

Teaching financial mathematics through the flipped classroom: a bibliometric study

Enseñanza de las matemáticas financieras a través del aula invertida: un estudio bibliométrico

Received: 26/07/2025 - Accepted: 24/10/2025

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Abstract

Teaching financial mathematics through the flipped classroom is essential for conveying, understanding, and applying financial concepts in an academic context. This article therefore set out to analyze research on teaching financial mathematics through the flipped classroom, with the aim of identifying possible avenues for future research. A study was conducted using a bibliometric approach. Articles from the Scopus database were analyzed using the Bibliometrix and Posit Cloud (RStudio) packages in research related to the variables “flipped classroom” and “financial mathematics.” Of the 268 articles found, an increase in scientific production was reported between 2011 and 2015, with a decrease to only ten publications in 2016. Ten leading journals stand out in which bibliometric analysis research on the flipped classroom in financial mathematics is published. Likewise, relevant institutions were identified, such as the University of La Sabana (Colombia) and ULM University (Germany). In addition, two large collaboration groups were observed, the United States and Germany, which are consolidating themselves as the main research network and show greater scientific production. This analysis revealed various trends in the learning of financial mathematics through flipped classrooms, showing steady growth in scientific output until 2021; however, a decline in the number of citations suggests a disconnect between the amount of research and its impact. These findings emphasize the need to evaluate the quality and impact of research in this emerging area.

Keywords: learning, teaching method, university

Resumen

La enseñanza de matemáticas financieras mediante el aula invertida es fundamental para transmitir, comprender y aplicar concepto financieros en un contexto académico. De allí que este artículo se propuso analizar la investigación sobre la enseñanza de las matemáticas financieras mediante el aula invertida, con el fin de identificar posibles líneas de investigación futura. Se realizó un estudio con un enfoque bibliométrico. Se analizaron artículos de la base de datos Scopus, utilizando el paquete Bibliometrix y Posit Cloud (RStudio), en investigaciones relacionadas con las variables “aula invertida” y “matemática financiera”. De los 268 artículos encontrados, se reportó un aumento de la producción científica entre los años 2011 y 2015, con una disminución

a solo diez publicaciones en 2016. Destacan diez revistas principales en las que se publican investigaciones de análisis bibliométrico del aula invertida en matemáticas financieras. Asimismo, se identificaron instituciones relevantes, como Universidad de La Sabana (Colombia), ULM University (Alemania). Además, se observaron dos grandes grupos de colaboración, Estados Unidos y Alemania, quienes se consolidan como la principal red de investigación y muestran una mayor producción científica. Este análisis mostró diversas tendencias en el aprendizaje de las matemáticas financieras a través de aulas invertidas, lo que evidencia un crecimiento constante en la producción científica hasta 2021; sin embargo, una disminución en el número de citas sugiere una desconexión entre la cantidad de investigación y su impacto. Estos hallazgos enfatizan la necesidad de evaluar la calidad y el impacto de la investigación en esta área emergente.

Palabras clave: aprendizaje, método de enseñanza, universidad

Introduction

The flipped classroom is an active teaching methodology (Sarvarizadeh et al., 2024). It involves students engaging with thematic content outside the classroom, allowing class time to be devoted to practical activities and addressing queries that arise while viewing videos, readings, and other resources (O’Flaherty & Phillips, 2015; Espinosa et al., 2018; Wu et al., 2024). In face-to-face sessions, concepts are deepened, and problems are resolved collaboratively and practically (Bergmann & Sams, 2012). This approach facilitates the organization of class time and promotes deeper learning (Alarcón & Alarcón, 2021). Furthermore, the flipped classroom is widely utilized to enhance classroom interaction, foster active learning, personalize instruction, and improve student academic performance (Ledo et al., 2016). This strategy also boosts student motivation by allowing for greater personalization of learning experiences (Escudero-Nahón et al., 2019). Technological advancements have bolstered this methodology, enabling individuals to learn and improve their skills in a simple and practical manner (Alcayhuamán et al., 2022). In this context, the role of the teacher evolves into that of a guide and facilitator of the learning process (Liu et al., 2024), indicating the path forward while avoiding parallel or premature advancement compared to students (Lopes & Soaresb, 2018; Moya, 2017). In light of these points, it can be asserted that the implementation of the flipped classroom as a teaching and learning strategy yields favorable outcomes for students.

The flipped classroom method has been developed over recent decades by various researchers (Bergmann & Sams, 2012), but its application across different educational levels and disciplines has been primarily documented since the early 2000s (Fidalgo-Blanco et al., 2020; Keong & JiMei, 2024). Studies indicate that the implementation of the flipped classroom correlates with improvements in academic performance, self-regulated learning, student motivation, collaboration, and levels of participation among peers (Escudero-Nahón et al., 2019). Therefore, the adoption of this methodology that fosters student-centered teaching and learning in various fields is imperative (Suire et al., 2024). This will facilitate better academic development, especially in the current landscape, where technology and virtual learning advance exponentially, enabling learning from home (Rincon-Flores et al., 2024). Moreover, these practices can effectively complement in-person classes, where instructors can address student queries, thus enhancing their comprehension and understanding.

The teaching of financial mathematics is crucial for equipping students with practical skills for managing financial aspects in everyday life and professional environments (Zeledón, 2018). While this instruction plays a fundamental role in developing financial competencies, it also presents challenges regarding the understanding and application of complex concepts (Koju et al., 2018). Over recent decades, diverse pedagogical approaches have been researched and developed to enhance the teaching of financial mathematics, including the integration of technology (Neri Ayala et al., 2020), the implementation of active learning strategies (Genes et al., 2017), and the exploration of case-based teaching methods (Carangui et al., 2017). Specific areas have been addressed, such as the evaluation of the effectiveness of various teaching methods (Cevallos, 2020) and the adaptation of content for diverse contexts and audiences (Breda et al., 2018). Therefore, research continues to evolve in this field, aiming to improve the effectiveness and impact of financial mathematics instruction.

In recent years, there has been a surge of interest in the use of the flipped classroom (Ohlenburg et al., 2024) for teaching financial mathematics. Although the literature on this topic is limited, its significance is recognized, and there is an expectation for greater investigation into its benefits and challenges across various educational contexts (Keong & JiMei, 2024). Additionally, there is a growing interest in the application of game theory (Holler, 2002), which relates to financial mathematics by employing mathematical models in financial decision-making, although much remains to be explored in this area (Domínguez et al., 2023).

The primary purpose of the present study is to analyze research concerning the teaching of financial mathematics through the flipped classroom, in order to identify potential avenues for future research (Gong et al.,

2024). This study aims to underscore the importance of applying this pedagogical approach in the instruction of this discipline, particularly in such a critical field as financial mathematics (Shen et al., 2024). Moreover, it is anticipated that the findings will significantly contribute to the scientific understanding of this area (Ni et al., 2024). Additionally, this study is expected to be highly beneficial to both the scientific community and academic practitioners. Consequently, it is hoped that the insights gained from this research will provide a robust foundation for the implementation of the flipped classroom methodology in university settings, which could enhance the learning process for students. In this manner, the study justifies the importance of investigating the application of the flipped classroom methodology in teaching financial mathematics, aiming to promote greater learning and understanding within this domain.

In this regard, the forthcoming bibliometric study aims to quantitatively evaluate patterns and trends in the scientific literature (Tiwari et al., 2023), systematically review the historical research relevant to this field, and explore its future directions within specific scientific disciplines. This study will provide a detailed analysis of the current state of research, identify critical issues, and establish a network of international collaboration among countries, institutions, or key authors.

Methodology

Bibliometric analysis is a tool that employs mathematical and statistical methods to examine scientific production (Wang et al., 2024). This technique has been utilized across various disciplines, including environmental sciences, due to its advantages such as data visualization, quantitative analysis, and the discovery of knowledge patterns (Hetu, 2018; Torres-Salinas et al., 2024).

The present study adopts a quantitative, bibliometric approach featuring an observational, longitudinal, and retrospective design. It focuses on analyzing existing scientific production in the Scopus database rather than manipulating variables. The aim is to provide evidence regarding trends in the teaching of financial mathematics through the flipped classroom methodology.

Data collection occurred on May 30, 2024. The methodology relied on the Elsevier Scopus database to conduct a comprehensive bibliometric search (Visconti-López et al., 2022). A total of 268 documents were collected, including articles, conference papers, conference reviews, and reviews. All document types were considered without exclusion to thoroughly analyze research trends. Citation data and bibliographic information, along with abstracts and keywords derived from the acquired results (He et al., 2022), were exported to a CSV file for subsequent analysis.

The keyword search formula used was: (TITLE-ABS-KEY("inverted classroom" + "financial mathematics") OR TITLE-ABS-KEY("inverted classroom" + "teaching") OR TITLE-ABS-KEY("inverted classroom" + "finance") AND TITLE-ABS-KEY("inverted classroom")) AND PUBYEAR > 2003 AND PUBYEAR < 2024.

Analysis focused on a sample of 268 documents published between 2004 and 2023, obtained from the Scopus database. The Bibliometrix package in Posit Cloud (RStudio) was utilized to identify studies related to the flipped classroom methodology in financial mathematics. Additionally, the bibliometric study adhered to the ethical standards established by the university's scientific integrity committee. Finally, works published after 2023 were excluded from the study. The limitations were: (1) the database is restricted to articles indexed in Scopus, published from 2004 to 2023; (2) the study employed Posit Cloud (RStudio), utilizing the Bibliometrix package for analysis.

Results and discussion

Figure 1 illustrates annual scientific production from 2004 to 2023. A sustained growth is evident from 2011 to 2015. However, in 2016, the number of publications decreased to an average of 10 per year. Starting in 2017, an upward trend was noted, peaking in 2021 with an average of 40 articles per year. It is noteworthy that this increase was temporary and intermittent, as evidenced in the years 2013, 2015, and 2017 through 2021, followed by a decline up to 2023. This suggests that some authors do not maintain consistent publication rates but instead publish intermittently.

Figure 1
Annual scientific production (2004-2023)

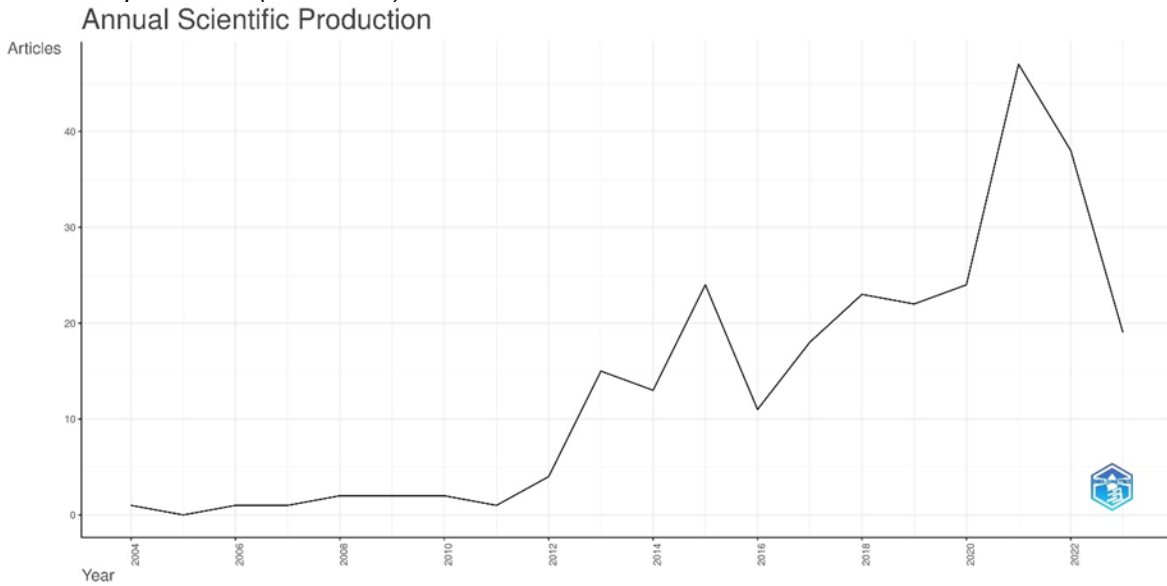
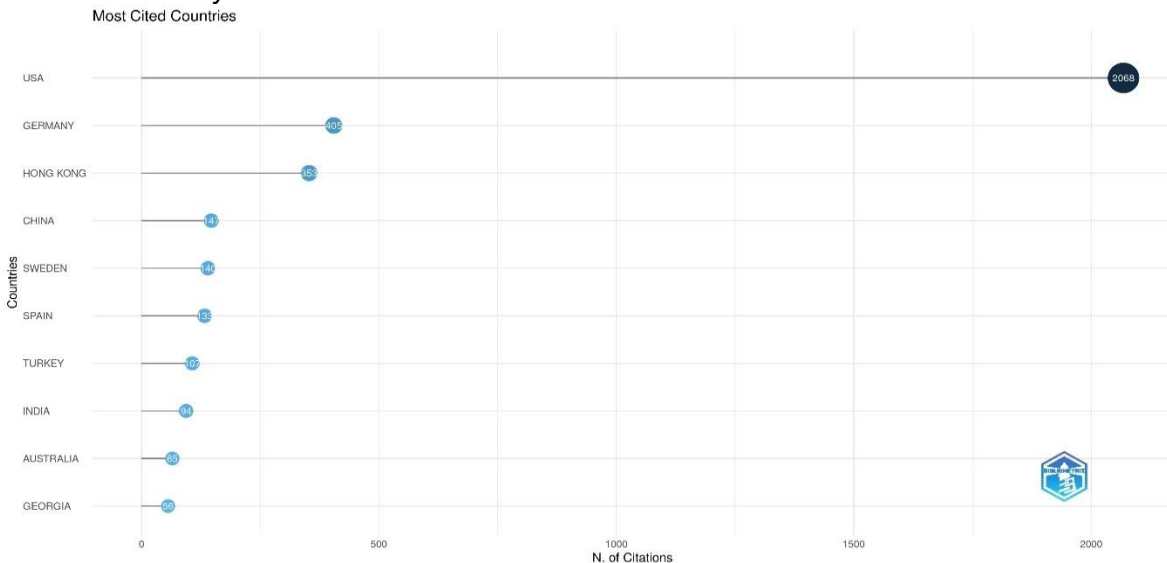


Figure 2 visualizes the relationship among countries, the number of documents per country, and citation counts. The countries with the highest number of documents in the study area are the United States and Germany. Furthermore, the most cited country is the United States, followed by Germany, with Hong Kong in third place, China next, and Sweden last. Various countries are represented by points with varying citation values along the "x" axis. The United States stands out with approximately 2068 citations, followed by Germany with around 418 citations and Hong Kong with about 405 citations. Other countries, such as China, have 353 citations and Sweden has 140. The distribution of points in the graph visually illustrates how these countries rank regarding citations received, with the United States being a significant leader in this dataset.

Figure 2
Most relevant citations by countries



Scientific production often results from institutional collaboration. Figure 3 displays various academic institutions and the number of articles associated with each. According to the figure, the universities leading the study of financial mathematics learning through flipped classrooms are Universidad de la Sabana (Colombia) with

20 published articles, ULM University (Germany) with 18, The University of Hong Kong (Hong Kong) with 17 articles, and Ohio State University (USA) with 9 articles.

Figure 3
Author-institution collaboration

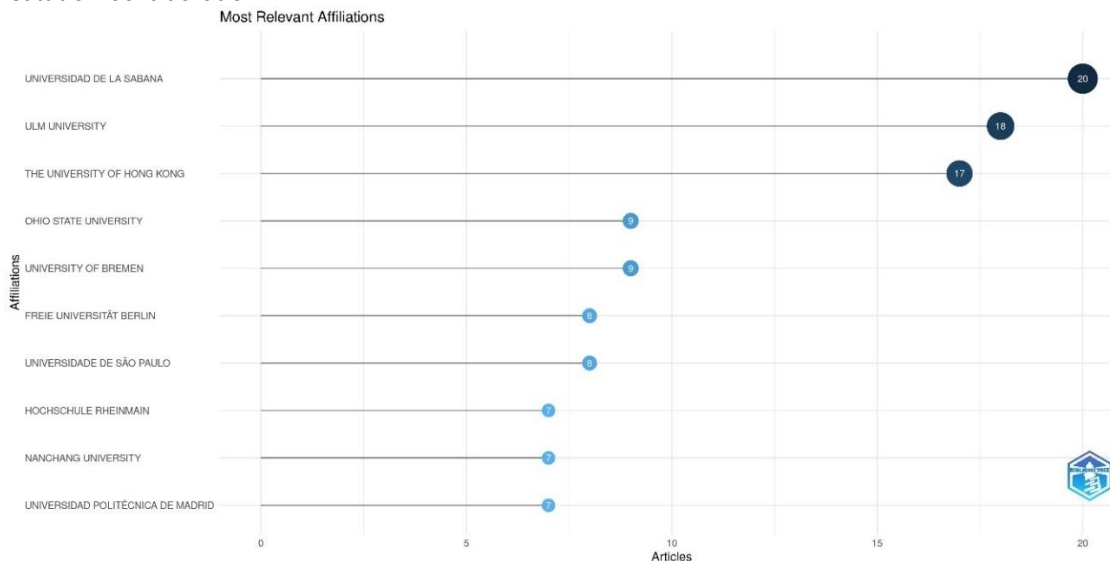
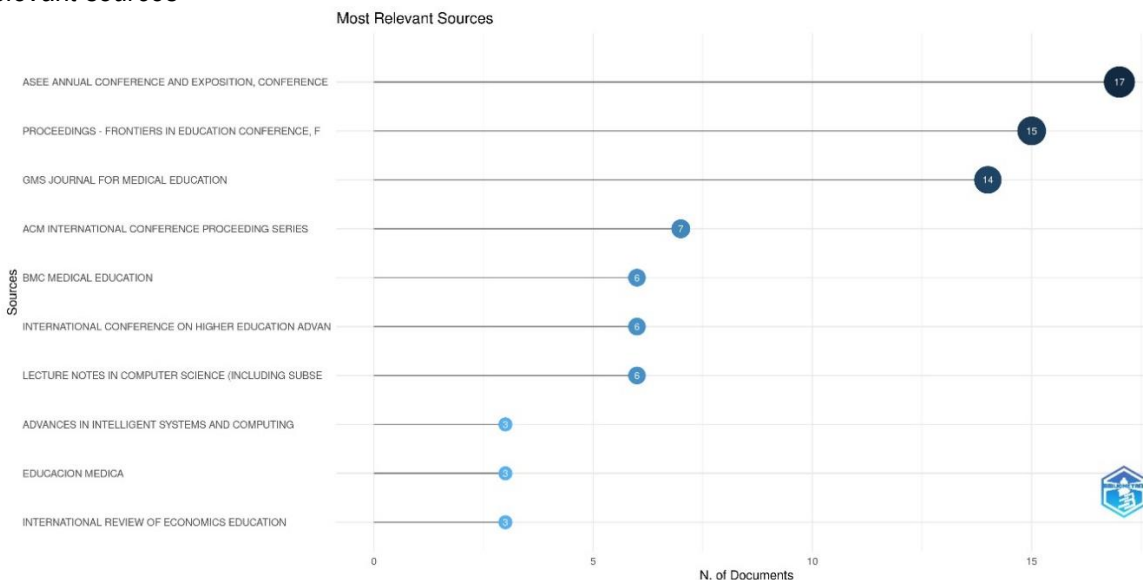


Figure 4 provides a clear visual representation of document distribution among various academic sources. Notable sources include the "ASEE Annual Conference and Exposition, Conference" with 17 documents, followed by the "Proceedings - Frontiers in Education Conference" with 15 documents, the "GMS Journal for Medical Education" with 14 documents, and the "ACM International Conference Proceeding Series" with 7 published documents. Other sources are dispersed below these, with document counts ranging from 3 to 6. This visualization is instrumental in identifying the most relevant sources in a specific field, understanding research trends, and facilitating resource allocation decisions within the academic domain.

Figure 4
Most relevant sources



Keywords employed by authors in research pertaining to flipped classrooms and financial mathematics are outlined below. Statistical analysis of these keywords can provide research directions and serves as a useful method for delving deeper into scientific production. The 50 most frequently used keywords in the publications are enumerated in a Word TreeMap (Figure 5), along with their relative occurrences. The most frequently utilized

in research or the need for new innovations to maintain academic interest (Fung et al., 2021). Similarly, Lin and Hwang (2019) indicated that variability in the implementation of flipped classrooms may affect the consistency and impact of results, which could explain the observed disconnect in the analysis (Yang et al., 2021).

Moreover, scientific production in flipped classroom analysis has been bolstered by notable international collaboration. Universities such as Universidad de La Sabana (Colombia), ULM University (Germany), The University of Hong Kong, and Ohio State University (USA) have led in terms of publications, showcasing global academic leadership (Fung et al., 2021; Lo & Hew, 2021; Fernández-Martín et al., 2020). This international collaboration could be crucial for advancing knowledge and disseminating methodology, considering that the strong ties between countries like the USA and Germany highlight the importance of collaborative networks in the development of flipped classrooms (Colomo-Magaña et al., 2020; Yang et al., 2021).

From a theoretical perspective, this research reaffirms the significance of the flipped classroom methodology in the learning of financial mathematics. Theoretically, the results align with active learning theory, suggesting that flipped classroom methodologies can significantly enhance student academic performance (Chen et al., 2022; Yang et al., 2021; Lo & Hew, 2021). Practically, the results indicate that institutions should promote international collaboration to ensure research quality and maximize its impact. The identification of keyword trends can guide future research and practical applications in academic settings (Chen et al., 2022; Lo & Hew, 2021; Fung et al., 2021).

Despite these significant findings, this study has limitations. The results may be influenced by the reliance on specific databases and variability in publication quality. Therefore, future research is encouraged to focus on experimental studies to validate these findings and explore new research avenues. Additionally, it is essential to investigate the underlying reasons for the disconnect between scientific production and citation impact, as well as how this gap can be addressed (Rotellar & Cain, 2016; Algayres & Triantafyllou, 2020; Zainuddin & Halili, 2016).

Conclusions

A consistent growth was observed until 2015, peaking in 2021; however, this increase does not correspond with a proportional rise in citations, indicating a potential disconnect between the volume of research produced and its impact. The downward trend in citations since 2015 suggests a diminishing influence of the field within the academic community. These findings underscore the importance of assessing not only the quantity but also the quality and impact of research in the studied area.

Scientific production in the field of flipped classroom analysis has been driven by prominent international institutional collaboration. This reflects global academic leadership and a shared commitment to improving education through innovative pedagogical approaches.

The *ASEE Annual Conference and Exposition*, *Conference y los Proceedings - Frontiers in Education Conference* (FIE) are the most significant sources in the scientific production regarding flipped classrooms in financial mathematics education. Additionally, the *GMS Journal for Medical Education* and *BMC Medical Education* also feature prominently. The dynamics of these sources indicate a growing trend in publications, especially since 2006, highlighting the increasing interest of journals in articles related to learning methodologies.

Keyword analysis, network mapping, and the conceptual structure of research on flipped classrooms reveal that the most commonly used terms are "teaching," "inverted classroom," and "students." The relationships among these keywords suggest potential future research directions, such as linking the flipped classroom approach to subjects like financial mathematics, providing a valuable pathway for scientific production in this domain.

The United States and Germany lead in productivity and maintain a strong collaborative relationship, emphasizing their central role in advancing this area of research. These findings highlight the significance of collaborative networks in the development and dissemination of knowledge regarding flipped classroom methodologies and their association with financial mathematics.

Finally, this bibliometric study has identified various critical research points. It has been established that analyzing flipped classrooms in the context of financial mathematics learning represents an emerging field of inquiry. Furthermore, the flipped classroom methodology offers significant advantages for learning financial mathematics, such as improved academic performance and increased student engagement. With meticulous design and appropriate support, flipped classrooms have the potential to substantially transform teaching and learning within the context of financial mathematics.

References

- Alarcón, D. S., & Alarcón, O. (2021). El aula invertida como estrategia de aprendizaje. *Conrado*, 17(80), 152-157. <http://scielo.sld.cu/pdf/rc/v17n80/1990-8644-rc-17-80-152.pdf>
- Alcayhuamán, S., Sánchez, B., Santander, K. V., & Suárez, E. S. (2022). El aula invertida en la comprensión de textos: Revisión bibliométrica. *Salud, Ciencia y Tecnología - Serie de Conferencias*, 1, 263. <https://doi.org/10.56294/sctconf2022263>
- Algayres, M., & Triantafyllou, E. (2020). Learning Analytics in Flipped Classrooms: A Scoping Review. *Electronic Journal of E-Learning*, 18(5). <https://doi.org/10.34190/JEL.18.5.003>
- Bergmann, J., & Sams, A. (2012). *Flip Your Classroom: Reach Every Student in Every Class Every Day*. https://books.google.com.pe/books/about/Flip_Your_Classroom.html?hl=es&id=nBi2pwAACAAJ&redir_e_sc=y
- Breda, A., Font, V., Rosário, V. M., & Villela, M. (2018). Componentes e indicadores de los criterios de idoneidad didáctica desde la perspectiva del enfoque ontosemiótico. *Transformación*, 14(2), 162-176. http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S2077-29552018000200003
- Caranguí, L. R., Cajamarca, O. A., & Mantilla, X. A. (2017). Impacto del uso de simuladores en la enseñanza de la administración financiera. *Innovación educativa*, 17(75), 103-122. https://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S1665-26732017000300103
- Cevallos, J. C. (2020). Evaluación de las Estrategias Metodológicas del Trabajo Autónomo en el Aprendizaje de la Asignatura de Matemática Financiera. *Mikarimín. Revista Científica Multidisciplinaria*, 6, 63-82. <https://dialnet.unirioja.es/servlet/articulo?codigo=8605510>
- Chen, C. K., Huang, N. T. N., & Hwang, G. J. (2022). Findings and implications of flipped science learning research: A review of journal publications. *Interactive Learning Environments*, 30(5), 949-966. Scopus. <https://doi.org/10.1080/10494820.2019.1690528>
- Colomo-Magaña, E., Soto-Varela, R., Ruiz-Palmero, J., & Gómez-García, M. (2020). University Students' Perception of the Usefulness of the Flipped Classroom Methodology. *Education Sciences*, 10(10), <https://doi.org/10.3390/educsci10100275>
- Domínguez, L. C., Morab, C. M., & Restrepo, J. A. (2023). "Learning to learn" in the Extended Inverted Classroom: An evaluation of the effects of interactive teaching on knowledge and cognitive regulation in medical students. 52(4), 314-319. <https://doi.org/10.1016/j.rcp.2021.07.007>
- Escudero-Nahón, A., Mercado López, E. P., Escudero-Nahón, A., & Mercado López, E. P. (2019). Uso del análisis de aprendizajes en el aula invertida: Una revisión sistemática. *Apertura*, 11(2), 72-85. <https://doi.org/10.32870/ap.v11n2.1546>
- Espinosa, T., Solano, I., & Veit, E. A. (2018). *Aula invertida (flipped classroom): Innovando las clases de física*. 30(2), 59-73. <https://doi.org/10.55767/2451.6007.v30.n2.22736>
- Fernández-Martín, F. D., Romero-Rodríguez, J. M., Gómez-García, G., & Ramos Navas-Parejo, M. (2020). Impact of the Flipped Classroom Method in the Mathematical Area: A Systematic Review. *Mathematics*, 8(12), Article 12. <https://doi.org/10.3390/math8122162>
- Fidalgo-Blanco, Á., Sein-Echaluce, M. L., & García-Peñalvo, F. J. (2020). *Ventajas reales en la aplicación del método de Aula Invertida-Flipped Classroom*. <https://doi.org/10.5281/ZENODO.3610577>
- Fung, C. H., Besser, M., & Poon, K. K. (2021). Systematic Literature Review of Flipped Classroom in Mathematics. *Eurasia Journal of Mathematics, Science and Technology Education*, 17(6). <https://doi.org/10.29333/ejmste/10900>
- Genes, J., Nájera, F., & Monroy, S. (2017). *Metodologías activas para la solución de problemas al enseñar matemáticas financieras*. 23(1), 44-58. <https://www.redalyc.org/pdf/737/73753475005.pdf>
- Gong, J., Cai, S., & Cheng, M. (2024). Exploring the Effectiveness of Flipped Classroom on STEM Student Achievement: A Meta-analysis. *Technology, Knowledge and Learning*, 29(2), 1129-1150. <https://doi.org/10.1007/s10758-023-09700-7>
- He, W., Deng, Y., & Luo, X. (2022). Bibliometric analysis of the global research status and trends of the association between Vitamin D and infections from 2001 to 2021. *Frontiers in Public Health*, 10. <https://doi.org/10.3389/fpubh.2022.934106>
- Hetu, M. (2018). La bibliométrie et l'innovation: L'étude de l'impact de la propriété intellectuelle sur le progrès scientifique. *Ethics, Medicine and Public Health*, 4, 81-86. <https://doi.org/10.1016/j.jemep.2018.01.001>
- Holler, M. J. (2002). Classical, Modern, and New Game Theory. *Jahrbucher fur Nationalökonomie und Statistik*, 222(5), 556-583. <https://doi.org/10.1515/jbnst-2002-0504>

- Julia, J., Afrianti, N., Soomro, K. A., Supriyadi, T., Dolifah, D., Isrokatun, I., Erhamwilda, E., & Ningrum, D. (2020). Flipped Classroom Educational Model (2010-2019): A Bibliometric Study. *Başlık*, 9(4), 1377-1392. <https://doi.org/10.12973/eu-jer.9.4.1377>
- Keong, T. C., & JiMei, G. (2024a). Analysing Flipped Classroom Themes Trends in Computer Science Education (2007–2023) Using CiteSpace. *Journal of Advanced Research in Applied Sciences and Engineering Technology*, 46(1). <https://doi.org/10.37934/araset.46.1.1527>
- Keong, T. C., & JiMei, G. (2024b). Analysing Flipped Classroom Themes Trends in Computer Science Education (2007–2023) Using CiteSpace. *Journal of Advanced Research in Applied Sciences and Engineering Technology*, 46(1). <https://doi.org/10.37934/araset.46.1.1527>
- Koju, L., Koju, R., y Wang, S. (2018). Does Banking Management Affect Credit Risk? Evidence from the Indian Banking System. *International Journal of Financial Studies*, 6(3). <https://doi.org/10.3390/ijfs6030067>
- Ledo, M. V., Michelena, N. R., Cao, N. N., Suárez, I. del R. M., & Vidal, M. N. V. (2016). Aula invertida, nueva estrategia didáctica. *Revista Cubana de Educación Médica Superior*, 30(3), 678-688. http://www.scielo.sld.cu/scielo.php?script=sci_arttext&pid=S0864-21412016000300020
- Lin, H. C., & Hwang, G. J. (2019). Research trends of flipped classroom studies for medical courses: A review of journal publications from 2008 to 2017 based on the technology-enhanced learning model. *Interactive Learning Environments*, 27(8), 1011-1027. <https://doi.org/10.1080/10494820.2018.1467462>
- Liu, K., Liu, S., Ma, Y., Jiang, J., Liu, Z., & Wan, Y. (2024). Comparison of blended learning and traditional lecture method on learning outcomes in the evidence-based medicine course: A comparative study. *BMC Medical Education*, 24(1), 680. <https://doi.org/10.1186/s12909-024-05659-w>
- Lo, C. K., & Hew, K. F. (2017). Using «first principles of instruction» to design secondary school mathematics flipped classroom: The findings of two exploratory studies. *Educational Technology and Society*, 20(1). https://www.researchgate.net/publication/312045900_Using_First_Principles_of_Instruction_to_design_secondary_school_mathematics_flipped_classroom_The_findings_of_two_exploratory_studies
- Lo, C. K., & Hew, K. F. (2021). Student Engagement in Mathematics Flipped Classrooms: Implications of Journal Publications From 2011 to 2020. *Frontiers in Psychology*, 12. <https://doi.org/10.3389/fpsyg.2021.672610>
- Lopes, L., & Soaresb, F. (2018). *Perception and performance in a flipped Financial Mathematics classroom*. 16, 105-111. <https://doi.org/10.1016/j.ijme.2018.01.001>
- Moya, J. L. M. (2017). *La docencia universitaria mediante el enfoque del aula invertida*. Ediciones Octaedro. https://diposit.ub.edu/dspace/bitstream/2445/144100/1/MEDINA_La-docencia-universitaria-mediante-el-enfoque-del-aula-invertida_p.pdf
- Neri Ayala, A. C., Ramos y Yovera, S. E., & Caro Soto, F. (2020). Herramientas google en el aprendizaje de matemática financiera en los estudiantes universitarios. *Telos: Revista de Estudios Interdisciplinarios en Ciencias Sociales*, 22(2), 429-444. <https://dialnet.unirioja.es/servlet/articulo?codigo=7383221>
- Ni, Z. H., Huang, J., Yang, D. P., & Wang, J. (2024). Nursing students' experience of flipped classroom combined with problem-based learning in a paediatric nursing course: A qualitative study. *BMC Nursing*, 23(1), 88. <https://doi.org/10.1186/s12912-024-01744-z>
- O'Flaherty, J., & Phillips, C. (2015). The use of flipped classrooms in higher education: A scoping review. *The Internet and Higher Education*, 25, 85-95. <https://doi.org/10.1016/j.iheduc.2015.02.002>
- Ohlenburg, H., Arnemann, P. H., Hessler, M., Görlich, D., Zarbock, A., & Friederichs, H. (2024). Flipped Classroom: Improved team performance during resuscitation training through interactive pre-course content – a cluster-randomised controlled study. *BMC Medical Education*, 24(1), 459. <https://doi.org/10.1186/s12909-024-05438-7>
- Rincon-Flores, E. G., Castano, L., Guerrero Solis, S. L., Olmos Lopez, O., Rodríguez Hernández, C. F., Castillo Lara, L. A., & Aldape Valdés, L. P. (2024). Improving the learning-teaching process through adaptive learning strategy. *Smart Learning Environments*, 11(1), 27. <https://doi.org/10.1186/s40561-024-00314-9>
- Rotellar, C., & Cain, J. (2016). Research, Perspectives, and Recommendations on Implementing the Flipped Classroom. *American Journal of Pharmaceutical Education*, 80(2). <https://doi.org/10.5688/ajpe80234>
- Sarvarizadeh, M., Miri, S., Darban, F., & Farokhzadian, J. (2024). Innovative cultural care training: The impact of flipped classroom methods on critical cultural competencies in psychiatric nursing: a quasi-experimental study. *BMC Nursing*, 23(1), 340. <https://doi.org/10.1186/s12912-024-02001-z>
- Shen, J., Qi, H., Mei, R., & Sun, C. (2024). A comparative study on the effectiveness of online and in-class team-based learning on student performance and perceptions in virtual simulation experiments. *BMC Medical Education*, 24(1), 135. <https://doi.org/10.1186/s12909-024-05080-3>

- Suire, K., Hastert, M., Herrmann, S. D., & Donnelly, J. E. (2024). Feasibility of the flipped classroom approach for health education in a clinical weight loss program. *PEC Innovation*, 5, 100308. <https://doi.org/10.1016/j.pecinn.2024.100308>
- Tiwari, A., Dindorkar, N., & Kaur, S. (2023). Bibliometric and Knowledge Network of Global Research on Pile Foundations: A Review of Recent Developments. *Sustainability*, 15(14). <https://doi.org/10.3390/su151411108>
- Torres-Salinas, D., Orduña-Malea, E., Delgado-Vázquez, Á., Gorraiz, J., & Arroyo-Machado, W. (2024). Foundations of Narrative Bibliometrics. *Journal of Informetrics*, 18(3), 101546. <https://doi.org/10.1016/j.joi.2024.101546>
- Visconti-Lopez, F. J., Hernández-Vásquez, A., Azañedo, D., & Sanchez Carbonel, J. F. (2022). Global Research Trends in the Latarjet Procedure: A Bibliometric and Visualized Study. *Medicina*, 58(8). <https://doi.org/10.3390/medicina58081008>
- Wang, M., Xu, C., Wang, D., Lu, J., Wang, A., & Zhou, Q. (2024). Analysis of current trends in angiogenesis research for wound healing: A bibliometric study from 2013 to 2023. *Heliyon*, 10(12). <https://doi.org/10.1016/j.heliyon.2024.e32311>
- Wu, T., Xia, H., Sun, W., Ge, Y., Liu, C., He, F., Cheng, T., Zhao, Y., & Chen, S. (2024). Effectiveness of a flipped classroom for undergraduate in implant dentistry hands-on course. *BMC Medical Education*, 24(1), 545. <https://doi.org/10.1186/s12909-024-05536-6>
- Yang, Q. F., Lin, C. J., & Hwang, G. J. (2021). Research focuses and findings of flipping mathematics classes: A review of journal publications based on the technology-enhanced learning model. *Interactive Learning Environments*, 29(6), 905-938. <https://doi.org/10.1080/10494820.2019.1637351>
- Zainuddin, Z., & Halili, S. H. (2016). Flipped Classroom Research and Trends from Different Fields of Study. *The International Review of Research in Open and Distributed Learning*, 17(3). <https://doi.org/10.19173/irrodl.v17i3.2274>
- Zeledón, O. (2018). Importancia de Matemática Financiera para los estudiantes de las carreras Económicas y Administrativas. *Revista Multi-Ensayos*, 4(7). <https://doi.org/10.5377/multiensayos.v4i7.9489>