

 Review Article

Research Trends on Flipped Classroom: A Bibliometric Analysis (2012–2023)

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Abstract

Technology is developing very fast especially during the pandemic of COVID-19. The objectives of this paper are to analyze the current dynamics of the flipped classroom studies and offer a direction for further research on the topic. The Scopus database yielded a total of 3206 papers that were published in journals until September 2023. Search volume for “flipped classroom” rose over time and peaked in 2022, according to the data. The field was founded in 2012, as evidenced by the publication of the first paper. The most cited article was written by O’Flaherty J. and Phillips C. The most prolific writer is Hew, KF. In a flipped classroom, the most common topics are engineering, computer science, and social sciences. BMC Medical Education, Education Sciences, Education And Information Technologies are the most productive sources. Harvard Medical School, The University of Hong Kong, The Education University of Hong Kong are the most active institutions. United States, China and Spain are the most relevant countries. Trending keywords include “flipped classroom,” “human,” “humans,” “teaching,” and “education.” An extensive summary of the field’s research output and potential future prospects is given in this review.

Keywords: Bibliometric analysis, flipped Classroom, research trends, Scopus

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1. INTRODUCTION

Technology is developing very fast especially during the pandemic of Covid 19. Flipped Classroom (FC) is a learning model that uses technology. The FC model has been modified to incorporate new technologies and the prevalent online learning models (Namaziandost & Çakmak, 2020; Stöhr et al., 2020). Students are very actively involved in a flipped classroom (Subramaniam & Muniandy, 2019). In the flipped classroom, teachers discuss complex materials in the class, while simple materials are being assigned to students. Due to that, teacher have enough time for active learning in the classroom. Active learning covers discussions, individual projects or small scale groups, demonstrations, situational discussion, games, problem series, weekly reflection, freetime to work and investigation (Leo & Puzio, 2016).

Flipped classrooms allow participants to do independent study by the teacher with the help of online resources. This model applied to various disciplines knowledge (math, engineering, social knowledge, health knowledge, human knowledge, etc), at different levels and stages of education (primary education, secondary education, and tertiary education (Hao, 2016). The flipped classroom model is interesting for research because it has a postive impact for the participants. Flipped classroom trains participants to be independent and proactive. An approach known as “flipped classroom” involves teaching the skills and material that are typically taught in class outside of it, freeing up time for in-class activities such as case studies, discussions, tests, exercises, and simulations (Srinivasan et al., 2018) and work on deep collaborative tasks (Tomory & Watson, 2015).

A flipped classroom combines computer based learning, active and interactive learning, lecture based learning (Behmanesh et al., 2022) and student centered, based on constructivist learning theories, which

highlights how crucial it is for students to create social meaning from previously learned material and newly acquired knowledge (Olanmi, 2017). Flipped classroom practice increases student interaction with teachers and gives teachers more opportunities to provide feedback to students (Subramaniam & Muniandy, 2019). The advantage of a flipped classroom is that it encourages self-directed learning and provides an environment where students can access resources from anywhere at any time. In a flipped classroom, lessons are studied outside of class and are prioritized over in-class instruction (Li et al., 2022) and actively participate in assignments and learning (Polat & Karabatak, 2022).

Research shows that students taught using flipped classroom have better performance and attitudes towards chemistry than traditional teaching methods (Olanmi, 2017). The implementation of the flipped classroom also increases student achievement in science classes (Dixon & Wendt, 2021). Bibliometric analysis of flipped classroom has been carried out by Kushairi but only until 2021. Therefore, it is necessary to carry out the latest bibliometric analysis to determine researchers' interest in flipped classroom.

1.1 Aim of the Study

In this research, the following are the research questions (RQs):

RQ1. What are the annual trends in citations and publications?

RQ2. What are the most productive sources, universities, nations, and cited references?

RQ3. Which authors are the most well-known?

RQ4. How do authors and countries fare in terms of co-authorship, and how are author keywords distributed?

2. METHODS

In this research, we used analysis mapping bibliometrics. For the scientific mapping study, a 5 step procedure was conducted including design research, bibliometric data compilation, analysis, visualization, and interpretation (Zupic & Čater, 2015). In this research used analysis bibliometrics based on series criteria, such as subjects, annual publications, author, references, journal, institution, country, and keywords in the field. This research did not have an ethical agreement because there was no human or animal interaction during the study.

Table 1. Search Protocol

Study period	2012-2023
Databases	Scopus
Keywords	Flipped classroom
Inclusion criteria	Journal articles Publications in the previous few years (2012-2023) Documents in English Language
Exclusion criteria	Published papers in a language other than English
Last date accessed	September 21, 2023

2.1 Data Collection

Searching and electronic data retrieval was conducted on September 21, 2023. Research was done by looking for articles in one of the bibliographic databases most importantly Scopus (<https://www.scopus.com/>). Because Scopus includes a greater variety of documents than other databases for science, it was chosen (Mongeon & Paul-Hus, 2016). As well as its standing as the biggest abstract and indexing database ever constructed (Burnham, 2006), always updating articles every day. With complete bibliographic data, 6194 articles were found in the Scopus database. 3206 articles remained for the

bibliometric analysis after some irrelevant documents were filtered out using inclusion and exclusion criteria. It should be emphasized that the Scopus database does not contain any articles on flipped classrooms that were written before 2012. There are just four articles in the oldest publication, which was established in 2012.

2.2 Data Analysis

Keywords, bibliographical data, and citation information were among the data that were downloaded in CSV (comma-separated values) and research information systems (RIS) formats from the Scopus database. For visualization and data analysis, we used Microsoft Excel and VOSviewer (N. J. van Eck and L. Waltman., 2021). VOSviewer was used to make a collaborative network for various variables and keywords. The descriptive data, including journal distribution and the most productive authors and nations, were analyzed using Excel. It should be mentioned that the scientific production statistics of the institutions, nations, and authors were compiled into a single count. In the event that a paper had two authors, for instance, each author received full credit for a single count. Figure 1 shows the data search process for this study, and is based on the Preferred Reporting Items for Systematic Reviews and Meta Analyses (Moher et al., 2010)

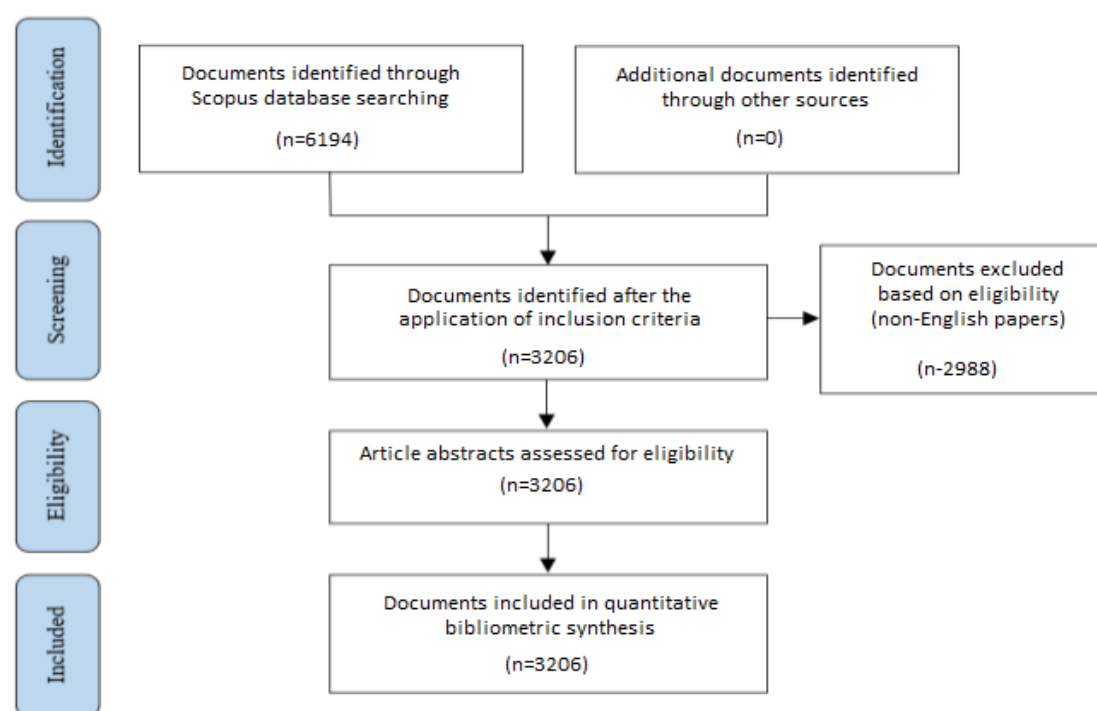


Figure 1. The Research Protocol

The documents from all time periods, highly cited papers, most prolific writers and sources, most productive institutions and nations, and co-authorship were all examined in this study. The number of articles and citations, as well as the journals, organizations, and nations that had a significant influence on the field, were examined through citation analysis. Strong correlation nodes are grouped together in the visualization network map. After that, a unique color code was given to each cluster, with the exceptionally homogeneous nodes within the same cluster. This Bibliometric mapping analysis has made it possible for scientists to find out the state of the research and the most popular subjects being done between the years 2012 and 2023.

3. FINDINGS

3.1 Publication and Citation Trends

Search results show that 3206 documents were published between 2012-2023. The first flipped classroom publications were published in 2012 with 4 documents published that year. Over a 5 year period (2012-2016) there were 435 documents (13.57%) with the annual publication amount 87 publications. In the next 5 year (2017-2021), total flipped classroom research increase significant, and 1859 documents were published (covering 57.99% of publications). In 2022-2023 there were 912 documents were published (28.45%). Citation amounts increased until 2015, where it declined the next year. Up to this point as many as 58,493 articles with 18.2 citations per article on average. Furthermore, a determination value (R^2) of 0.5455 was calculated, indicating the reliability of the exponential trend line. We can conclude that there has been a slight increase in the number of publications about flipped classrooms. The trend in the number of citations keeps rising year over year, in line with the rise in the quantity of publications in the field. The number of publications has increased, indicating that the flipped classroom model is increasing in interest and is attracting the attention of more researchers. In the upcoming year, this encouraging trend is likely going to continue.

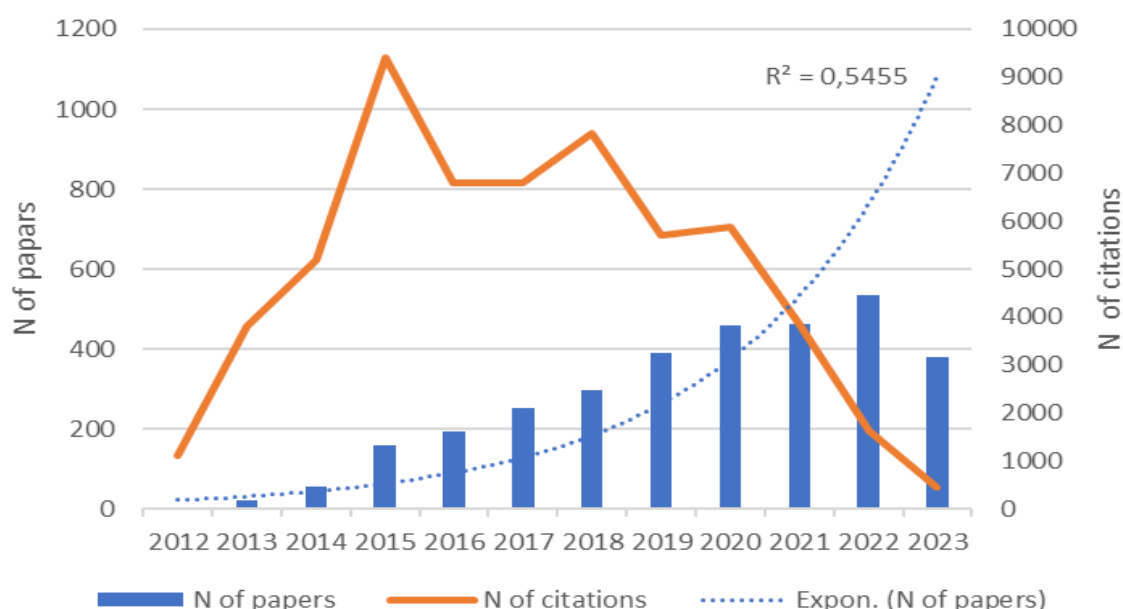


Figure 2. Distribution Articles and Citations 2012-2023

3.2 Highly Cited Documents

The Ten big the most cited documents in the 2012-2023 period are presented in Table 2 with cited documents based on the amount citations (C) and average citations per article (C/A). O’Flaherty J and Phillips C.’s article entitled “The use of flipped classrooms in higher education: A scoping review” ranking First with 1198 citations (150 per year).

Table 2. Top 10 Most Cited References

Authors	Title	Source title	C	C/A
O’Flaherty & Phillips (2015)	The used of flipped classrooms in higher education: A Scoping review	Internet and Higher Education	1198	150

Authors	Title	Source title	C	C/A
Abeysekera & Dawson (2015)	Motivation and cognitive load in the flipped classroom: definition, rationale and a call for research	Higher Education Research and Development	923	115
Strayer (2012)	How learning in an inverted classroom influences cooperation, innovation and task orientation	Learning Environments Research	899	82
McLaughlin et al. (2014)	The flipped classroom: A course redesign to foster learning and engagement in health professions school	Academic Medicine	766	85
Mason et al. (2013)	Comparing effectiveness of an inverted classroom to a traditional classroom in an upper-division engineering course	IEEE Transactions on Education	674	67
Chick et al. (2020)	Using technology to Maintain the education of Residents During the covid-19 Pandemic	Journal of Surgical Education	577	192
Akçayır & Akçayır (2018)	The flipped classroom: A review of its advantages and challenges	Computers and Education	566	113
Davies et al. (2013)	Flipping the classroom and instructional technology integration in a college-level information systems spreadsheet course	Educational Technology Research and Development	564	56
Kim et al. (2014)	The experience of three flipped classrooms in an urban university: An exploration of design principles	Internet and Higher Education	536	60
Gilboy et al. (2015)	Enhancing student engagement using the flipped classroom	Journal of Nutrition Education and Behavior	526	66

This article aimed to fill any gaps in the literature by offering a thorough overview of pertinent studies on the origins of the flipped classroom and its relationship to pedagogy and learning outcomes. These gaps could be used to guide future research and design. According to the findings, there is a wealth of indirect evidence indicating that the flipped approach enhances academic performance as well as student and staff satisfaction, even though there is a lack of conclusive evidence connecting it to the development of lifelong learning and other 21st century skills in undergraduate and graduate education. The second most quoted article is written by Abeysekera L and Dawson P with 923 citations (115 per year). In this article, Abeysekera L and Dawson P give a general definition of the flipped classroom and make an effort to adapt it with a pedagogical justification that we explain through six verifiable claims. They develop a theoretical case for how flipped classrooms could increase student motivation and aid in cognitive load management. Work Strayer JF entitled “How learning in an inverted classroom influences cooperation, innovation and task orientation” occupies third position with 899 citations and 82 citations per year. Articles ranked 4-10 were cited more than 500 times respectively. In total in general, there were 35 articles cited more than 200 times, 62 articles have more than 100 citations; 148 documents have more than 50 quotes and 878 have more than 10 quotes; 1440 articles have at least one quote. This study illustrates how researchers from all over the world have become interested in flipped classrooms. Seven of the top ten papers were conducted and published in the United States as the first author. The remaining papers are from Turkey (one paper) and Australia (two papers). This suggests that United States academics wrote the majority of highly cited papers.

3.3 Most Influential Authors and Sources

Table 3 displays the top 10 most productive authors according to the total number of articles (A), the total number of citations for all articles (C), and the h-index. According to the results, six writers produce at least ten documents. Hew, KF is the most significant writer with 18 papers. Hew’s research indicates that using quizzes at the beginning of each in-class session made the flipped classroom approach more successful. More participants reported they preferred flipped to traditional classrooms (Hew & Lo, 2018). Jeong, JS follows Hew, K. F with 16 articles. Lo, CK and González -Gómez, D each published 15 articles.

Table 3. Top 10 Most Prominent Authors

Author	Institution	Country	A	H-Index
Hew, KF	The University of Hong Kong	Hong Kong	18	46
Jeong, JS	Universidad de Extremadura	Spain	16	21
Lo, CK	The Education University of Hong Kong	China	15	15
González-Gómez, D.	University of Extremadura	Spain	15	31
Zainuddin, Z.	Ar-Raniry State Islamic University	Indonesia	12	15
Hwang, G.J	University of Science and Technology	Taiwan	11	14
McLaughlin, J.E	University of North Carolina	US	9	21
Zou, D.	The Education University of Hong Kong	China	7	26
Pardo, A	The University of Sydney	Australia	7	35
Hung, H.T	National Kaohsiung First University of Science and Technology	Taiwan	7	13

The top ten journals for publishing papers on flipped classroom are listed in Table 4. In the top 10 journals, 458 articles were published, accounting for 14.28 % of the total. These journals are highly influential in the field of flipped classroom, as evidenced by the fact that five of the ten highest-influence sources are listed in the first quartile. BMC Medical Education, Interactive Learning Environments and Computers And Education are three of the four UK sources that is in the first quartile. The remaining six sources are divided into three from US and two each from Switzerland, one from Austria. These journals are published by nine different publishers.

Table 4. Top 10 Most Influential Sources

Source	Country	A	Q	SJR 2022	H-Index	Publisher
BMC Medical Education	UK	68	Q1	0.91	87	BioMed Central
Education Sciences	Switzerland	55	Q2	0.61	40	MDPI AG
Education and Information Technologies	US	51	Q1	1.25	61	Kluwer Academic Publishers
International Journal of Emerging Technologies in Learning	Austria	44	Q2	0.54	39	International Association of Online Engineering
Sustainability Switzerland	Switzerland	42	Q1	0.66	136	MDPI AG
Primus	UK	42	Q3	0.33	22	Taylor and Francis
Interactive Learning Environments	UK	42	Q1	1.17	57	Taylor and Francis
Medical Science Educator	US	39	Q2	0.39	20	Springer
Mededportal The Journal of Teaching and Learning Resources	US	39	Q3	0.5	14	Association of American Medical Colleges
Computers and Education	UK	36	Q1	3.68	215	Elsevier

3.4 Ten Most Subject

The top ten subject for publishing papers on flipped classroom are listed in Table 5. Social sciences, computer science and engineering are the top three of the subject.

3.5 The Most Productive Institutions and Countries

Displayed in Table 6 the top three most productive institutions are Harvard Medical School (United States; 35 publications), The University of Hong Kong (Hong Kong; 35), and The Education University of

Hong Kong (Hong Kong; 26). Institution ranks 4- 10 have 20 to 25 papers that have been published. Regarding with leading countries, total paper by country analyzed.

Table 5. Top 10 Most Subjects

Subject	N
Social Sciences	2,303
Computer Science	668
Engineering	454
Medicine	435
Arts and Humanities	214
Psychology	178
Mathematics	177
Business, Management and Accounting	160
Nursing	153
Health Professions	136

Table 6. Top 10 Most Relevant Institutions

Institutions	Country	Type	N
Harvard Medical School	US	Private	35
The University of Hong Kong	Hong Kong	Public	35
The Education University of Hong Kong	Hong Kong	Public	26
The University of North Carolina at Chapel Hill	US	Public	25
Universidad de Extremadura	Spain	Public	21
Monash University	Australia	Public	21
National Taiwan Normal University	Taiwan	Public	20
National Taiwan University of Science and Technology	Taiwan	Public	20
University of Malaya	Malaysia	Public	20
Bartın University	Turkey	Public	20

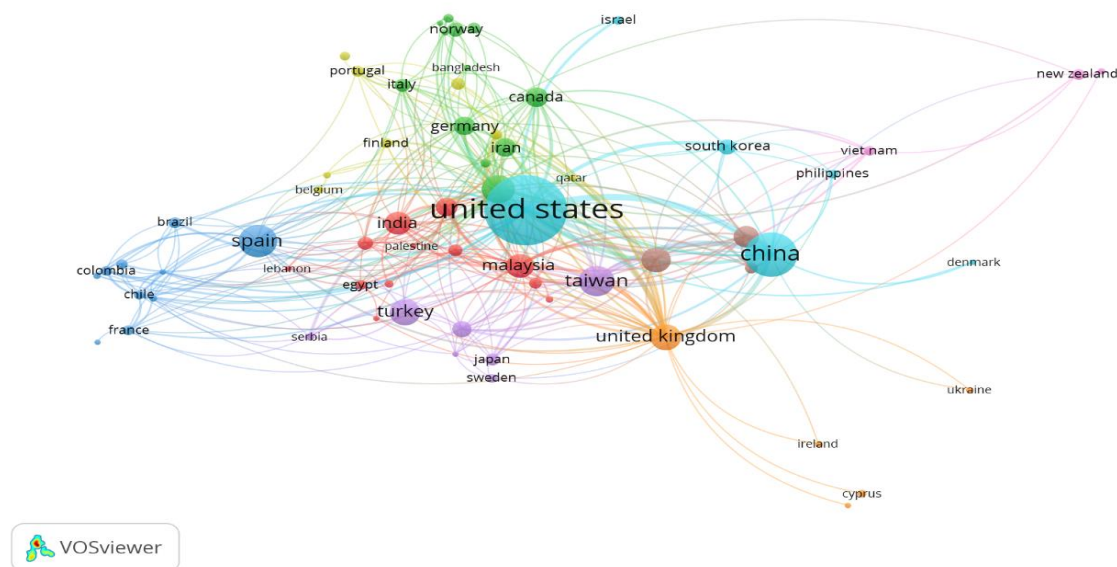
Table 7 shows top 10 relevant country publications, total citations, and average article citations. Based on said table, the United States provides the largest contribution in flipped classroom research with 929 publications. Followed by China and Spain with 370 and 201 documents. Very interesting that the amount of publications in the top 3 countries is 1500 (46.79%). It suggests that the top three nations investigating the use of flipped classrooms are the US, China, and Spain. This indicates that industrialized nations are significant players in the field of flipped classroom research.

Table 7. Top 10 Most Productive Countries

Country	N	%
United States	929	28.98
China	370	11.54
Spain	201	6.27
Taiwan	176	5.49
Australia	151	4.71
United Kingdom	133	4.15
Turkey	126	3.93
Indonesia	115	3.59
Malaysia	108	3.37
India	102	3.18



3.6 Co-Authorship of Authors and Countries



We also looked at cross-national co-authorship connections. Figure 3 displays the co-authorship map by country. The number of publications in the nation is represented by the size of the nodes on the map, and the strength of the relationship between them is indicated by the distance between them (N. J. van Eck and L. Waltman., 2021). The size of the node, as indicated by the map, is the number of national publications and the separation between the cluster suggests how strong their relationship is. A country's minimum number of documents was set at 5, and 73 of them met the requirement. On the map, different colors indicate different clusters. With 927 documents, the United States leads the largest blue-colored cluster.

3.7 Co-Occurrence of Keywords

Occurrence amount (Occ) of relevant words in connected publications with writer keywords identified. The top 10 keywords are appear simultaneously, presented in Table 8.

Table 8. Top 10 Most Keyword

Keywords	N
Flipped Classroom	1,750
Human	755
Humans	615
Teaching	613
Education	565
Students	512
Learning	448
Curriculum	442
Articles	442
Medical Education	320

Analysis results show that the most frequent keywords are as follows : Flipped Classroom, human, humans, teaching, education. Maps of keyword occurrences produced by VOSviewer are used to visualize research hotspots, as shown in Figure 4. Analysis of keywords provides information about related research. With a minimum occurrence threshold of 5, 868 written keywords out of 9076 were analyzed. Related keywords that appear in the same color make up each cluster.

4. DISCUSSION

The foundation of bibliometric analysis is the pursuit of statistically consistent patterns across time in the various components associated with the creation and use of scientific knowledge. It is able to asserted that it is beneficial to see how research is progressing and the creation of knowledge, enabling further areas of inquiry to be clarified. In this study, we analyze 3206 documents were published between 2012-2023. The first flipped classroom publications were published in 2012 with 4 documents published that year. In 2017-2021, total flipped classroom research increase significant, and 1859 documents were published. n 2017-2021, the total number of flipped classroom studies increased significantly, and a total of 1859 documents were published. The significant increase that year was due to the Covid-19 pandemic which implemented distance learning in 2020-2022. Flipped classroom gives students didactic material in the form of a video lecture that has been produced, which they can watch whenever they have free time before the conference. After that, the conference session's focus switches to case-based discussion, synthesis, and

application (Chick et al., 2020). The flipped classroom is a learning innovation that is very appropriate to apply during the pandemic. According to the increase shown in the tables and data in the preceding sections, many people are expected to adopt the flipped classroom approach in the future. The number of publications has increased, indicating that the flipped classroom is gaining interest and is attracting the attention of more researchers. In the upcoming year, this encouraging trend is likely going to continue.

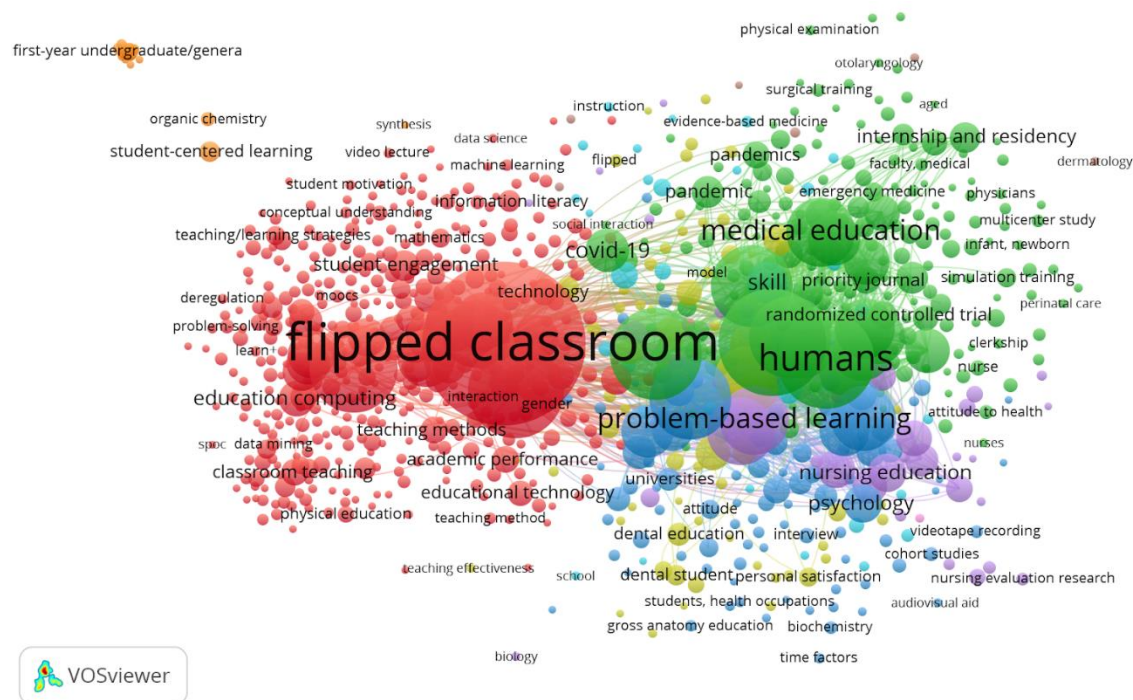


Figure 4. Co-keyword Network Visualization: The Most Used Author Keywords

Five out of the ten highest-influence sources are listed in the first quartile, indicating that these journals are highly influential in the field of flipped classroom. BMC Medical Education, Interactive Learning Environments and Computers And Education are three of the four UK sources that is in the first quartile. The remaining six sources are divided into three from US and two each from Switzerland, one from Austria. These journals are published by nine different publishers. O’Flaherty J and Phillips C.’s article entitled The use of flipped classrooms in higher education: A scoping review ranking First with 1198 citations (150 per year). This article aimed to fill any gaps in the literature by offering a thorough overview of pertinent studies on the origins of the flipped classroom and its relationship to pedagogy and learning outcomes. These gaps could be used to guide future research and design. According to the findings, there is a wealth of indirect evidence indicating that the flipped approach enhances academic performance as well as student and staff satisfaction, even though there is a lack of conclusive evidence connecting it to the development of lifelong learning and other 21st century skills in undergraduate and graduate education.

The flipped classroom provides opportunities for students to participate in their own learning, assessment, which necessitates a change in the learning culture and they must be actively involved in the construction of knowledge (Abeysekera & Dawson, 2015; O’Flaherty & Phillips, 2015). Articles that are widely cited are high-quality articles. The top three nations investigating the use of flipped classrooms are the US, China, and Spain. This indicates that industrialized nations are significant players in the field of flipped classroom research. These nations have substantial funding for research.

Hew, KF is the most significant writer with 18 papers. Hew’s research indicates that using quizzes at the beginning of each in-class session made the flipped classroom approach more successful. More

participants reported they preferred flipped to traditional classrooms (Hew & Lo, 2018). Jeong, JS follows Hew, K. F with 16 articles. Lo, CK and González -Gómez, D each published 15 articles.

According to the data, with 929 papers, the United States has made the largest contribution to the field of flipped classroom research. China and Spain came next, with 370 and 201 documents respectively. It's quite intriguing that 1500 publications (46.79%) are found in the top 3 countries. It suggests that the top three nations investigating the usage of flipped classrooms are the US, China, and Spain. This indicates that industrialized nations are significant players in the field of flipped classroom research. The number of publications in the nation is represented by the size of the nodes on the map, and the strength of the relationship between them is indicated by the distance between them (N. J. van Eck and L. Waltman., 2021). The size of the node, as indicated by the map, is the number of national publications and the separation between the cluster suggests how strong their relationship is. A country's minimum number of documents was set at 5, and 73 of them met the requirement. On the map, different colors indicate different clusters. The most frequent keywords are as follows : Flipped Classroom, human, humans, teaching, education.

5. CONCLUSIONS AND LIMITATIONS

This study is to investigate the flipped classroom research trend by examining the state of publications at the moment, the citation pattern, presenting the relevant theme, and suggesting the fields of inquiry. For upcoming studies on flipped classrooms. The field was founded in 2012, as evidenced by the publication of the first paper. The most cited article was written by O'Flaherty J. and Phillips C. The most prolific writer is Hew, KF. In a flipped classroom, the most common topics are engineering, computer science, and social sciences. BMC Medical Education, Education Sciences, Education And Information Technologies are the most productive sources. Harvard Medical School, The University of Hong Kong, The Education University of Hong Kong are the most active institutions. United States, China and Spain are the most relevant countries. Trending keywords include "flipped classroom," "human," "humans," "teaching," and "education." Thus an extensive summary of the field's research output and potential future prospects is given in this review.

It has been successful for this study to present a current picture of research trends on flipped classroom. Nonetheless, it is important to consider some limits. First off, the target papers examined in this study solely make reference to the bibliographic information recorded in Scopus as the primary source; as a result, the conclusions offered represent a single viewpoint within the body of extant literature. Despite the fact that Scopus was chosen because of its extensive collection of peer-reviewed research papers in the field of education, other scientific sources that could have been more useful were not included in the online databases that were examined, including WoS, Google Scholar, Microsoft Academic. To arrive at more comprehensive conclusions that better reflect the evolution of publications in this field, we recommend that future scholars extend their analysis utilizing additional well-known datasets. In order to allow future study to take into account additional sources, such as books, book chapters, or notes, we limited our attention to documents that were published in research publications. Finally, this review's database only extracted and evaluated English-language materials; as a result, it missed additional non-English publications that would have produced more insightful findings. Finally, while this bibliometric study only examined the five factors that were specified in the research questions, more work must integrate it with content analysis to examine the research design and techniques, primary emphasis areas, and research findings in the examined publications.

Conflict of Interest

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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