Remote Teaching and Learning: A Preliminary Bibliometric Analysis

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Abstract

Purpose- This study examines trends in the publication of remote teaching and learning (RTL) research by year, universities, nations, topic matters, and keywords.

Design/methodology/approach- Using the keywords "remote teaching and learning," "remote learning," or "remote teaching," the data was extracted from the Scopus database. The final dataset used for analysis is 1,748. Three techniques were used to examine the dataset: performance analysis using the Scopus analyzer; science mapping based on citation, co-authorship, and co-word, and network analysis through visualization with the VOSviewer programme.

Findings- The findings reveal that RTL research publications contribute the most in 2022. The top-cited document is by Mukhtar et al. (2020). The most active and highest number of publications in RTL is Fuchs, K. COVID-19 and emergency remote teaching are identified as the top two authors' keywords. Monash University, Pennsylvania State University, and University College London are the top three universities. The United States of America is the most active country, followed by the United Kingdom and Australia. Social Sciences, Computer Science, and Medicine are the subject areas that have the most publications. Journal of Chemical Education is the most represented journal, followed by the Journal of Chemical Education, Education Sciences, and Sustainability (Switzerland).

Research limitation- This study used the keywords "remote teaching", "remote learning", and "remote teaching" from the Scopus database, and the method used was only descriptive analysis to understand the trends of publication.

Originality/value- This study gives an overview of the remote teaching and learning studies that provide a preliminary idea for the researcher on what has been researched. It is helpful, particularly to young scholars.

Keywords Bibliometric analysis, VOSviewer, Scopus database, Remote Teaching and Learning, Performance analysis, Science mapping

Paper type Literature review paper

Introduction to this study

Information and communication technology (ICT) with internet technologies has influenced our work, communication with others, and how companies store, analyze, and share information with their stakeholders. It is the same situation with the education system. The approach of teaching and learning not only within the four walls, which is based on face-to-face (F2F) but can be conducted with the help

of internet technology through an online platform. With current technology, education involves much more than just the transfer of knowledge from the teacher to the students but also involves group projects, individual projects, peer collaboration on the idea, and much more (Zhang, *et al.,* 2013). It took place away from campus, where educators and learners are not close to each other, and the interaction between both parties is through a two-way communication technology (Dhurumraj, 2021; Richards, 2021). In addition, the establishment of several virtual meeting platforms namely, ZOOM, Webex, Google Meet, and Microsoft Teams has become the leading platform to remotely strengthen people's connections from different places (Lim *et al.,* 2022).

Virtual platforms are essential to education, particularly during the pandemic of COVID-19. The face-to-face (F2F) teaching approach is shifted to a remote platform when the government implements movement control orders (MCO) due to COVID-19, where instructors and students are not allowed to be on the university premises to prevent COVID-19 from spreading. The sole distinction between remote learning and traditional learning is that in remote learning, instructors and students are confined to their homes. Educational institutions were instructed to use online classes recorded or presented live on virtual meeting platforms during the predicament period of Covid-19. As a result, students are virtually attending classes from anywhere, utilizing their devices along with Internet connectivity (Yi & Moon, 2021).

The term "remote" was first used in education by Schultz & Schooley (1970); when the authors studied "An Economical Remote Teaching System". The paper investigates Arizona's remote teaching system (ARTS) for college courses. Since then, publications have gradually increased until 2019. Interestingly, the number of publications rose from seven in 2019 to 258 in 2020, 809 in 2021, and 561 in August 2022, showing significant increases during the pandemic period of Covid-19.

There have been massive studies in remote teaching and learning since 1970. Earlier studies focused on technological issues; Arizona remote teaching systems (Schultz & Schooley, 1970), Audio-visual media (Decaigny, 1978), local area networks used for advanced automation functions (Liang, 1986), medical information networks (Rankin *et al.,* 1987), use of interactive multimedia technologies (IMT) connected through telecommunications to create distributed multimedia learning environments (DMLE) (Pea & Gomez, 1992), a Web-based algorithm animation system (Brown & Najork, 1997), multi behaviour-based mobile robot for remote supervisory control through the Internet (Luo & Chen, 2000), remote learning laboratories (Calvo *et al.,* 2010) and virtual world training simulation of ICU (Brown *et al.,* 2012). Gradually the area of research on RTL focuses on non-technical issues such as the program or framework that suite remote learning (Kayama & Okamoto, 2002; Tsutsuguchi *et al.,* 2002; Huang & Huang, 2003; Schultz & Robbins, 2009), challenges (Shih *et al.,* 2003), experience on traditional learning instrument such as a lab exercise into a remote learning environment (Kostanoski & Totans, 2005), approach for learner evaluation in an open distance environment (Balla, 2009). Recent studies concentrate on issues in the relation to RTL and COVID-19 pandemic. It includes the impact of clinical and lab courses (Jamli *et al.,* 2022; Mageswaran & Ismail, 2022; Desa *et al.,* 2022;

Woon & Hadie, 2022), students' perceptions (Riadi *et al.,* 2022; Razami & Ibrahim, 2021); challenges (Basar *et al.*, 2021) and impacts on education (Abumalloh *et al.,* 2021), the psychological well-being on students (Ahmad *et al.,* 2022; Radeef *et al.,* 2022; Zainal Badri & Wan Mohd Yunus, 2022), and health issue such as weight status (Tan *et al.,* 2022). As a result of the vast number of studies, the present study argues that there is a need to review the kinds of literature and discover the evolution of trends for future research using a bibliometric approach. According to Donthu *et al.,* (2021), a bibliometric study can help scholars overview the trends, identify research gaps and ideas for further studies and contribute to the existing literature. The following sections cover the data research methods based on the research protocol, analysis, discussion, conclusions, and recommendations for future research.

Research Methods

The research protocol by Lardo *et al.,* (2021), as shown in Figure 1, was adapted in this study to ensure there are no errors or any missing steps to accomplish the research objectives.

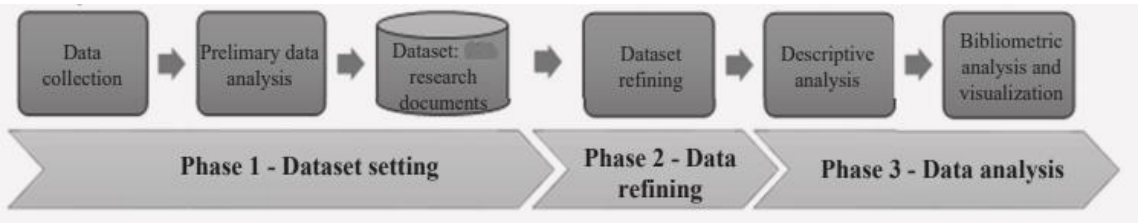

Figure 1: Research Protocol
(Source: Lardo *et al.,* (2021))

Phase 1: Dataset Setting

The Scopus database was utilized to acquire data for the study because of its coverage, extensive scientific data and literature, and analytical capabilities (Elsevier, 2022). Scopus databases consist of more than 87 million documents, more than 1.7 billion cited references, more than 17 million author profiles, and more than 94 thousand affiliation profiles. The data gathering on the Scopus database was conducted in August 2022. The study employed the terms "remote teaching and learning," "remote learning," or "remote teaching" to find the pertinent body of literature. The query resulted in a total of 3,372. It was then limited to only articles for document type, the final stage of publication, source type for the journal, and English version. The result from the query shows 1,778 documents. The extracted dataset is more than 500 articles. Therefore, it can be significant for bibliometric analysis (Donthu *et al.,* 2021). The following search query was constructed and apply in the database: TITLE-ABS-KEY("remote teaching and learning" or "remote learning" or "remote teaching") AND (LIMIT-TO (PUBSTAGE,"final")) AND (LIMIT-TO (DOCTYPE,"ar")) AND (LIMIT-TO (LANGUAGE,"English")) AND (LIMIT-TO (SRCTYPE,"j"))

Phase 2: Dataset Refining

According to Donthu *et al.,* (2021), the dataset used for bibliometric analysis needs to perform data cleaning to remove any duplication and erroneous entries. The collection of datasets is essential to understand the research coverage since the term remote teaching and learning was published in the Scopus database by Schultz and Schooley in the year 1970. Microsoft Excel Power Query Editor is used to identify mistakes, blank rows, and duplications of the 1,778 datasets. Following this process, the final dataset included is 1,748. Additionally, a thesaurus file is employed to identify a collection of keywords with similar meanings which need to be clarified. Examples include "covid," "covid19," "coronavirus," "covid-19 pandemic," "emergency remote teaching (ert)," "student," and "students." Thesaurus data file is created for the co-word analysis in VOSviewer. The authors with the same initial surname must be manually updated on the dataset, aside from the keyword. For instance, "Lin H." stands in for Hunter Lin and Hannah Lin, and "Chen, X." for Xiang Chen, Xiaoxiao Cheng, and Xiufang Chen. It will ensure that the co-authorship analysis does not contain any mistakes. Similarly, the initial "Jr."—intended for "Junior"—appear as one of the authors' names such as Rocha R.D.S. Jr. and Benjamin D.K. Jr.

Phase 3: Data Analysis Phase

The authors utilize the following data analysis in the present study: performance analysis and science mapping. The performance analysis analyses the publications and citations in RTL, and the science mapping analysis includes the citation, co-authorship, and co-word analysis. The VOSviewer visualization software is used to visualize, build maps, and investigate bibliometric networks (Van Eck & Waltman, 2022). Citation analysis assists researchers to identify popular research topics and papers that other researchers work on (Lai, 2020). In contrast, co-authorship means some publications two researchers have co-authored and a co-occurrence analysis to show the link between terms or keywords (Van Eck & Waltman, 2022).

Analysis and Discussion

Using a Scopus analyzer, the present study analyses the trend of publications by year, affiliation, author, country, source, and subject area. On the other hand, the authors used the VOSviewer to produce a map of the citation, co-authorship, and co-occurrence analysis. The analysis based on Donthu et al. (2021)

Performance Analysis: Documents Analysis by Year

Figure 2 depicts the history of 1,788 documents for RTL research, which began in 1970. From 1971 to 1977, 1979 to 1985, 1988-1991, and 1993, there was no publication; however, starting in 1994, the RTL publications have emerged annually. About 15 or fewer publications were published between

1970 and 2019. Remarkably, the number dramatically increased in the initial period of COVID-19, from seven in 2019 to 258 in 2020, representing 14.5% of publications. The number of publications is observed at its peak in the year 2021 at 809, 45.5%, before falling to 561, 31.6% in August 2022. Notably, in the early period of Covid-19, governments in most countries, particularly in the education industry, dramatically changed the learning platforms from face-to-face meetings to RTL.

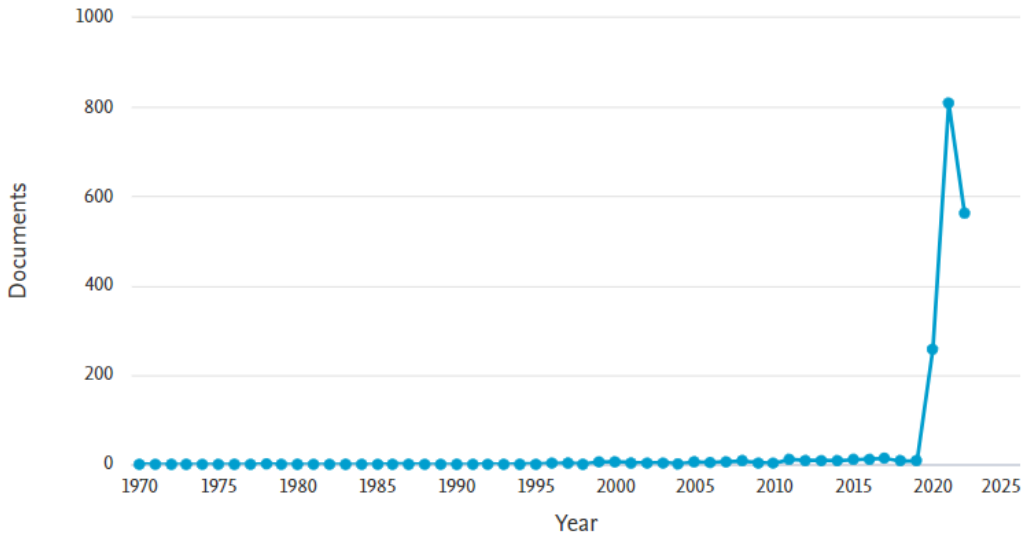

Figure 2: Document Analysis by Year

Source: Scopus analyzer (assessed on 24 August 2022)

Performance Analysis: Document Analysis by Affiliation

Figure 3 presents the top ten document analysis by affiliation. Monash University is ranked first place with 22 publications, or 2.31% of 160 publications published, followed by Pennsylvania State University with 13 publications (1.36%), the University of College London with 12 (1.26%) publications, and the University of Toronto, University of Melbourne, the University of California with 11 publications, respectively. The remaining universities contribute less than 11 publications, yielding less than 1%. The two renowned research universities in Malaysia are University Malaya with eight publications (0.84%), and Universiti Kebangsaan Malaysia with six publications (0.63%).

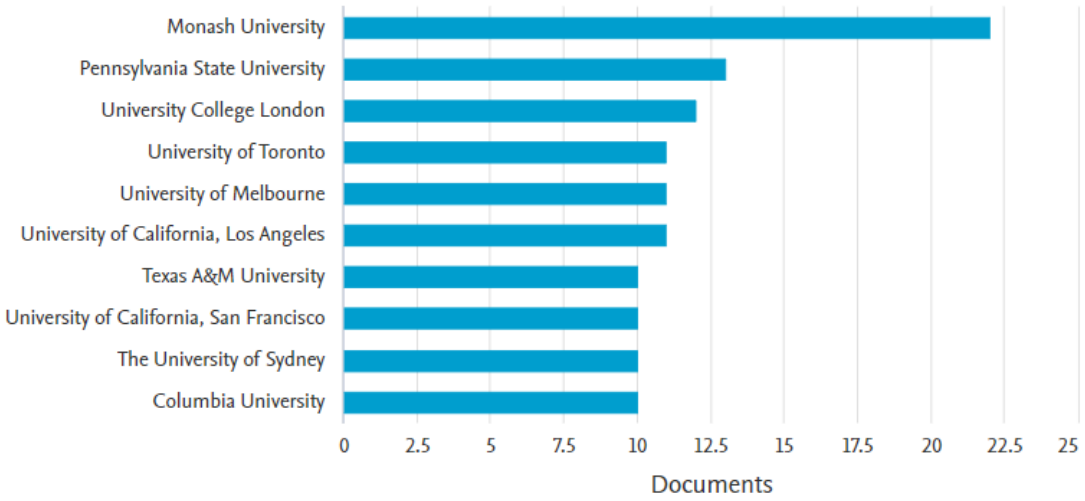

Figure 3: Document Analysis by Affiliation

Source: Scopus analyzer (assessed on 24 August 2022)

Performance Analysis: Document Analysis by Country

Research in RTL covers 159 countries, of which 44 countries cannot be defined. The authors find that about 678 (31.3%) of the publications were from the United States of America (USA), followed by the United Kingdom (UK), 113 (5.2%), Australia, 91 (4.2%), Canada, 85 (3.9%) China, 58 (2.7%), and other countries of 2.5% and below. Interestingly, Malaysia is ranked 13th and has 35 publications representing about 1.6% of the country's journals published in the Scopus database. The present study can plausibly argue that research in the field of RTL is predominantly conducted in Western countries relative to other regions in this world. This is aligned with the evidence found in Figure 3.

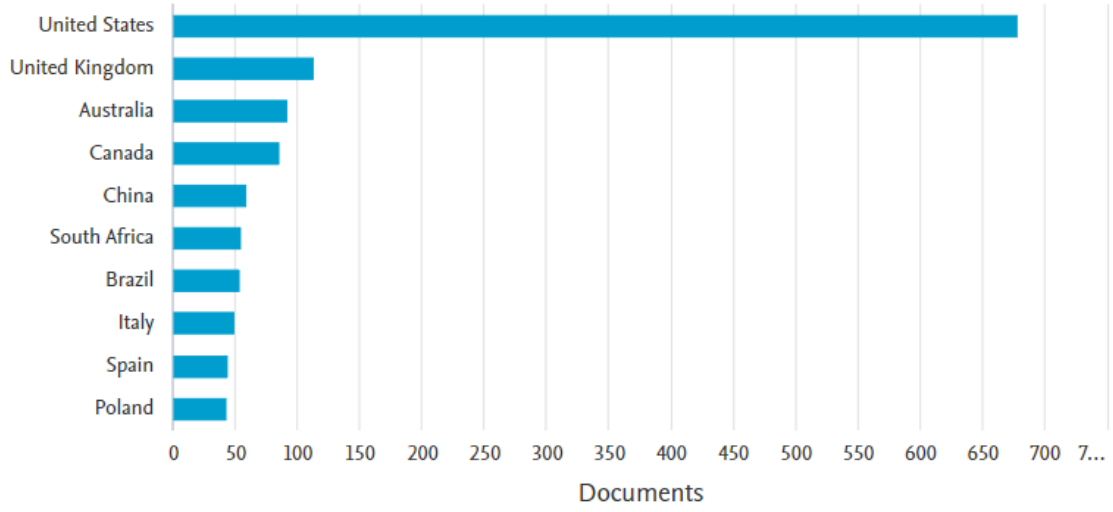

Figure 4: Document Analysis by Country

Source: Scopus analyzer (assessed on 24 August 2022)

Performance Analysis: Document Analysis by Subject

Figure 5 presents the subject-area analysis of the documents. There are 27 subject areas based on the Scopus database, where Social Sciences cover more than other areas, with 1,221 publications (38.9%). The second highest subject area is Computer Science at 313 (10.0%), followed by Medicine at 279 (8.9%), Psychology at 197 (6.3%) and Engineering at 168 (5.4%), and Business, Management, and Accounting at 66 (2.1%).

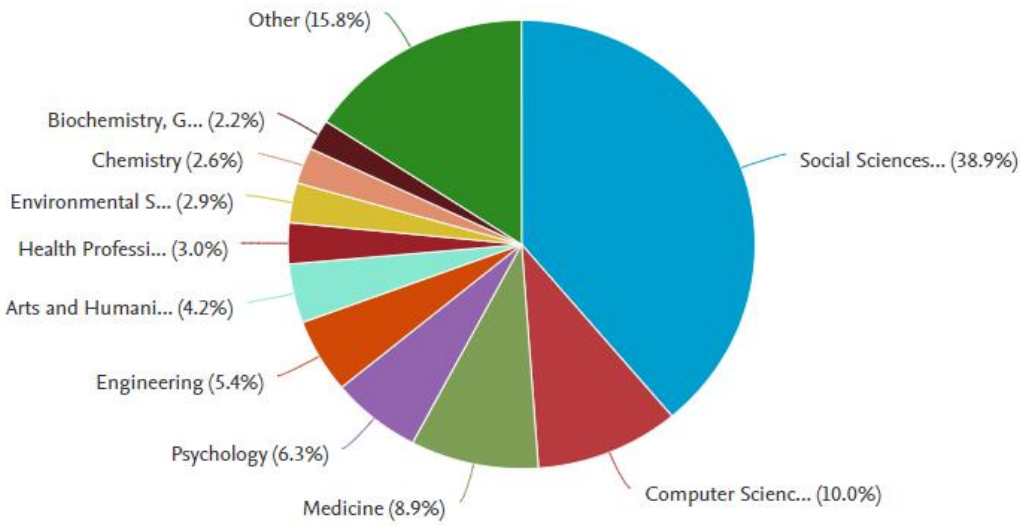

Figure 5: Document Analysis by Subject

Source: Scopus analyzer (assessed on 19 August 2022)

Performance Analysis: The Most Cited Journals, the Highest Number of Documents, and Total Link Strength

According to Lai (2020), citation analysis assists researchers to identify the most popular research areas and publications within their context. The results identify 819 journals with a minimum of 15 articles and only 10 articles meet the criteria. To identify the most influential journals, the total link strength between journals is important to emphasize (Djeki *et al.*, 2022). The result reveals that the Journal of Chemical Education (JCE) ranked first as the most cited journal of 529, with the highest number of documents, 64 (6.4%), and the most influential journal in the RTL research field. This is then followed by Education Sciences, cited by 321, with total documents of 45 (4.5%), and Sustainability (Switzerland) with a total citation of 279 and a total of documents of 44 (4.4%). The JCE is launched in 1924, and it is well-known as the world's premier education journal the Education

Sciences published articles across relevant fields of research, including education administration, management, philosophy and theory of education, educational technology and related areas.

Table 1: Most Cited Journals with the Total Number of Documents

List of Journals	Citations	Documents	Total Link Strength
Journal of Chemical Education	529	64	20
Education Sciences	321	45	19
Sustainability (Switzerland)	279	44	16
Online Learning Journal	257	17	13
Education and Information Technologies	170	24	6
Frontiers in Psychology	119	34	6
Frontiers in Education	117	38	16
BMC Medical Education	94	16	1
Plus One	76	16	3

Source: Authors' compilation of SCOPUS database data

Figure 6 depicts the document analysis by journal from the year 2020 until 2022. The number of documents published by year increased from 2020 to 2021 due to aggressive implementations of RTL among the institutions globally; however, the number is declining from 2021 to 2022 as most of the institutions conducting physical teaching and learning.

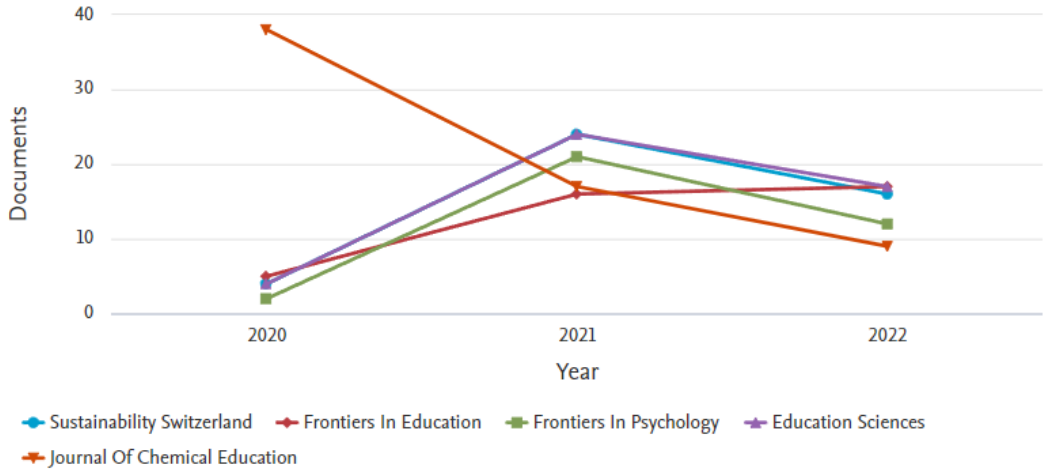

Figure 6: Document Analysis by Journal

Source: Scopus analyzer (assessed on 24 August 2022)

Performance Analysis: Top Ten Cited Documents

Table 2 depicts the top ten cited documents in the RTL field of study. To be included in the analysis, the study specifies the criteria for each document with at least 100 citations with no relation to any other document. From Table 2, the analysis discovers that Mukhtar *et al.* (2020) is the most cited article with 285 citations, published in the Pakistan Journal of Medical Sciences. The authors investigate the advantages and limitations of online learning during the Covid-19 pandemic from the perspective of teachers and students from universities in Lahore, Pakistan using a focus groups approach. The findings indicate that online learning provides comfort, and accessibility and encourages student-centred learning to the participants, however, the method of learning creates inefficiency and difficult to maintain academic integrity. The second most cited article is a review paper by Carrillo & Flores (2020), reviewing 134 empirical studies on online teaching and learning practices in education. The authors recommend the need for a comprehensive review of the pedagogy of online education and learning practices concerning the use of technology in supporting the approach. To support the online teaching methodology, a study by Johnson & Veletsianos (2020) contends that faculty and administrators at 672 US institutions adopting emergency teaching and learning, regardless of their experiences with this method, by developing appropriate changes in the assessments to adapt to the new transition from physical meeting to a virtual meeting. However, they also mentioned that the students need appropriate guidance in accessing the online materials and adapting to the new approach.

Table 2: Top Ten Cited Documents

Title	**Author**	**Year**	**Journal**	**Cite Score 2021**	**Number of Citation**
Advantages, Limitations, and Recommendations for online learning during the COVID-19 pandemic era	Mukhtar K., Javed K., Arooj M., Sethi A.	2020	Pakistan Journal of Medical Sciences	2.3 (Open Access)	285
COVID-19 and teacher education: a literature review of online teaching and learning practices	Carrillo C., Flores M.A.	2020	European Journal of Teacher Education	7.3	229
U.S. Faculty and Administrators' Experiences and Approaches in the Early	Johnson N., Veletsianos G., Seaman J.	2020	Online Learning Journal	5.7 (Open Access)	181

Weeks of the COVID-19 Pandemic					
Forced Disruption of Anatomy Education in Australia and New Zealand: An Acute Response to the Covid-19 Pandemic	Pather N., Blyth P., Chapman J.A., Dayal M.R., Flack N.A.M.S., Fogg Q.A., Green R.A., Hulme A.K., Johnson I.P., Meyer A.J., Morley J.W., Shortland P.J., Štrkalj G., Štrkalj M., Valter K., Webb A.L., Woodley S.J., Lazarus M.D.	2020	Anatomical Sciences Education	8.5	180
Online Learning and Emergency Remote Teaching: Opportunities and Challenges in Emergency Situations	Ferri F., Grifoni P., Guzzo T.	2020	Societies	2.0 (Open Access)	155
Virtual and remote robotic laboratory: comparative experimental evaluation	Tzafestas C.S., Palaiologou N., Alifragis M.	2006	IEEE Transactions on Education	5.9	147
Changes in alcohol use as a function of psychological distress and social support following COVID-19 related University closings	Lechner W.V., Laurene K.R., Patel S., Anderson M., Grega C., Kenne D.R.	2020	Addictive Behaviors	6.7	139
'Like a rug had been pulled from under you': The impact of COVID-19 on teachers in England during the first six weeks of the UK lockdown	Kim L.E., Asbury K.	2020	British Journal of Educational Psychology	5.2	135

Emergency remote teaching and students' academic performance in higher education during the COVID-19 pandemic: A case study	Iglesias-Pradas S., Hernández-García Á., Chaparro-Peláez J., Prieto J.L.	2021	Computers in Human Behavior	14.9	130
The future of business education: A commentary in the shadow of the Covid-19 pandemic	Krishnamurthy S.	2020	Journal of Business Research	11.2	125

Source: Authors' compilation of SCOPUS database.

Performance Analysis: Most Active Authors with the Highest Publications

Figure 7 presents the most active authors with the highest publication in RTL. The results show that there are a total of 160 authors published their research works in RTL. Kevin Fuchs from Prince of Songkla University, Phuket, Thailand; is identified as the most significant or active author in the field of RTL research with a total of eight articles, followed by the other authors: Lucas Kohnke, Benjamin Luke Moorhouse, Alison Power, Maila Rahiem, and James Russo, each contributes four articles, respectively.

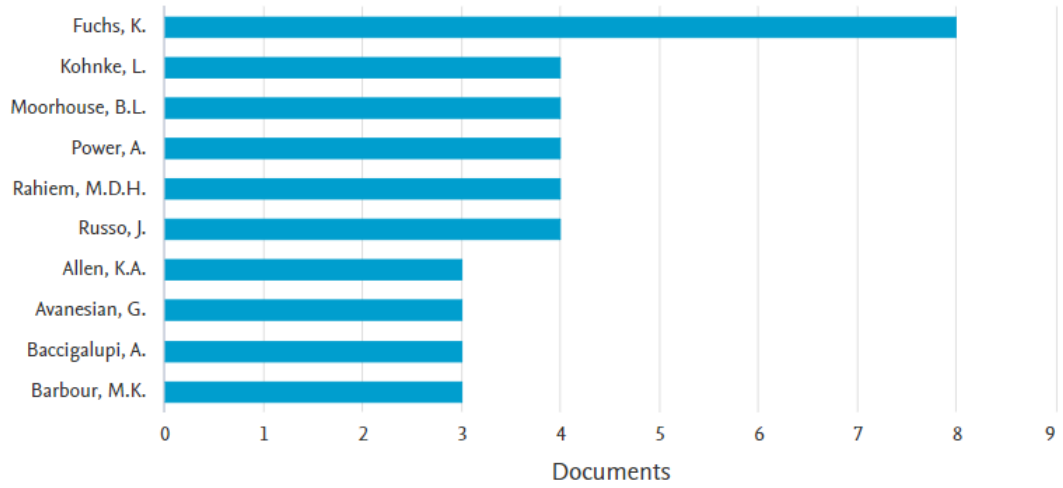

Figure 7: Document Analysis by Author

Source: Scopus analyzer (assessed on 24 August 2022)

Table 3: The Most Active Scholars for Remote Teaching and Learning

Scholar/s	Title	Year	Source Title	Cite Score 2021	Citation
Fuchs K.	An Exploratory Interview Study about Student Perceptions of Using social media to Facilitate their Undergraduate Studies	2022	Frontiers in Education	2.0 (Open Access)	1
Fuchs K.	Lessons Learned: A Comparative Study About the Perceived Satisfaction of Emergency Remote Teaching in Thailand	2021	International Journal of Information and Education Technology	1.3	1
Fuchs K., Karrila S.	Satisfaction with Remote Teaching in Thai Higher Education	2022	Obrazovanie I Nauka	2.3 (Open Access)	2
Fuchs K.	Advances in Tourism Education: A Qualitative Inquiry About Emergency Remote Teaching in Higher Education	2021	Journal of Environmental Management and Tourism	2.1	7
Fuchs K., Karrila S.	The Perceived Satisfaction with Emergency Remote Teaching (ERT) Amidst COVID-19: An Exploratory Case Study in Higher Education	2021	Obrazovanie I Nauka	2.3 (Open Access)	9
Fuchs K.	Online Learning and Emergency Remote Teaching in Higher Education During COVID-19: Student Perspectives	2022	International Journal of Information and Education Technology	1.3	0
Fuchs K.	The Difference Between Emergency Remote Teaching And E-Learning	2022	Frontiers In Education	2.0 (Open Access)	0
Fuchs K.	Perceived Satisfaction of Emergency Remote Teaching: More Evidence from Thailand	2021	International Journal of Learning, Teaching and	1.1	0

Source: Authors' compilation of SCOPUS database data

Table 3 outlines the most active scholars in RTL. Fuchs, K. published the most with eight documents: four articles in the years 2021 and 2022, respectively. Of the eight documents, only two articles he worked on and the co-author, Karrila, S. from Prince of Songkla University, Phuket, Thailand. The highest number of citations was recorded in the year 2021, with total citations of seven and nine, respectively. Though Fuchs, K. is the most active author in this field of study, the study contends that he is not the most influential author in RTL (Djeki *et al.*, 2022).

Science Mapping: Co-authorship Analysis

Co-authorship analysis is conducted to determine the collaboration between authors in RTL as shown in Figure 8. Of 6,199 authors, only 347 fulfil the criteria when the study specifies a minimum of two publications. Using the VOSViewer, the analysis shows that only 22 authors have the most apparent connections, with the highest total link strength at 39, and the lowest total link strength at eight. Total link strength for co-authorship analysis means two researchers have co-authored in several publications (Van Eck & Waltman, 2022). The results also identify two clusters: cluster 1 (red colour) consists of 17 authors, and cluster 2 (green colour) includes the remaining five authors. The following authors from cluster 1 (red colour) namely Michelle Daniel, Morris Gordon, Ahmad Hider, Deena Khamees, Teresa Pawilkowska, William Peterson, Jennifer Stojan, and Sophie Park are found to be the most outstanding co-authorship relationship, each having co-authored three publications, respectively. The second highest co-authorship relationship includes Sebastian Alston, Nicola Clarke, Mohan Pammi, and Eliot Rees, who have co-authored two publications, respectively.

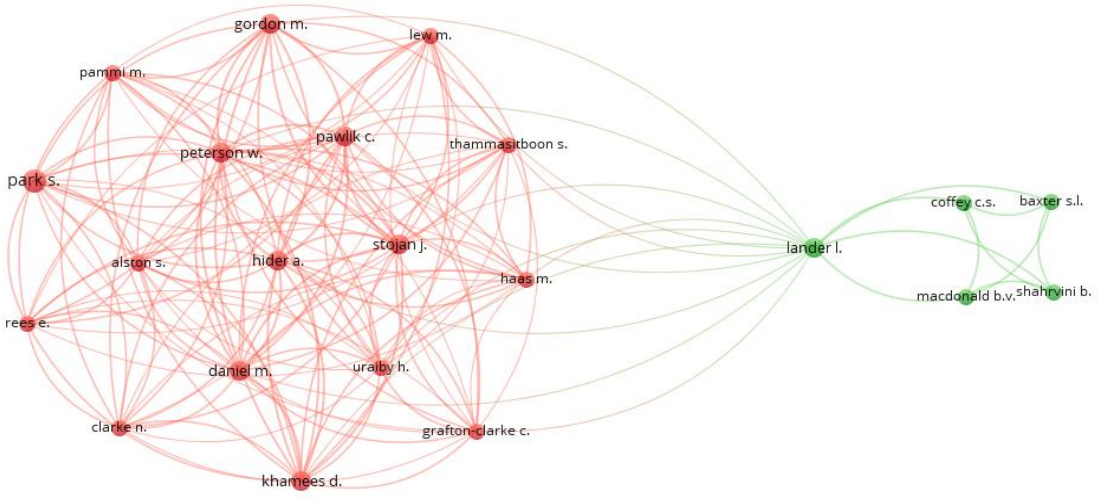

Figure 8: Network Visualization for Co-authorship Analysis
Source: Dataset based on Scopus database with VOSviewer software on Network Visualization Map

Based on the result of the co-authorship analysis, the top ten citations among scholars are reflected in Table 4. Ahsan Sethi from Qatar University is the most outstanding author in the RTL field of study. He published two articles with the highest citations of 327 and a total link strength of one. The second highest author is Maria Assuncao Flores from Minho University in Portugal with a total citation of 240; followed by Nicole Johnson and George Veletsianos from Canada, with 203 total citations and a total link strength of seven; and finally, Daniel K. Benjamin, Jr., Maurice Alan Brookhart, and Kanecia O. Zimmerman from Duke University, USA, each author contribute two articles, with a total citation of 102 and a total link strength of four.

Table 4: Top Ten Authors Based on Co-Authorship Analysis

Rank	**Authors name**	**Affiliation**	**Country**	**No. of Articles**	**Citations**	**Total Link Strength**
1	Ahsan Sethi	Qatar University	Qatar	2	327	1
2	Maria Assuncao Flores	University of Minho	Portugal	3	240	0
3	Nicole Johnson	Canadian Digital Learning Research Association	Canada	3	203	7
4	George Veletsianos	Royal Roads University	Canada	3	203	7
5	Daniel K. Benjamin, Jr.	Duke University	USA	2	102	4
6	Maurice Alan Brookhart	Duke University	USA	2	102	4
7	Kanecia O. Zimmerman	Duke University	USA	2	102	4
8	Sonia Rajendra Tiwari	Pennsylvania State University	USA	3	84	1

9	Janine Williams	The University of the West Indies	Trinidad and Tobago	2	80	1
10	Sana Mahmood	University of Toronto	Canada	1	77	0

Source: Authors' compilation of SCOPUS database data

Science Mapping: Co-Word Analysis

Co-occurrence analysis reveals the domain's evolution over time (Deng & Xia, 2020). It is, therefore, considered an efficient method to identify hot topics in each research domain. The present study analyzes the list of clusters for co-word analysis (Table 5), the top ten keywords (Table 6), the keywords network visualization map (Figure 9) and the keywords density visualization map (Figure 10) in the RTL field of study. In all 1,748 documents selected in the present study, we obtained 3,879 keywords, 20 meet the threshold, and the minimum occurrence of a keyword is nine. The selection of requirements in VOSviewer on the minimum number of occurrences for author keywords is nine. However, some of the 20 keywords are not connected. The cluster keywords provide details on related study areas of interest (Goksu, 2021) and the present study identifies nine clusters in the RTL field of research.

Table 5: List of Clusters for Co-word Analysis

Cluster	**Keyword**
1	covid-19, parents, and children
2	the survey, remote instruction, and self-regulated learning
3	stem, equity, and undergraduate
4	undergraduate medical education, telehealth, and gamification
5	emergency remote teaching and social presence
6	academic performance
7	community of inquiry
8	remote education
9	teaching and learning

Source: Authors' compilation of SCOPUS database data

From Table 6 and Figure 9, the results show that the keywords "Covid-19" (708 occurrences and 178 total link strength); "emergency remote teaching" (197 occurrences and 121 total link strength); "community of inquiry" (9 occurrences and 10 total link strength); "parents" (9 occurrences and 10 total link strength); "survey" (9 occurrences and 10 total link strength); "academic performance" (9

occurrences and 9 total link strength); “remote instruction” (9 occurrences and 8 total link strength); “self-regulated learning” (9 occurrences and 8 total link strength); and “teaching and learning” (9 occurrences and 8 total link strength) form the main core of keywords in the research topic and aligned with the size of label and size of the nodes. The node of “Covid-19” has a thicker line (the authors only include the link strength of 4 and above) with “emergency remote teaching” (link strength of 10); and “remote instruction” (link strength of 4); showing a strong link between these keywords. In addition, the present study also utilizes the visual density map to visualize the keywords. Figure 9 informs us of the understanding of each node has its colour, indicating the density of items at that point, and the colour is ranging from blue to green and to yellow. It is notable that the keywords in yellow colour appear more frequently and contribute higher weights. On the contrary, the lower the frequency and the weight, the closer the colour of the point to blue. In this study, the researchers identify that the most profound keywords are “Covid-19”, and “emergency remote teaching”, consistent with the findings shown in Table 6.

Table 6: Top Ten Frequency of Keywords based on Co-word Analysis

Rank	**Keywords**	**Frequency**	**Link**	**Total Link Strength**
1	covid-19	708	17	178
2	emergency remote teaching	197	10	121
3	community of inquiry	9	2	10
4	parents	9	3	10
5	survey	9	3	10
6	academic performance	9	2	9
7	remote instruction	9	4	8
8	self-regulated learning	9	3	8
9	stem	9	4	8
10	teaching and learning	9	1	8

Source: Authors’ compilation of SCOPUS database data

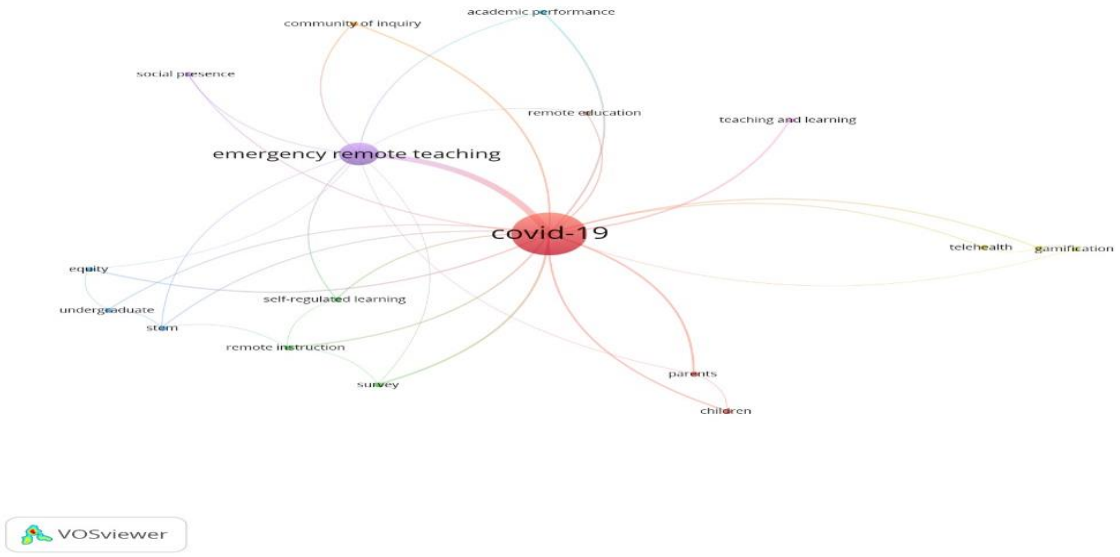

Figure 9: Network Visualization for Co-Occurrence Analysis

Source: Dataset based on Scopus database with VOSviewer software on Network Visualization Map

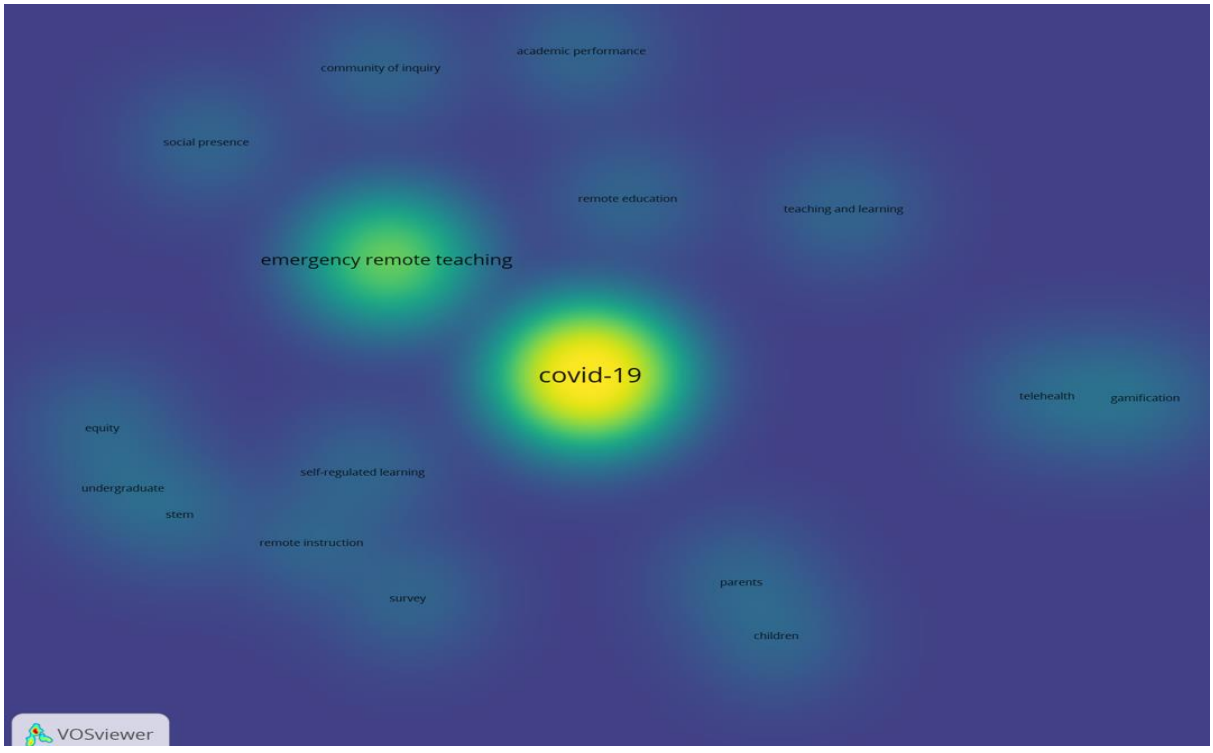

Figure 10: Density Visualization for Co-word Analysis based on Author Keywords

Source: Dataset based on Scopus database with VOSviewer software on keywords density visualization map

Conclusion

This study conducted a bibliometric analysis based on data derived from the Scopus database using performance analysis and science mapping analysis. The performance analysis is conducted using data generated by the Scopus analyzer. On the other hand, the present study employs a science mapping approach to perform citation, co-authorship, and co-word analysis using the VOSViewer. The present study identifies a total of 1,748 documents in remote teaching and learning (RTL) as a final dataset used in the analysis.

Remarkably, the number dramatically increased in the initial period of COVID-19, from seven in 2019 to 258 in 2020, representing 14.5% of publications. The number of publications is observed at its peak in the year 2021 at 809, 45.5%, before falling to 561, 31.6% in August 2022. The significant increases in the number of publications in the year 2021 could be influenced by the predicament period of COVID-19. However, due to most countries returning to normal and Covid-19 being declared as an endemic, the number of publications is seen deteriorating aggressively. Monash University is identified as the most active affiliation, with a significant number of articles published 22 (2.31%), followed by Pennsylvania State University with 13 publications (1.36%), and the University College London with 12 (1.26%) publications. Research in RTL is significantly produced by the USA, with about 678 articles (31.3%) followed by the United Kingdom (UK), 113 (5.2%), and Australia, 91 (4.2%). Notably, there are 27 subject areas based on the Scopus database, where Social Sciences cover more than other areas, with 1,221 publications (38.9%). The second highest subject areas are Computer Science at 313 (10.0%), followed by Medicine at 279 (8.9%). The result also reveals that the Journal of Chemical Education (JCE) ranked first as the most cited journal of 529, with the highest number of documents, 64 (6.4%), and the most influential journal in the RTL research field. Education sciences and Sustainability (Switzerland) fall second and third, respectively. Fuchs, K. is the most active scholar in RTL, with eight papers in total. However, Fuchs, K. is not considered an influential scholar, given that only two papers he worked on with a co-author and the highest cited paper unfortunately just only nine citations. In addition, based on co-authorship analysis, which is used to determine the collaboration between authors, Fusch, K. has no connection with other authors with two or more publications. Instead, Ahsan Sethi from Qatar University recorded the highest citation, with a total of 327 and a total link strength of 1.0. The co-word analysis reveals that the keywords “Covid-19” (708 occurrences and 178 total link strength) and “emergency remote teaching” (197 occurrences and 121 total link strength) are the top two keywords searched in RTL research. The preliminary bibliometric analysis has several limitations. Firstly, it only counts those studies which used the keywords "remote teaching", "remote learning", and "remote teaching". Secondly, the method used was only descriptive analysis to understand the trends of publication, and finally, this study was based on data from the Scopus database. Future research could be conducted on the thematic analysis of the relevant RTL

topics and cover other popular databases such as the Web of Science (WOS) to provide comprehensive results.

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