technologies, creating opportunities to innovate in the educational field.

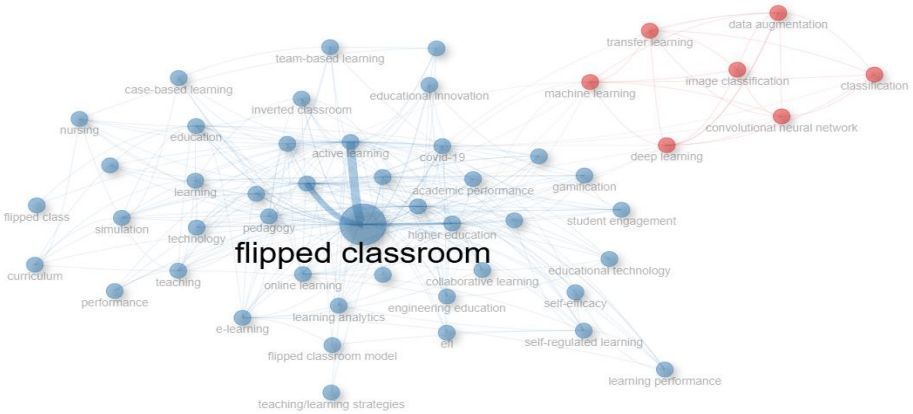

Figure 7. Keyword Co-Occurrence Network

Source: Generated by the authors via Biblioshiny

4.11 Article co-citation network

Figure 8 presents a co-citation network that illustrates which authors and theories are most frequently cited together in flipped classroom studies, thus facilitating the identification of the conceptual foundations of the area. Bergmann J.I. (2012) stands out as a key figure, since his work is widely considered one of the foundations of the model. Around him are other prominent authors such as Lage, M.J. Strayer, J.F. and others who contributed to the early development of the flipped classroom.

There are also newer groups, such as Lee G.'s (2020), which examine the most recent versions of the model, as well as others that are further away from the core, such as He K. or Simonyan K., related to technological topics such as artificial intelligence. In addition, classical theorists such as Vygotsky (1978) continue to be an important source, indicating that current research integrates traditional principles with novel approaches. Overall, this network shows how understanding of the flipped classroom has developed and expanded.

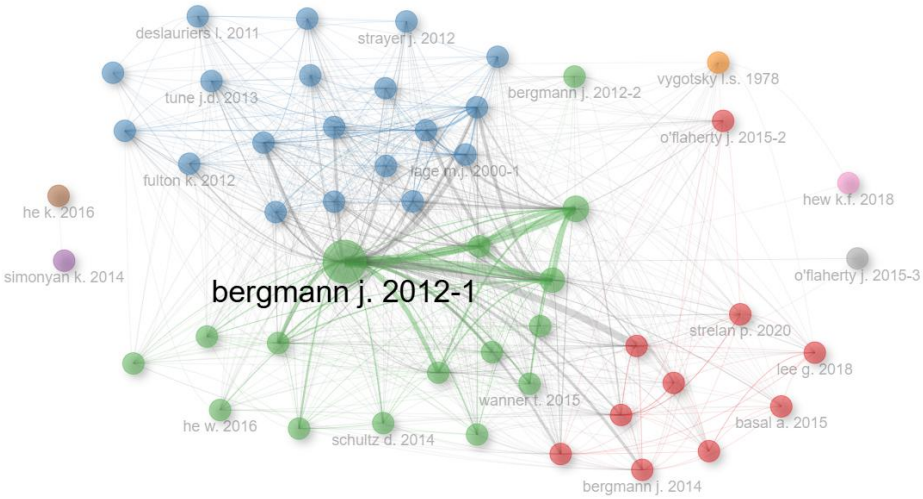

Figure 8. Article co-citation network

Source. Generated by the authors via Biblioshiny

4.12 Author co-citation network

Figure 9 illustrates a network of author co-citation, which implies the relationship between researchers according to the number of times they are cited together in research on the flipped classroom. Each dot symbolizes an author, and its size reflects their degree of influence in the area. Bergmann J. stands out. as the most referenced and central author, demonstrating his importance in various areas of research. Thematic communities gather around it, such as the green one, which includes Bishop M. Judge Prober C.J. demonstrates robust collaboration.

In contrast, the blue and gray groups show a small number of connections, indicating that they may be conducting more specific or lesser-known research. Authors such as Szegedy and Krizhevsky, who are in the peripheral field, are connected to issues related to emerging technologies. In summary, the image shows the organization of knowledge in this area, highlighting both the key influences and the new trends that are beginning to be incorporated.

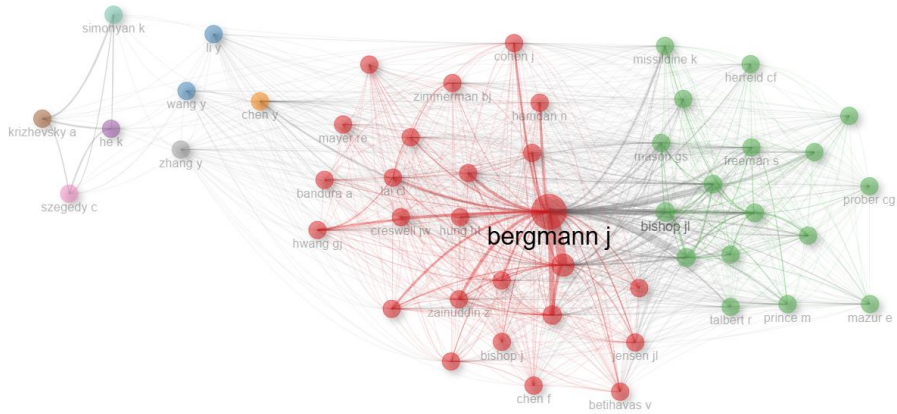

Figure 9. Author co-citation network

Source: Generated by the author via Biblioshiny

4.13 Institutional collaboration network

Figure 9 shows the collaboration between various universities on flipped classroom research, organized by color according to the frequency of their cooperation. International associations such as the University of California and the University of Granada stand out, leading the purple group, uniting the United States and Spain. On the other hand, the green group is characterized by the active participation of Asian institutions, such as the Hong Kong University of Education and Zhejiang University, the latter playing the role of liaison between various networks. Other groups show closer collaborations, such as red (Hong Kong institutions) and orange (Spanish universities), evidencing strong regional ties.

You can also see international collaborations, such as the one between Ghent University in Belgium and Wuhan in China. By comparison, universities such as Monash (Australia) seem to be more disconnected, with reduced participation in the network. Overall, this representation highlights the importance of some institutions as central points in the creation and linking of global academic knowledge related to the flipped classroom.

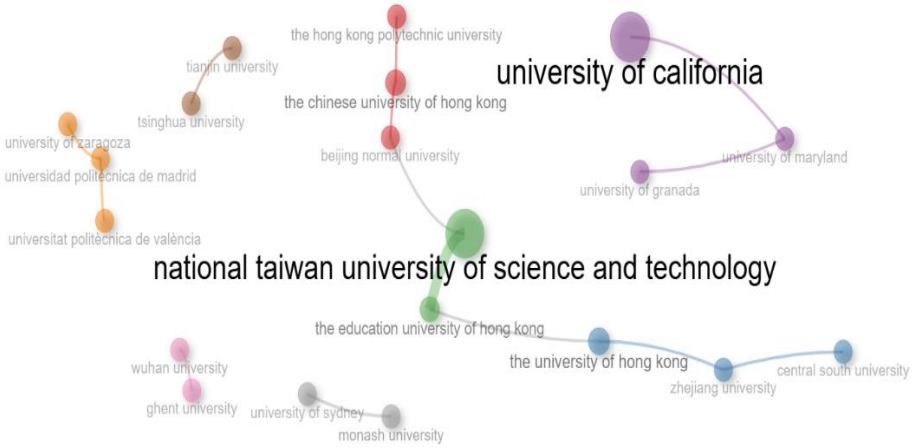

Figure 9. Institutional collaboration network

Source: Generated by the authors via Biblioshiny

5 DISCUSSION

The flipped classroom approach has gained recognition in the educational field due to its ability to make the learning experience more active and relevant, promoting student participation and improving their academic performance. This bibliometric review contributes to the topic by providing a clear perspective of the progress in scientific production related to the flipped classroom, pointing out both its benefits and the challenges it faces. According to O'Flaherty & Phillips (2015), although its role in curriculum and assessment alignment is valued, there is still a lack of sufficient evidence to support its long-term effectiveness in developing twenty-first-century skills. This underscores the need for more thorough and ongoing research in diverse educational contexts.

From the bibliometric evidence obtained, it becomes clear that research on the flipped classroom has evolved from a descriptive focus on teaching innovation to a more analytical examination of how this methodology contributes to the acquisition of competencies such as critical thinking, collaboration, and self-regulation. The quantitative trends identified in this study—particularly the growth in publications after 2013 and the thematic prominence of terms like “active learning” and “performance”—demonstrate a growing academic interest in measuring not only learning outcomes but also the development of soft and transversal skills.

This article further establishes that the flipped classroom is closely linked to student-centered approaches, such as problem-based learning, and addresses the limitations of traditional methods (McLaughlin et al., 2014; McLaughlin et al., 2013). Research conducted by Akçayır & Akçayır, (2018) have shown progress in student performance

and satisfaction. The same Davies et al., (2013) They stress that the use of technology is central to this model, but warn of the need to prevent digital saturation through meticulous planning. However, one of the biggest challenges is the absence of self-regulation. Lai el Hwang, (2016) They point out that, if students do not encourage their autonomy, they could face challenges in adjusting to the model. Likewise, although technologies have the potential to improve learning, they do not necessarily increase student satisfaction (Hanged, 2015; Missildine et al., 2013), which highlights the need for meticulous pedagogical integration. Pierce and Fox, (2012) They point out that prior preparation improves performance, emphasizing the need to create activities that support this process.

The bibliometric results also highlight that the most cited studies those by O'Flaherty & Phillips (2015), McLaughlin et al., (2014), and Akçayır & Akçayır, (2018) tend to converge on a shared idea: flipped learning promotes meaningful learning only when it integrates formative evaluation and student autonomy as central pillars. This confirms that academic performance in flipped environments is not merely a product of technological mediation, but of how effectively the instructional design fosters cognitive engagement and skill transfer.

From an organizational perspective, the flipped classroom has proven to be adaptable to different levels and teaching modalities, although it needs institutional support and appropriate resources for its proper execution (Iglesias-Pradas et al., 2021). Things like motivation and self-confidence have a direct impact on your success. According to Thai et al., (2017), the model reinforces these individual dimensions, although it does not necessarily increase the perception of flexibility. To increase engagement, gamification has proven to be an effective strategy by incorporating motivational elements such as rewards or badges (Zainuddin, 2018).

Furthermore, the network analysis carried out in this bibliometric study confirms that international collaboration and the participation of leading institutions such as the University of Granada and the University of California have significantly contributed to the evolution of the field, particularly in studies addressing performance improvement and skills assessment. The presence of emerging topics such as artificial intelligence, adaptive learning, and digital competence suggests that future flipped classroom research will increasingly focus on data-driven personalization and lifelong learning competencies.

Returning to the above, an increase in research related to the flipped classroom is shown, highlighting the notable participation of countries such as the United States and China, as well as an expanding interest in emerging areas such as personalized learning and artificial intelligence. Although its widespread effect cannot yet be confirmed, the results indicate that it is a developing methodology with high potential, provided that fundamental elements such as self-regulation, educational design and institutional context are taken into account. The bibliometric indicators thus reveal both quantitative growth and qualitative diversification, showing that flipped learning has become a multidisciplinary topic connecting education, technology, and human development. The article contributes to the area by providing a firm foundation for future research that attempts to improve and adjust the model according to contemporary educational needs.

In light of the recent literature, the flipped classroom emerges not merely as an instructional strategy but as a transformative educational paradigm that continues to expand across disciplines and pedagogical frontiers. In addition, Gallardo-Guerrero et al., (2022) demonstrated how the model evolves toward personalised learning, promoting self-directed engagement and contextualized competency development in sports and physical education. Their findings underscore the significance of integrating sustainability and digital literacy within flipped learning environments to achieve meaningful, student-centered transformation. Likewise, Baig & Yadegaridehkordi, (2023) offered a comprehensive synthesis of higher-education studies, identifying methodological inconsistencies, short-term designs, and the need for robust theoretical frameworks that can better explain how motivation, achievement, and satisfaction interact in flipped settings.

Additionally, Naing et al., (2023) confirmed these tendencies through a systematic meta-analysis in health-science education, reporting clear gains in academic performance and engagement, yet warning that success depends heavily on the pedagogical coherence and institutional quality that support implementation. Complementing this, Castillo Castillo, (2025) linked the flipped model with the STEAM approach and competency-based curricular design, emphasizing that the greatest challenge is not the use of technology itself, but ensuring that teaching practices truly lead to the acquisition of transversal, integrative, and future-ready skills.

In the same line, Dan & Binti Mohamed, (2024) highlighted the motivational dimension of flipped classrooms in language-learning contexts, showing how students develop greater self-efficacy and commitment when autonomy and formative feedback are intentionally designed. Finally, Alpat & Görgülü, (2024) demonstrated that flipped environments cultivate critical thinking, reflection, and academic writing skills, confirming that the model's potential extends beyond procedural knowledge toward the realm of transformative learning.

Altogether, these six studies reaffirm that the flipped classroom stands at the intersection of technological innovation, active pedagogy, and competency development. However, they also expose persisting gaps that must be addressed: the uneven quality of research designs, the scarcity of longitudinal data, the limited focus on teacher professionalization, and the absence of large-scale comparative evidence across educational levels and regions. The alignment between this bibliometric evidence and the theoretical foundations of active learning indicates that the flipped classroom functions as a mediator between cognitive engagement and academic achievement, positioning it as a bridge between learning theory and measurable educational performance.

The convergence of these findings reveals that the success of flipped learning depends not only on digital tools or instructional videos but on the thoughtful alignment of curriculum, pedagogy, and assessment with learner autonomy and contextual needs. This reinforces the main objective of the present study: to systematize and interpret global research trends to understand how the flipped classroom contributes to skill formation and academic performance through active, student-centered learning. Consequently, future research should deepen the exploration of how artificial intelligence, personalised learning

analytics, and STEAM-oriented curricula can consolidate the flipped classroom as an inclusive, adaptable, and evidence-based methodology. Integrating these dimensions will enable educational systems to bridge the gap between innovation and equity, fostering a new generation of learners capable of critical inquiry, collaboration, and lifelong learning.

This discussion confirms that the flipped classroom's contribution to the development of skills and improvement of academic performance is both measurable and conceptually grounded. However, further empirical and bibliometric work is needed to determine the degree to which these competencies translate into long-term professional outcomes. By situating this analysis within the global educational agenda, this study provides a replicable model for evaluating innovation in teaching through bibliometric evidence, reinforcing the coherence between the study's objective, results, and conclusions.

6 CONCLUSIONS

The flipped classroom is established as a revolutionary methodology that has the power to change the way of teaching, especially in the university context. The bibliometric review shows a continuous increase in scientific production, with evident benefits such as improved academic performance, increased motivation among students, and greater active participation. However, challenges are also recognized, such as the importance of promoting student self-regulation and efficiently organizing the use of technologies and assessment methods.

This study fulfilled its main objective of analyzing, through a bibliometric approach, the global research on the flipped classroom and its relationship with skill development and academic performance. The analysis of publications indexed between 1971 and 2024 allowed the identification of thematic concentrations, collaboration networks, and the main conceptual and methodological trends that explain how flipped learning contributes to both individual and institutional educational outcomes.

This study offers an organized perspective on the current situation in the area, highlighting the most relevant authors, thematic trends, and emerging fields, such as artificial intelligence and personalized learning. The evidence obtained indicates that research on the flipped classroom has evolved from focusing on teaching innovation to addressing the measurable impact on student competencies such as autonomy, critical thinking, and teamwork. These findings validate the growing recognition of the flipped classroom as a driver of competency-based and performance-oriented education.

To advance its implementation, it is essential that institutions modify the model according to their contexts, train teachers and students, and develop educational proposals that align with their goals. Institutional leadership, pedagogical coherence, and digital infrastructure emerge as determining factors in ensuring that flipped learning transcends the level of methodology to become a systemic innovation in higher education. The incorporation of Information and Communication Technologies (ICT) remains fundamental to facilitating access to resources, interaction, and personalized feedback, while maintaining the human dimension of teaching.

Future research should address the existing gaps identified in this review, particularly the limited number of studies focused on postgraduate education, teacher professional development, and long-term impact assessment. Expanding the scope of analysis to include longitudinal and comparative studies will make it possible to assess how flipped learning affects the sustained acquisition of competencies and its translation into improved academic and professional performance. Moreover, a stronger empirical focus on teacher training and the assessment of soft skills would contribute to building more valid and transferable evidence across disciplines.

It is also necessary to strengthen empirical evidence on how the flipped classroom contributes to soft-skill acquisition, interdisciplinary collaboration, and equity in digital learning environments. In this sense, the integration of Science, Technology, Engineering, Arts, and Mathematics (STEAM)-oriented approaches, along with advances in artificial intelligence and learning analytics, opens new possibilities for adaptive learning and the design of inclusive educational ecosystems that favor the participation and empowerment of all students. Expanding bibliometric analyses to databases such as Web of Science or the Education Resources Information Center (ERIC) could provide broader insights into regional trends and collaboration networks.

In conclusion, the findings of this study confirm that the flipped classroom is not only a didactic strategy but an evolving educational paradigm that bridges technology, pedagogy, and skill development. Its global expansion, reflected in the bibliometric data, demonstrates a growing academic consensus on its effectiveness, while also revealing the need for deeper and contextually grounded research. Strengthening the connection between flipped learning, competency development, and academic performance will be essential to guide future reforms in higher education and to ensure that innovation translates into meaningful and equitable learning outcomes.

AUTHORS' CONTRIBUTIONS

Jesús Abraham Zazueta-Castillo: writing (original draft), writing (review & editing). Carlos Jesús Hinojosa-Rodríguez: conceptualization, resources, software, supervision, validation, visualization. Alberto Galván-Corral: conceptualization, resources, software, supervision, validation, visualization.

FUNDING

Not applicable.

DATA AVAILABILITY STATEMENT

The work used data from the Scopus repository.

ACKNOWLEDGEMENTS

No other support was provided.

CONFLICTS OF INTEREST

The authors declare that they have no conflict of interest.

REFERENCES

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

Alpat, M. F., & Görgülü, E. (2024). Transformative learning: flipped classroom and its impact on writing skill and critical thinking level. *Open Praxis*, *16*(3), 396–409. https://doi.org/10.55982/openpraxis.16.3.704

Al-Samarraie, H., Shamsuddin, A., & Alzahrani, A. I. (2020). A flipped classroom model in higher education: A review of the evidence across disciplines. *Educational Technology Research and Development*, *68*(3), 1017–1051. Scopus. https://doi.org/10.1007/s11423-019-09718-8

Aria, M., & Cuccurullo, C. (2017, noviembre). *Bibliometrix: An R-tool for comprehensive science mapping analysis*. *11*, 959–975. 10.1016/j.joi.2017.08.007. 10.1016/j.joi.2017.08.007

Baig, M. I., & Yadegaridehkordi, E. (2023). Flipped classroom in higher education: A systematic literature review and research challenges. *International Journal of Educational Technology in Higher Education*, *20*(1), 61. https://doi.org/10.1186/s41239-023-00430-5

Betihavas, V., Bridgman, H., Kornhaber, R., & Cross, M. (2016). The evidence for "flipping out": A systematic review of the flipped classroom in nursing education. *Nurse Education Today*, *38*, 15–21. Scopus. https://doi.org/10.1016/j.nedt.2015.12.010

Bhagat, K. K., Chang, C.-N., & Chang, C.-Y. (2016). The impact of the flipped classroom on mathematics concept learning in high school. *Educational Technology and Society*, *19*(3), 134–142. Scopus. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85000733446&partnerID=40&md5=84fc666a02d0678da6f38fca26ed95d7

Brewer, R., & Movahedazarhouligh, S. (2018). Successful stories and conflicts: A literature review on the effectiveness of flipped learning in higher education. *Journal of Computer Assisted Learning*, *34*(4), 409–416. Scopus. https://doi.org/10.1111/jcal.12250

Castillo Castillo, M. (2025). Relación entre el diseño curricular por competencias y el enfoque steam: propuesta de estrategia procedimental para la planificación didáctica en los politécnicos del distrito 03-04 de la República Dominicana. *Sciencevolution*, *4*(3), 73–87. https://doi.org/10.61325/ser.v4i3.209

Chang, S.-C., & Hwang, G.-J. (2018). Impacts of an augmented reality-based flipped learning guiding approach on students' scientific project performance and perceptions. *Computers and Education*, *125*, 226–239. Scopus. https://doi.org/10.1016/j.compedu.2018.06.007

Chen, F., Lui, A. M., & Martinelli, S. M. (2017). A systematic review of the effectiveness of flipped classrooms in medical education. *Medical Education*, *51*(6), 585–597. Scopus. https://doi.org/10.1111/medu.13272

Dan, L., & Binti Mohamed, H. (2024). A systematic review of the impact on flipped classroom towards students' motivation in language teaching. *International Journal of Academic Research in Business and Social Sciences*, *14*(6), Pages 727-747. https://doi.org/10.6007/IJARBSS/v14-i6/21671

Davies, R. S., Dean, D. L., & Ball, N. (2013). Flipping the classroom and instructional technology integration in a college-level information systems spreadsheet course. *Educational Technology Research and Development*, *61*(4), 563–580. Scopus. https://doi.org/10.1007/s11423-013-9305-6

del Arco, I., Mercadé-Melé, P., Ramos-Pla, A., & Flores-Alarcia, Ò. (2022). Bibliometric analysis of the flipped classroom pedagogical model: Trends and strategic lines of study. *Frontiers in Education*, *7*. Scopus. https://doi.org/10.3389/feduc.2022.1022295

Fautch, J. M. (2015). The flipped classroom for teaching organic chemistry in small classes: Is it effective? *Chemistry Education Research and Practice*, *16*(1), 179–186. Scopus. https://doi.org/10.1039/c4rp00230j

Ferreri, S. P., & O'Connor, S. K. (2013). Redesign of a large lecture course into a small-group learning course. *American Journal of Pharmaceutical Education*, *77*(1). Scopus. https://doi.org/10.5688/ajpe77113

Foldnes, N. (2016). The flipped classroom and cooperative learning: Evidence from a randomised experiment. *Active Learning in Higher Education*, *17*(1), 39–49. Scopus. https://doi.org/10.1177/1469787415616726

Gallardo-Guerrero, A.-M., Maciá-Andreu, M.-J., Conde-Pascual, E., Sánchez-Sáez, J.-A., Zurita-Ortiz, B., & García-Tascón, M. (2022). From flipped classroom to personalised learning as an innovative teaching methodology in the area of sports management in physical activity and sport sciences. *Sustainability*, *14*(13), 7714. https://doi.org/10.3390/su14137714

González-Gómez, D., Jeong, J. S., Airado Rodríguez, D., & Cañada-Cañada, F. (2016). Performance and perception in the flipped learning model: an initial approach to evaluate the effectiveness of a new teaching methodology in a general science classroom. *Journal of Science Education and Technology*, *25*(3), 450–459. Scopus. https://doi.org/10.1007/s10956-016-9605-9

Gross, D., Pietri, E. S., Anderson, G., Moyano-Camihort, K., & Graham, M. J. (2015). Increased preclass preparation underlies student outcome improvement in the flipped classroom. *CBE Life Sciences Education*, *14*(4), 1–8. Scopus. https://doi.org/10.1187/cbe.15-02-0040

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

Hew, K. F., Jia, C., Gonda, D. E., & Bai, S. (2020). Transitioning to the "new normal" of learning in unpredictable times: Pedagogical practices and learning performance in fully online flipped classrooms. *International Journal of Educational Technology in Higher Education*, *17*(1). Scopus. https://doi.org/10.1186/s41239-020-00234-x

Huang, A. Y. Q., Lu, O. H. T., & Yang, S. J. H. (2023). Effects of artificial Intelligence–Enabled personalized recommendations on learners' learning engagement, motivation, and outcomes in a flipped classroom. *Computers and Education*, *194*. Scopus. https://doi.org/10.1016/j.compedu.2022.104684

Hung, H.-T. (2015). Flipping the classroom for English language learners to foster active learning. *Computer Assisted Language Learning*, *28*(1), 81–96. Scopus. https://doi.org/10.1080/09588221.2014.967701

Iglesias-Pradas, S., Hernández-García, Á., Chaparro-Peláez, J., & Prieto, J. L. (2021). Emergency remote teaching and students' academic performance in higher education during the COVID-19 pandemic: A case study. *Computers in Human Behavior*, *119*. Scopus. https://doi.org/10.1016/j.chb.2021.106713

Kerr, B. (2015). The flipped classroom in engineering education: A survey of the research. *Proc. Int. Conf. Interact. Collab. Learn., ICL*, 815–818. Scopus. https://doi.org/10.1109/ICL.2015.7318133

Khanova, J., Roth, M. T., Rodgers, J. E., & Mclaughlin, J. E. (2015). Student experiences across multiple flipped courses in a single curriculum. *Medical Education*, *49*(10), 1038–1048. Scopus. https://doi.org/10.1111/medu.12807

Kong, S. C. (2014). Developing information literacy and critical thinking skills through domain knowledge learning in digital classrooms: An experience of practicing flipped classroom strategy. *Computers and Education*, *78*, 160–173. Scopus. https://doi.org/10.1016/j.compedu.2014.05.009

Lai, C.-L., & Hwang, G.-J. (2016). A self-regulated flipped classroom approach to improving students' learning performance in a mathematics course. *Computers and Education*, *100*, 126–140. Scopus. https://doi.org/10.1016/j.compedu.2016.05.006

Lapitan, L. D., Tiangco, C. E., Sumalinog, D. A. G., Sabarillo, N. S., & Diaz, J. M. (2021). An effective blended online teaching and learning strategy during the COVID-19 pandemic. *Education for Chemical Engineers*, *35*, 116–131. Scopus. https://doi.org/10.1016/j.ece.2021.01.012

Lin, C.-J., & Hwang, G.-J. (2018). A learning analytics approach to investigating factors affecting EFL students' oral performance in a flipped classroom. *Educational Technology and Society*, *21*(2), 205–219. Scopus. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85046101070&partnerID=40&md5=f739e2c76dcb5320b9d4b0b1471cefa4

Long, T., Cummins, J., & Waugh, M. (2017). Use of the flipped classroom instructional model in higher education: Instructors' perspectives. *Journal of Computing in Higher Education*, *29*(2), 179–200. Scopus. https://doi.org/10.1007/s12528-016-9119-8

Love, B., Hodge, A., Grandgenett, N., & Swift, A. W. (2014). Student learning and perceptions in a flipped linear algebra course. *International Journal of Mathematical Education in Science and Technology*, *45*(3), 317–324. Scopus. https://doi.org/10.1080/0020739X.2013.822582

Mason, G. S., Shuman, T. R., & Cook, K. E. (2013). Comparing the effectiveness of an inverted classroom to a traditional classroom in an upper-division engineering course. *IEEE Transactions on Education*, *56*(4), 430–435. Scopus. https://doi.org/10.1109/TE.2013.2249066

McLaughlin, J. E., Griffin, L. M., Esserman, D. A., Davidson, C. A., Glatt, D. M., Roth, M. T., Gharkholonarehe, N., & Mumper, R. J. (2013). Pharmacy student engagement, performance, and perception in a flipped satellite classroom. *American Journal of Pharmaceutical Education*, *77*(9). Scopus. https://doi.org/10.5688/ajpe779196

McLaughlin, J. E., Roth, M. T., Glatt, D. M., Gharkholonarehe, N., Davidson, C. A., Griffin, L. M., Esserman, D. A., & Mumper, R. J. (2014). The flipped classroom: A course redesign to foster learning and engagement in a health professions school. *Academic Medicine*, *89*(2), 236–243. Scopus. https://doi.org/10.1097/ACM.0000000000000086

Missildine, K., Fountain, R., Summers, L., & Gosselin, K. (2013). Flipping the classroom to improve student performance and satisfaction. *Journal of Nursing Education*, *52*(10), 597–599. Scopus. https://doi.org/10.3928/01484834-20130919-03

Moraros, J., Islam, A., Yu, S., Banow, R., & Schindelka, B. (2015). Flipping for success: Evaluating the effectiveness of a novel teaching approach in a graduate level setting. *BMC Medical Education*, *15*(1). Scopus. https://doi.org/10.1186/s12909-015-0317-2

Morton, D. A., & Colbert-Getz, J. M. (2017). Measuring the impact of the flipped anatomy classroom: The importance of categorizing an assessment by Bloom's taxonomy. *Anatomical Sciences Education*, *10*(2), 170–175. Scopus. https://doi.org/10.1002/ase.1635

Murillo-Zamorano, L. R., López Sánchez, J. Á., & Godoy-Caballero, A. L. (2019). How the flipped classroom affects knowledge, skills, and engagement in higher education: Effects on students' satisfaction. *Computers and Education*, *141*. Scopus. https://doi.org/10.1016/j.compedu.2019.103608

Naing, C., Whittaker, M. A., Aung, H. H., Chellappan, D. K., & Riegelman, A. (2023). The effects of flipped classrooms to improve learning outcomes in undergraduate health professional education: A systematic review. *Campbell Systematic Reviews*, *19*(3), e1339. https://doi.org/10.1002/cl2.1339

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

Pierce, R., & Fox, J. (2012). Vodcasts and active-learning exercises in a "flipped classroom" model of a renal pharmacotherapy module. *Am. J. Pharm. Educ.*, *76*(10). Scopus. https://doi.org/10.5688/ajpe7610196

Ramnanan, C. J., & Pound, L. D. (2017). Advances in medical education and practice: Student perceptions of the flipped classroom. *Advances in Medical Education and Practice*, *8*, 63–73. Scopus. https://doi.org/10.2147/AMEP.S109037

Ryan, M. D., & Reid, S. A. (2016). Impact of the flipped classroom on student performance and retention: a parallel controlled study in general chemistry. *Journal of Chemical Education*, *93*(1), 13–23. Scopus. https://doi.org/10.1021/acs.jchemed.5b00717

Schultz, D., Duffield, S., Rasmussen, S. C., & Wageman, J. (2014). Effects of the flipped classroom model on student performance for advanced placement high school chemistry students. *Journal of Chemical Education*, *91*(9), 1334–1339. Scopus. https://doi.org/10.1021/ed400868x

Shyr, W.-J., & Chen, C.-H. (2018). Designing a technology-enhanced flipped learning system to facilitate students' self-regulation and performance. *Journal of Computer Assisted Learning*, *34*(1), 53–62. Scopus. https://doi.org/10.1111/jcal.12213

Stöhr, C., Demazière, C., & Adawi, T. (2020). The polarizing effect of the online flipped classroom. *Computers and Education*, *147*. Scopus. https://doi.org/10.1016/j.compedu.2019.103789

Strelan, P., Osborn, A., & Palmer, E. (2020). The flipped classroom: A meta-analysis of effects on student performance across disciplines and education levels. *Educational Research Review*, *30*. Scopus. https://doi.org/10.1016/j.edurev.2020.100314

Tang, F., Chen, C., Zhu, Y., Zuo, C., Zhong, Y., Wang, N., Zhou, L., Zou, Y., & Liang, D. (2017). Comparison between flipped classroom and lecture-based classroom in ophthalmology clerkship. *Medical Education Online*, *22*(1). Scopus. https://doi.org/10.1080/10872981.2017.1395679

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

Tsai, H.-L., & Wu, J.-F. (2020). Bibliometric analysis of flipped classroom publications from the Web of Science Core Collection published from 2000 to 2019. *Science Editing*, *7*(2), 163–168. Scopus. https://doi.org/10.6087/KCSE.212

Tune, J. D., Sturek, M., & Basile, D. P. (2013). Flipped classroom model improves graduate student performance in cardiovascular, respiratory, and renal physiology. *American Journal of Physiology - Advances in Physiology Education*, *37*(4), 316–320. Scopus. https://doi.org/10.1152/advan.00091.2013

Turan, Z., & Akdag-Cimen, B. (2020). Flipped classroom in English language teaching: A systematic review. *Computer Assisted Language Learning*, *33*(5–6), 590–606. Scopus. https://doi.org/10.1080/09588221.2019.1584117

Velegol, S. B., Zappe, S. E., & Mahoney, E. (2015). The evolution of a flipped classroom: Evidence-based recommendations. *Advances in Engineering Education*, *4*(3). Scopus. https://www.scopus.com/inward/record.uri?eid=2-s2.0-84928332328&partnerID=40&md5=14f80b2f051803efb375a6f5d1b3607b

Wilson, S. G. (2013). The flipped class: a method to address the challenges of an undergraduate statistics course. *Teaching of Psychology*, *40*(3), 193–199. Scopus. https://doi.org/10.1177/0098628313487461

Zainuddin, Z. (2018). Students' learning performance and perceived motivation in gamified flipped-class instruction. *Computers and Education*, *126*, 75–88. Scopus. https://doi.org/10.1016/j.compedu.2018.07.003