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Charting the Evolution and Future Trajectory of Flipped Classroom Models: A Bibliometric Journey through a Decade of Research on Scopus (2013-2023)

Taufik Hidayat Stang[1]*, Alfan Rifai[1], Muh. Nur Rochim Maksum[1]

[1]Universitas Muhammadiyah Surakarta, Solo, Indonesia
*Co-email: O100230016@student.ums.ac.id O100230024@student.ums.ac.id Mnr127@ums.ac.id

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ABSTRACT

To ascertain the trajectory and growth of flipped classroom research in Scopus-indexed articles on flipped classroom from 2013 to 2023, this study used bibliometric analysis. Rstudio and Microsoft Excel were then used to examine the collected data. The simultaneous incidence of keywords and document citations can be shown using VOSviewer. 3,558 publications that met the given function, topic, and criteria were discovered by the author. Based on the research, the yearly rate is 5.12%, and in 2021, there will be the highest number of publications on flipped classrooms. The nation that contributes the greatest number of articles to the Chinese Academy of Sciences is China. The most prolific writer on the subject of flipped classrooms is Salvati, L. The scope of the bibliometric analysis was restricted to data from Scopus. This study does not incorporate databases from other countries or countries. This study offers suggestions for more research in addition to a concise summary of the literature that is currently available to scholars working in this field

INTRODUCTION

The development of the Industrial Revolution era had a profound impact on the world of education (Jamila, 2020; Juhary, 2019; Shin, 2018). The Industrial Revolution (Revin) is a concept that can fundamentally change life One of them has to do with education (Hu, 2021; Yeleussizkyzy et al., 2023). Increasing the industrial revolution has a positive influence (Campillo Ferrer & Miralles Martínez, 2023; Ivan et al., 2023; Sourg et al., 2023) that is, it can overcome existing problems (Techanamurthy, Ahmad, et al., 2020; Techanamurthy, Alias, et al., 2020), then has the effect of creating new challenges in all aspects which are closely linked to each other (Alahmadi & Saleem,

2022; Buhari & Sari, 2022). The Industrial Revolution era significantly changed the way we think about education (Chigbu et al., 2023; Guo & Yang, 2022). The progress achieved not only affects the way of teaching, but the most important thing is the change of perspective on the concept of education (Bond et al., 2023; Cevikbas & Kaiser, 2023; Pertuz et al., 2023). Education is the process of a person achieving a goal that can make a person better, as measured by both skills and knowledge (Akcali & Tastan, 2023; Gómez-Coma et al., 2023; He et al., 2023; Kejela et al., 2023).

The most recent, very rapid advancement in the world of education is the use of technology training (Sivapalan, 2017). Teachers can teach from anywhere and at any time, as can students (Bond et al., 2023). The Indonesian government encourages the use of technology in all aspects (Nadarajan et al., 2023). The use of this technology is neither something new in learning nor a reason not to use it, , rather it has become an urgent matter and an obligation to be fulfilled in the world of education (Anyanwu et al., 2019; Bosnić et al., 2022; Elledge et al., 2022; Sarpparaje et al., 2018). Technological developments also promote progress in the field of education (Gerlach et al., 2023; Solan & Shtub, 2023). Technology can be used as a tool to create very meaningful experiences in the teaching and learning process (de Jaegher, 2020; Weinhandl et al., 2020). By implementing the flipped classroom concept, the teaching and learning process can be carried out well (El-Bassiouny & El-Naggar, 2023; Sun et al., 2023).

The flipped classroom method is a student-centered education that transforms the traditional classroom learning system into an innovative pedagogical system (Fuchs, 2021; Liu, 2023; L. Zhao et al., 2021). Flipped Classroom is also one of the discoveries of innovative learning models in education, which are in line with current developments and can be used by teachers to improve the learning process. (Deng et al., 2023; Fischer et al., 2023; Ong et al., 2021; Ozenen, 2023; Pirie et al., 2021; Poulain et al., 2023). Teachers and students must truly adapt to the use of technology to achieve optimal benefits (Howell, 2021). By using this technology, learning becomes unlimited (Padilla et al., 2020).

There are two types of flipped classroom teaching: traditional and flipped peer teaching (Anggoro et al., 2023; Holm et al., 2022; Kochetkov, 2022; Shang, 2023). Both approaches involve watching instructional videos (Tarquini & McDorman, 2019) or other media at home (X. Zhao & Yang, 2023), The difference lies in the activities in the class (Fredriksen & Hadjerrouit, 2020). A flipped classroom learning model like this can provide more training and improvement in mathematical problem-solving skills through practice and problem-solving using problem-solving techniques in the classroom, with expert tutors as facilitators, namely teachers who guide students when they encounter difficulties in the class Solution process. Problems so that students don't stop when they encounter difficulties (Jeong & Chung, 2023; Kurup & Sendlewski, 2020; Mardiha et al., 2023; Padmaja et al., 2020)

Bibliometric indicators are a tool that plays a role in considering the results of scientific research, studying the interaction between science and technology, creating a mapping of scientific fields, tracking or tracking the development of new knowledge in certain areas and an indicator of The future is in creating strategic plans to implement the flipped classroom (Limaymanta et al., 2021; Muñoz-Estrada et al., 2022). This research aims to present the development and direction of flipped classroom research in publications indexed in the Scopus database from 2013 to 2023. 2013 was chosen as the starting year based on findings in the Scopus database that this was the year the first two publications on the subject of flipped classrooms were found.

LITERATURE REVIEW

In the journal "Development of the Flipped Classroom Learning Model" by Fransiska (2022)(Fransiska Sekar Kinasih, 2022). The development of the industrial revolution in the technological aspect is a driving force for the development of the flipped classroom learning model, which can be used as a solution to overcome the problem of a valid, practical, and effective product learning process and improve students' understanding and has an impact on improving student learning outcomes.

In the journal "Effectiveness of Implementing Flipped Class Rooms" by Ratnasari (2022)(Ratnasari Rahman, 2022) The concept of the flipped classroom itself is to learn material that should be done in class and then do practice questions in class that should be done at home. The goal is to find out how effective this flipped classroom model is for distance or online learning. However, it all depends on the motivation of the students themselves.

In the journal "Development of Flipped Classroom Learning Strategies" by Marselina (2021) (Marselina Oktavia Bara, 2021) The flipped classroom strategy is a learning strategy that can provide educators with a way to minimize teaching effort. The students first learn the theory freely outside of the classroom and then practice it in class under the guidance of the teacher.

METHOD

This research uses bibliometric analysis. From 2013 to 2023, data were obtained by searching the Scopus database using the Boolean search engine. Researchers searched on December 15, 2023 at 3:00 p.m. WIB and performed citation, document content, and network analysis using R and Rstudio tools, VosViewer, and Microsoft Excel. The data set was processed by the researchers in three steps.

In the first phase, researchers conduct a literature review of related topics to ensure that the research is relevant to the bibliometric topic. In addition, literature research helps identify appropriate keywords that reflect the scope of the research. In

addition, literature research helps identify appropriate keywords that reflect the scope of the research.

In the second step, the researchers used Boolean operators TITLE-ABS-KEY *(*flipped AND classroom*) and* conducted a search on Scopus which returned 6,894 documents. The filtering is then carried out using Boolean operators (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (SRCTYPE, 'J')) AND (LIMIT TO (LANGUAGE, "English")) To restrict the article document type to only journals and English-language articles, 3,558 final documents were used as source documents.

Using the Scopus analyzer, R, and Rstudio, an analysis of the final search documents was carried out in the third phase to ascertain the number of documents per year, as well as documents by journal, author, affiliation, nation, and subject/field. Next, network-level examination of the documents was carried out with VOSviewer and data processing in Microsoft Excel. The process of this research can be seen in the following image.

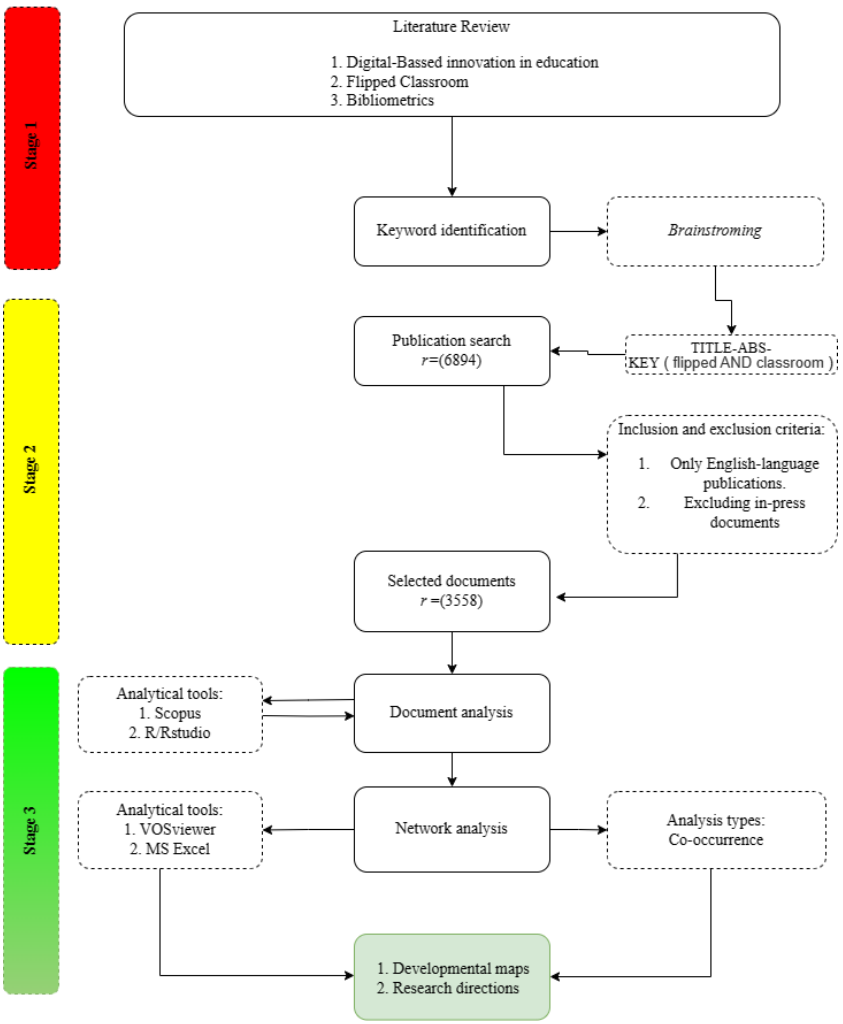

Figure 1. Research Workflow

RESULT AND DISCUSSION

Document Analysis

Table 1 provides an overview of the 2858 documents collected over 22 years. Includes 7742 authors, 569 single authors, 11.16% international authorship collaboration, and 87826 references with an average citation per document of 19.87 citations.

Table 1. Main information about the data

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2002:2024
Sources (Journals, Books, etc)	922
Documents	2858
Annual Growth Rate %	5.12
Document Average Age	3.4
Average citations per doc	19.87
References	87826
DOCUMENT CONTENTS	
Keywords Plus (ID)	4162
Author's Keywords (DE)	5403
AUTHORS	
Authors	7742
Authors of single-authored docs	518
AUTHORS COLLABORATION	
Single-authored docs	569
Co-Authors per Doc	3.24
International co-authorships %	11.16
DOCUMENT TYPES	
Article	2858

Document by Year

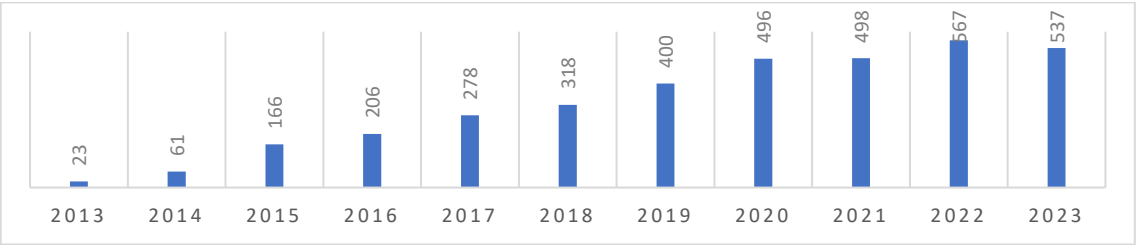

Figure 2. Document publication by year

The image below illustrates the evolution of Flipped classroom publications based on the year of publication. The documents first appeared in 2013 with a total of two to three documents, and this article reached its publication peak in 2022 with a total of 567 documents.

Most Relevant Author`s

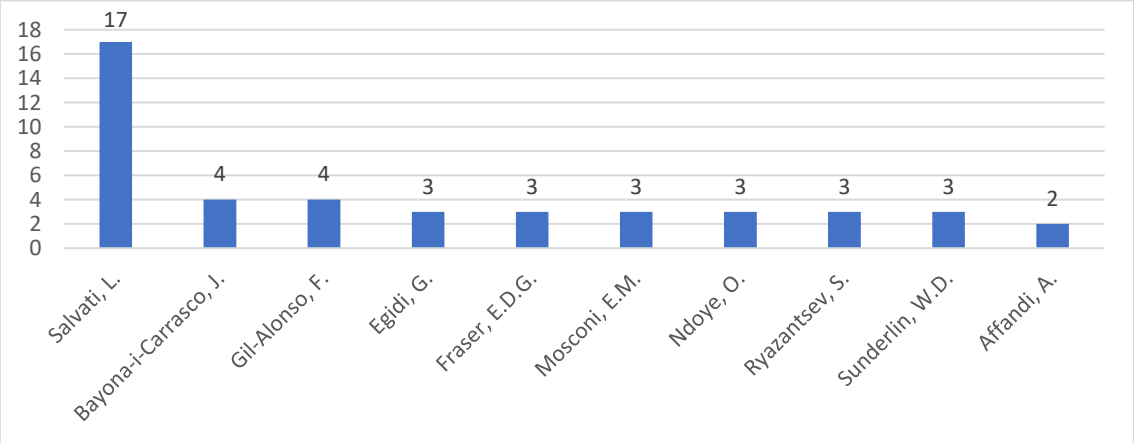

Figure 3. Graphical most relevant author`s

The following image shows the ten most influential authors in Flipped Classroom publications. Salvati, L leads with the number of publications of 17 documents, followed by Bayon and Alonso with 4 documents each.

Document by Affiliation

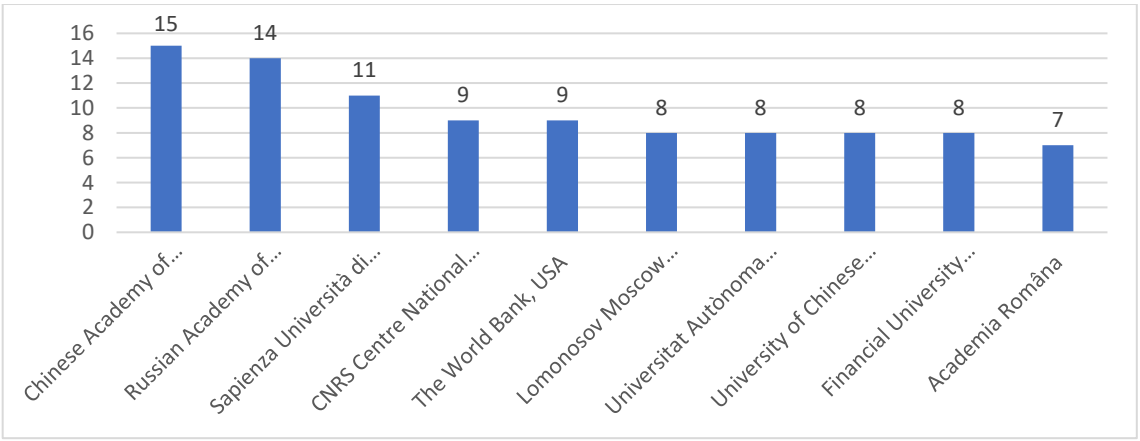

Figure 4. Document publication by affiliation

The following image shows the 10 most influential affiliates in Flipped Class Room publications. This thematic analysis was largely conducted by researchers from the Chinese Academy of Sciences, with a total of 15 articles. Then researchers from the Russian Academy of Sciences followed with a total of 14 articles.

Document by Country

The following image shows publications by country on the topic of flipped classrooms. Malaysia leads the publications with a total of 155 documents, followed by the USA with 59 documents. The countries of the Asian continent dominate with 7 countries, while the countries of the European continent occupy the second dominant position. This shows that research on flipped classrooms is popularly carried out by countries in the Asian continent.

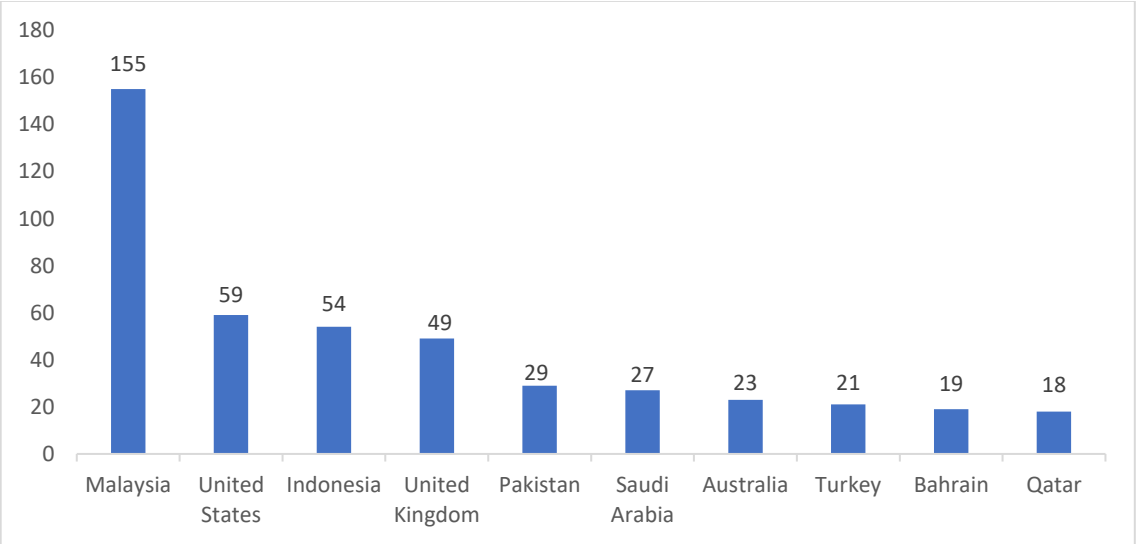

Figure 5. Document publication by Country

Document by Source

In the figure below, researchers have filtered data searches in Scopus based solely on journal sources, so this figure shows the 16 journals with the highest contribution to publishing documents via Flipped Classroom. The journal with the highest contribution is Family Planning with the publication of 65 documents, the lowest are Health Education, Sex Education, and Social Science with 20 documents each, all close to each other.

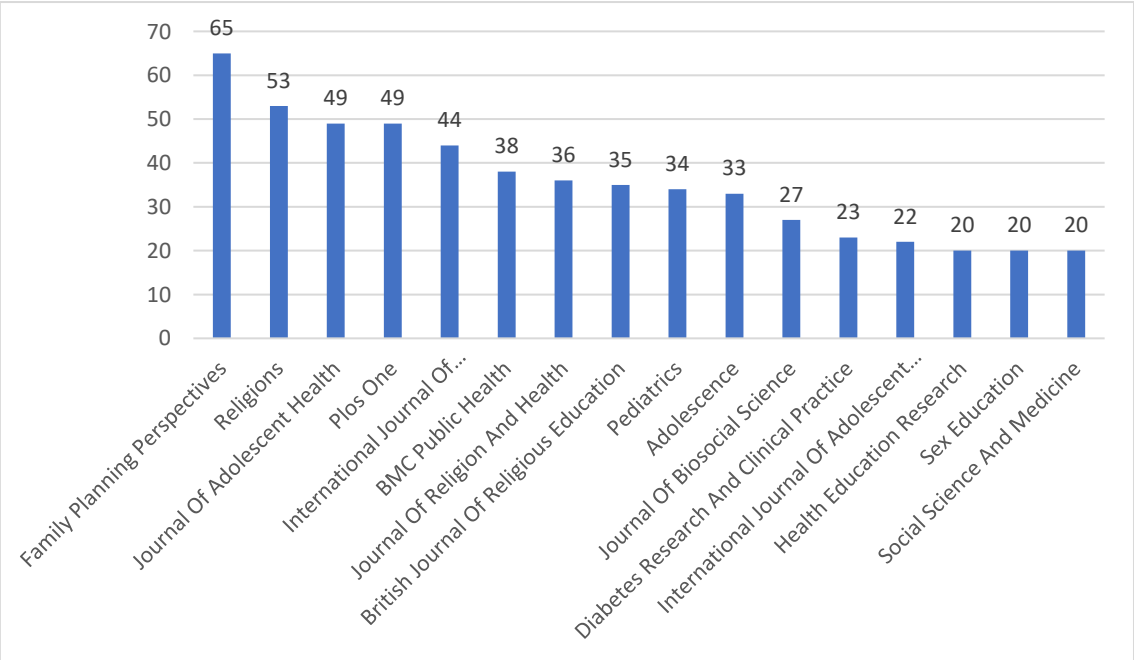

Figure 6. Document publication by source

Three-Field Plot

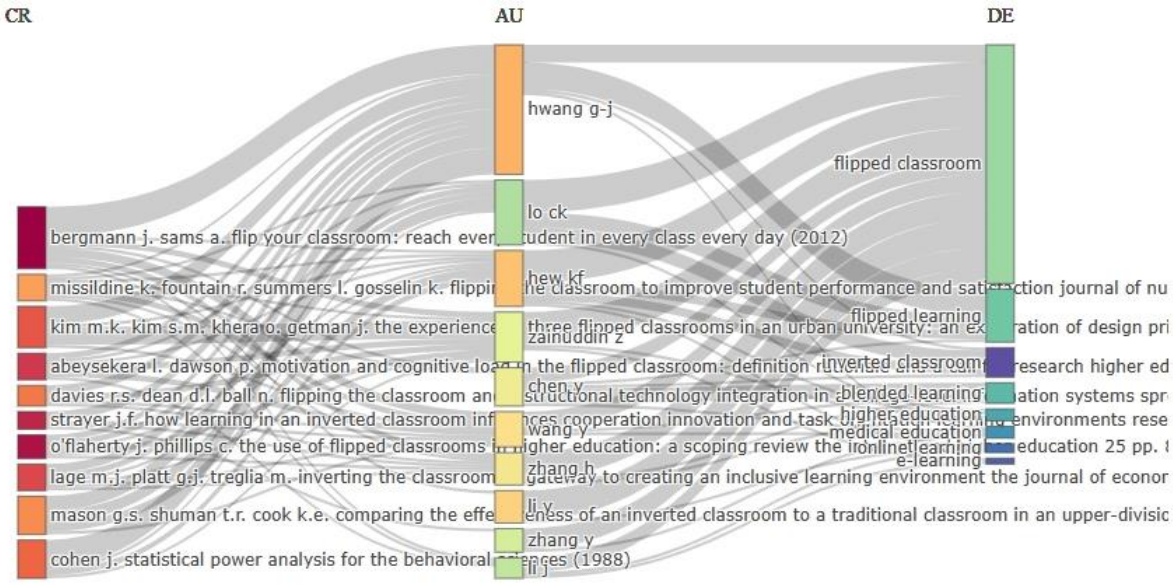

Figure 7. Three Field-Plot (Keyword, Author, Reference)

Figure 7 contains three observed elements; Name of the journal publication, name of the author, and topic or topic used. The three elements are then connected by gray lines of action that relate to each other. Using the journal name, each journal indicates which authors have contributed most frequently to its publications, particularly those with the flipped classroom theme.

The size of the chart indicates how many publications relate to this topic. Based on the picture above, there are 10 magazines. The journal that publishes the most research on the topic of flipped classrooms is Computer and Education, shown in dark red and linked to several authors such as Lock and Wang Y.

Based on the image above, there are 20. The size of the bar chart shows how much research has been published by each author. The 10 authors who wrote the most articles on the topic of flipped classrooms included Hwang G-J and Rock, Hew KF.

In the third element, each research topic is associated with authors who have written extensively on ICT skills topics. From the analysis results, there are 8 keywords, Flipped Class Room and Flipped Learning, which are at the top. This shows that the word is very closely linked to research on ICT literacy.

Corresponding Author's Countries

Viewed from the perspective of Multiple Country Publication (MCP) and Single Country Publication (SCP), the United States is the country of origin of most corresponding authors, both authors who do not collaborate with authors from other countries and authors who Collaborate with authors from other countries. The number

of SCPs from the USA is 600 publications and 30 MCP publications. Followed by China with 400 SCP releases and 50 MCP releases and Spain with 100 SCP releases and 15 MCP releases. According to the continental data, the Asian continent dominates with 11 countries, while the European continent comes second with 4 countries.

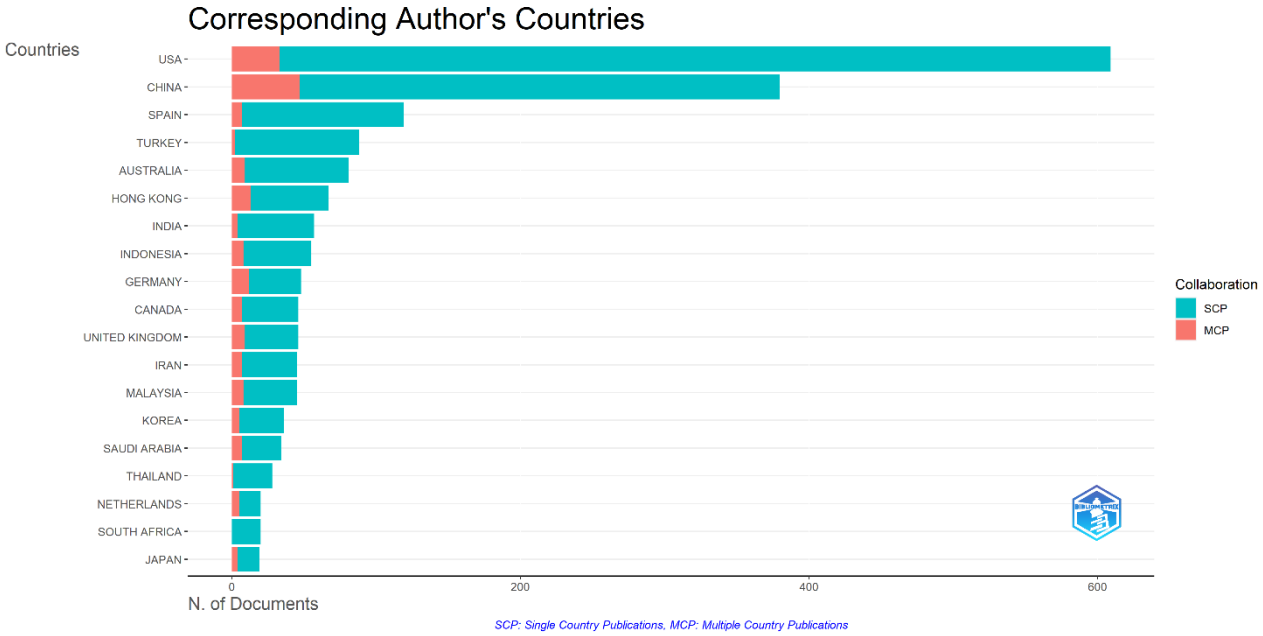

Figure 8. Graphical corresponding author countries

Most Global Cited Document

The article with the highest total citations (TC) is "o'flaherty j, 2015, Internet Higher Educ" with 1232 citations. Meanwhile, "O'flaherty j, 2015, Internet Higher Educ" is the article with the highest TC per year with 136.89 citations per year.

Based on this data, it can be found that TC (total citations) tends to influence TC per year (citations per year). In general, works with larger TCs also tend to have significant TCs per year. However, it is not always true that securities with large TCs necessarily have higher TCs per year than others and vice versa.

However, the publication year of the paper tends not to have a significant impact on TC. Although some papers with older publication years have lower TCs than papers with newer publication years, there are also exceptions where papers with older publication years can have high TCs. From the data provided, no consistent influence between the year of publication and the number of citations (TC) can be derived.

Table 2. Most globally cited document

Paper	Total Citations	TC per Year	Normalized TC
O'Flaherty J, 2015, Internet Higher Educ	1232	136.89	20.74
Abeysekera L, 2015, High Educ Res Dev	951	105.67	16.01
Strayer JF, 2012, Learn Environ Res	916	76.33	3.21

Mclaughlin JE, 2014, Acad Med	783	78.30	8.91
Mason GS, 2013 IEEE Trans Educ	686	62.36	3.96
Akcayir G, 2018, Comput Educ	599	99.83	22.01
Davies RS 2013, Educ Technol Res Dev	576	52.36	3.33
Kim MK, 2014, Internet Highereduc	550	55.00	6.26
Gilboy MB, 2015, J Nutr Educ Behav	540	60.00	9.09
Hew KF, 2018, Bmc Med Educ	514	85.67	18.89

Most Local Cited Documents

There are 2 documents with the highest local citations. The average publication has between 10 and 18 local citations, with the difference being global citations, so it can be said that the year of publication does not influence the local citations of a publication. The publications with the most local citations are Wajdi Dusuki A, 2008, Int J Islam Middle East Financial Management Pollard J, 2007, Trans Inst Br Geogr, each with 18 citations. The publication with the smallest comparison ratio can be seen in the publication of Hayat R, 2011, Emerg Mark Rev, with a ratio of 5.38%, where the local citations were only 10 while the global citations reached 186 citations.

Table 3. Most locally cited document

Document	Local Citations	Global Citations	LC/GC Ratio (%)
Wajdi Dusuki A, 2008, Int J Islam Middle East Financ Manage	18	118	15,25
Pollard J, 2007, Trans Inst Br Geogr	18	152	11,84
Tahiri Jouti A, 2019, Isra Int J Islamic Finance	14	24	58,33
Aggarwal Rk, 2000, J Money Credit Bank	13	241	5,39
Mohammad Mo, 2013, Middle East J Sci Res	12	54	22,22
Aliyu S, 2017, Emerg Mark Financ Trade	11	65	16,92
Ismail Abdel Mohsin M, 2013, Int J Islam Middle East Financ Manage	11	66	16,67
Kamla R, 2013, Account Audit Account J	11	99	11,11
Kuanova La, 2021, J Islamic Account Bus Res	10	17	58,82
Hayat R, 2011, Emerg Mark Rev	10	186	5,38

Network Analysis

This figure analyzes the number of flipped classroom research events, with the minimum number of clusters being 10. Four clusters are formed, with the number of items in each cluster being: Cluster 1 with 32 items, Cluster 2 with 31 items, Cluster 3 with 21 items, and Cluster 4 with 19 items. The dominant keyword is “Flipped Class Room” with a total frequency of 1457 and a link strength of 6180.

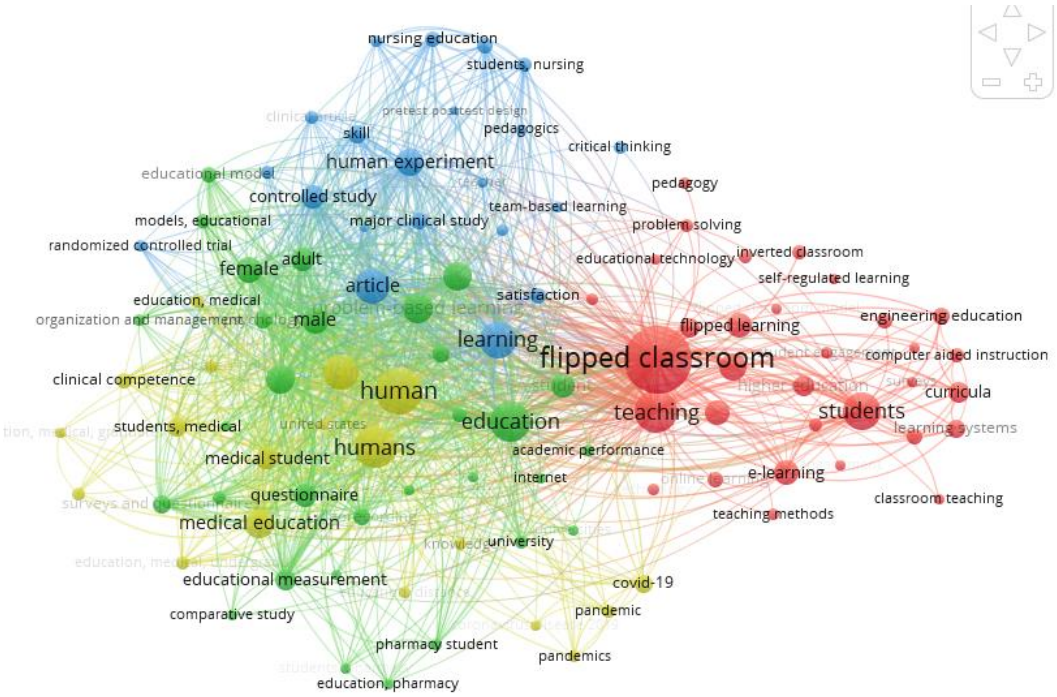

Figure 9. Visualization network based on occurrence

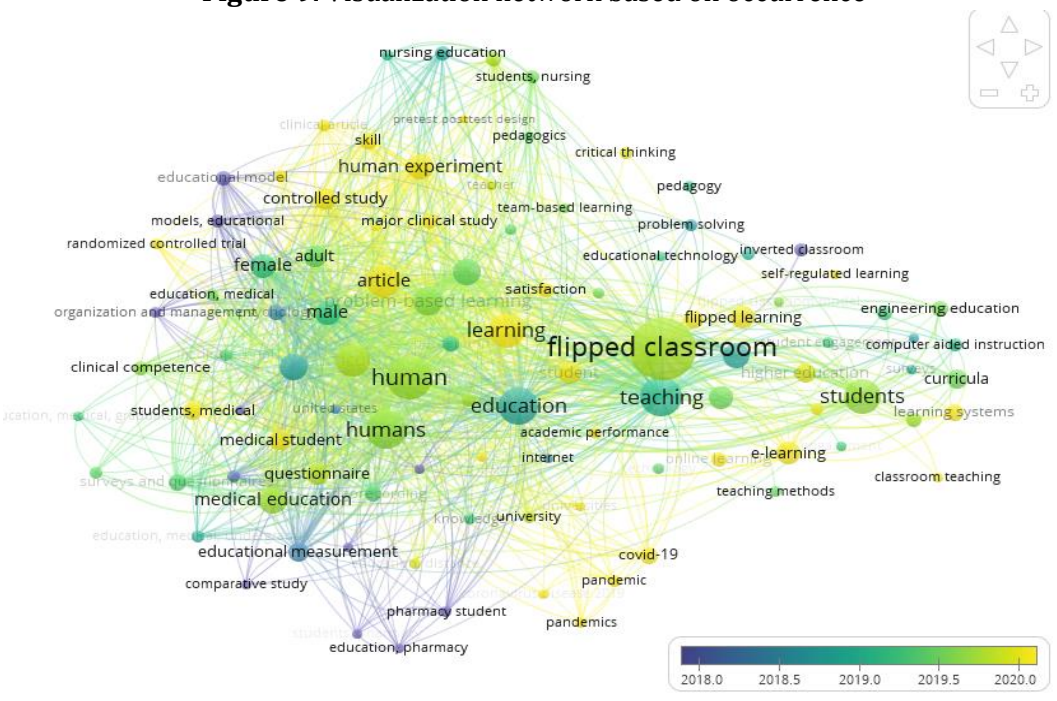

Figure 10. Visualization network based on overlay

The image above shows keyword network analysis based on overlay. It can be seen that the keywords "learning", "article" and "human experiment" are keywords used in the last year, namely 2020. Meanwhile, the keywords "education model", " Comparative study" and "educational pharmacy" are keywords that have been used relatively recently, around 2018.

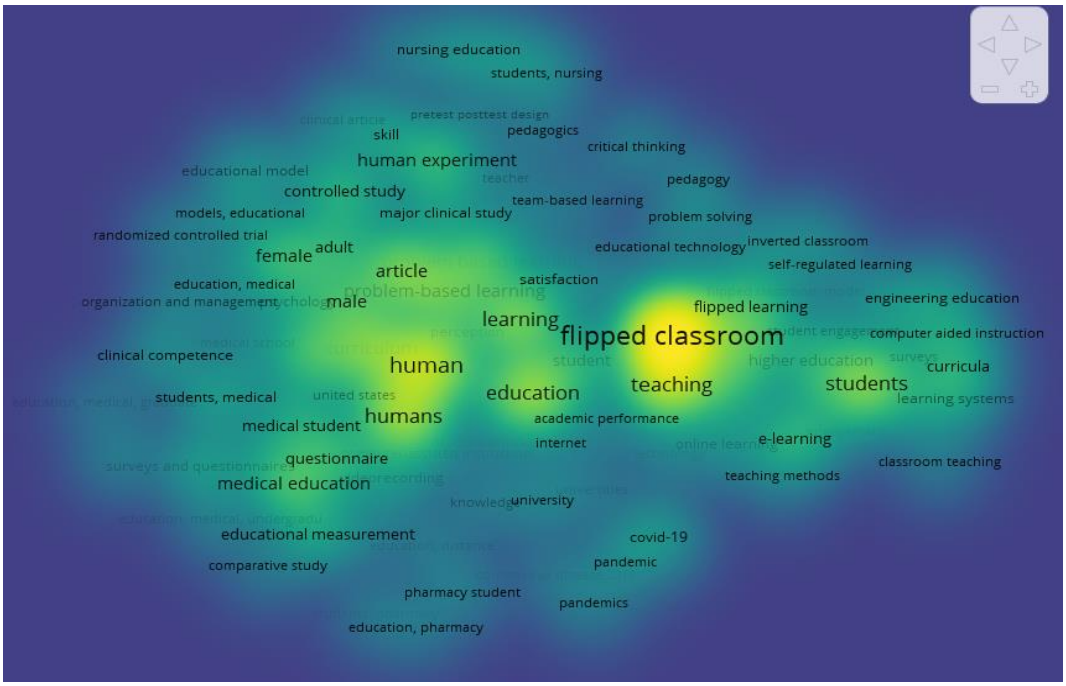

Figure 11. Network Visualization based on Density

The analysis of the research density showed that the keywords “flipped classroom”, “people” and “teaching” had a high density of research on this topic. This shows that focusing on this aspect plays a central role in the context of the flipped classroom. Keywords such as “education measurement”, “pharmacy student” and “teaching methods”, however, are researched relatively rarely. Nevertheless, further research into these rare keywords can provide valuable insight into discovering elements that may not have been fully explored before.

Table 4. Keyword and occurrence on each cluster

Keyword	Occurrences	Cluster
Flipped Classroom	1457	1
Teaching	580	
Students	462	
Active Learning	255	
Flipped Learning	204	
Education	529	2
Problem-Based Learning	284	
Procedures	273	
Female	221	
Male	217	
Learning	415	3
Article	402	
Human Experiment	233	
Controlled Study	184	
Skill	104	

Human	688	4
Humans	553	
Curriculum	396	
MedicalEducation	275	
Medical Student	159	

The above table shows the occurrence of each cluster, which is the main topic of research in the field of flipped classrooms. The topic in the first cluster is learning, the topic in the second cluster is school, the topic in the third cluster is students, and the topic in the fourth cluster is education.

CONCLUSION

This research can help us understand the evolution of flipped classroom research. Based on the results and the above discussion, it can be concluded that the flipped classroom research began in 2013 and peaked in 2022 with a total publication of 567 documents. The most important author is Salvati, L. with publications of 17 documents. The affiliate with the most publications is the Chinese Academy of Sciences with 15 documents. The country with the most publications is Malaysia with 155 documents. The journal source with the most contributions is Family Planning with the publication of 65 documents. Hwang G-J was one of the 10 authors who wrote the most articles on the flipped classroom topic. Based on the countries of the corresponding authors, the number of SCPs from the USA is 600 publications and 30 MCP publications. The article with the highest total citations (TC) is "O'Flaherty j, 2015, Internet Higher Educ" with 1232 citations. The publications with the most local citations are Wajdi Dusuki A, 2008, Int J Islam Middle East Financial Management Pollard J, 2007, Trans Inst Br Geogr, each with 18 citations. The limitations of this research are to only examine Scopus-indexed datasets and only analyze documents with English-language journal article types, without considering other global indexing, languages, and document types other than articles.

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