

A Bibliometric Analysis of Technology-Based Foreign Language Learning during the COVID-19 Pandemic: Direction for Indonesia Language Learning

Muhammad Fuad, Edi Suyanto, Sumarno, Ulul Azmi Muhammad, and Suparman

Abstract—During the COVID-19 pandemic, the process of Indonesia language learning is held in online in which it needs supporting technological tools and innovative learning approaches or models to create interactive and interesting learning process of Indonesia language. A bibliometric analysis was used to provide the bibliographic and bibliometric review related to the emerging trends of technology-based foreign language learning during the COVID-19 pandemic. VOSviewer and Publish or Perish (PoP) were some software employed to analyze the documents published between 2020 and 2022 from the Scopus database. The results revealed that there were 100 publications and 199 citations regarding the use of technology in foreign language learning in which the development of the number of publications and citations relatively fluctuated. Digital platforms such as learning management systems and social media applications were the trending technologies supporting the foreign language learning process. Subsequently, the trending foreign language learning in the COVID-19 pandemic implemented distance or online learning involving blended learning, mobile learning, or remote learning. Therefore, this study specifically implicates the Indonesian language learning in which teachers or lecturers can implement distance or online learning in teaching the Indonesian language to prevent the deployment of COVID-19 supported by digital platforms.

Index Terms—Bibliometric analysis, COVID-19, foreign language learning, Scopus, technology, VOSviewer.

I. INTRODUCTION

Coronavirus disease 2019 (COVID-19) pandemic that first time infected humans at the end of 2019, came from the animal market in Wuhan City, Hubei, China [1]. In a fast time, this virus spreads and infects humans in most of the whole country. As a consequence, every country that has been attacked by the COVID-19 outbreak begins to apply the social and physical distancing policy between each individual in preventing the deployment of the pandemic in which the implementation of the policy affects education

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fields [2], [3]. The policy causes the learning system conducted online where the learning usually carried out in the classroom face to face becomes the learning conducted online [4], [5]. The change of learning system from offline to online needs some factors such as technology, finance, and skill in which technology is the most important factor to hold online learning.

The implementation of online learning requires the use of technology that can support the learning process optimally. The use of technology in online learning expedites the execution of the learning process in which teacher can share and explain learning materials and students also can discuss and ask about everything that they have been learned so that it brings out interactive learning between teacher and students [6], [7]. Specifically, the implementation of foreign language learning online also needs learning technologies as a medium to hold the learning process. Some foreign language learners such as English, Japanese, Arabic, Russian, and Chinese utilize the technology to engage in online learning during the COVID-19 pandemic [8]–[15]. This indicates that the implementation of foreign language learning has employed many learning technologies during the COVID-19 outbreak.

On the other hand, Indonesia is the official language taught from lower education to higher education. During the COVID-19 outbreak, Indonesian language learning is also held in online in which to implement it, teachers or lecturers need innovative technologies to create an interactive learning process. Fuad *et al.* [16] argued that Indonesian language learning insists students have several skills such as reading, writing, speaking, and listening. Moreover, Lie *et al.* [17] revealed that writing and speaking are active skills. As a consequence, to facilitate students in enhancing their speaking and writing skills especially, the implementation of Indonesia language learning performed should be interactive in which the use of technology as an interactive learning media and the involvement of the interactive learning approach or model is required [13], [18]. Therefore, some recommendations related to interactive learning technologies from several studies which have been carried out by many researchers regarding technology-based foreign language learning are extremely needed for teaching the Indonesian language. These recommendations can be created by providing a review that can present technology trends utilized in foreign language learning and its development during the COVID-19 pandemic.

A bibliometric analysis is a suitable method to provide a review of the research trends of the use of technology in foreign language learning during the COVID-19 pandemic.

Donthu *et al.* [19] revealed that bibliometric analysis is a conscientious method of exploring and analyzing the numerous volumes of scientific data to present the state of the emerging trends of a research topic or field. To date, many bibliometric analysis studies related to foreign language education have been carried out widely by a lot of researchers [20]–[30]. In addition, several bibliometric analysis types of research regarding technology-based English learning such as computer, website-based assessment, e-books, social media, and wearable devices also have been performed by some researchers [31]–[35]. In contrast, this study focuses on exploring and analyzing the large scientific data from the Scopus database regarding technology-based foreign language learning during the COVID-19 outbreak. This bibliometric analysis study is expected to present the emerging trends of technologies utilized in foreign language learning in which the interactive learning technologies obtained from this study can be recommendations for implementing Indonesian language learning during the COVID-19 pandemic. Therefore, this recent study aims to provide a bibliometric and bibliographic review regarding the emerging technology trends in foreign language learning during the COVID-19 outbreak. Notably, the following research questions are to be directed to this current study:

- 1) What is about the publication-and-citation-related metric of technology-based foreign language learning studies?
- 2) What is the publication and citation trend in the field of technology-based foreign language learning studies?
- 3) Which document types, authors, countries, affiliations, journals, publishers, and documents contributed most to technology-based foreign language learning studies?
- 4) What are the most frequently emerging keywords regarding technology-based foreign language learning studies? What is the distribution of the most emerging keywords in the current period?
- 5) What are the social relationships among authors and author countries related to technology-foreign language learning studies? What is the distribution of the most emerging authors in the current period?

II. METHODS

To provide a bibliometric and bibliographic review related to the emerging trends of technology-based foreign language learning studies during the COVID-19 pandemic, a bibliometric analysis was used to perform this study [19], [36]–[38]. A bibliometric analysis had several functions that were to gain a one-step overview, identify knowledge gaps, position their intended contribution to the field, and derive novel ideas for investigation [19]. Some pieces of the literature revealed that in conducting a bibliometric analysis study, five stages were: 1) defining search keywords, 2) initials search results, 3) refinement of the search results, 4) compiling the initial data statistics, and 5) data analysis [39], [40]. In particular, the stages of this current bibliometric analysis study were elaborated in the following subsection.

A. Defining Search Keywords

The search of documents conducted on April 4, 2022, which was specifically at 4 PM employed some

combinational keywords such as "technology", "language learning", and "covid-19". Scopus database was used to search the documents because Scopus was one of the best scientific databases which had a lot of well-qualified documents. Firstly, the keywords were typed in the part of "search documents" by selecting the document part. Then, to obtain more documents, the format "article, abstract, keywords" was selected in the part of "search within".

B. Initial Search Results

The process of initial search found 246 documents published from 2020 to 2022. These documents consisted of the article, conference paper, review, conference review, book chapter, note, and letter in which the document types were written in English, Spanish, Russian, Chinese, French, Portuguese, Estonian, Japanese, and Korean. In addition, by using the combinational keywords, many documents did not have titles consisting of the words such as "technology", "language learning", and "covid-19".

C. Refinement of Search Results

To obtain the documents which were suitable for this study, a few inclusion criteria were assigned to select the documents. The inclusion criteria were as follows: 1) there were some words such as "technology", "language", and "covid-19" in the title of the document, 2) the document was published from 2020 until 2022, 3) the document was written in English, and 4) the type of document was the article, conference paper, review, and book chapter. The selection process of documents that were not suitable for the inclusion criteria is shown in Table I.

TABLE I: THE SELECTION PROCESS OF DOCUMENTS

Search Screening	Number of Documents	The Total of Remaining documents (n = 246)
Not from 2020 to 2022	0	246
Not in English such as Spanish, Russian, Chinese, French, Portuguese, Estonian, Japanese, or Korean	17	229
Not in the type of article, conference paper, review, or book chapters such as conference review, note, or letter	16	213
Not relevant (the title of the document did not consist of some words such as "technology", "language", and covid-19")	113	100

As a consequence of the document selection, there were 100 remaining documents to be extracted in the initial data statistics. The difference between the initial search and refinement search is shown in Table II.

TABLE II: COMPARISON BETWEEN INITIAL SEARCH AND REFINEMENT SEARCH

Metrics Data	Initial Search	Refinement Search
Query Data	04/04/2022	04/04/2022
Keywords	Technology, Language Learning, COVID-19	Technology, Language Learning, COVID-19
Database	Scopus	Scopus
Languages	English, Spanish, Russian, Chinese, French,	English

Document Types	Portuguese, Estonian, Japanese, or Korean	
	The article, Conference Paper, Book Chapter, Conference Review, Review, Note, and Letter	The article, Conference Paper, Book Chapter, or Review
Publication Years	3 Years: (2020 - 2022)	3 Years (2020 - 2022)
Number of Documents	246	100

D. Compiling the Initial Data Statistics

The documents were downloaded from the Scopus database by using two formats that were Research Information System (RIS) and Comma Separated Values (CSV). RIS and CSV format consisted of some important information of documents such as bibliometric information, bibliographical information, and abstract & keywords [41]. In the Publish or Perish (PoP) software, the documents compiled in RIS format could present the initial data statistics such as several citations, authors, document title, document type, source (journal or proceeding name), publication year, and publisher [39], [40]. In addition, the compiled documents also provided the descriptive analysis summary such as total citation (TC), the total publication (TP), number of authors per publication (NAP), number of citations per publication (NCP), number of citations per year (NCY), m-Index, h-Index, and g-Index [41]. Particularly, the g-Index represented the g-number of highly cited papers with at least g^2 citations whereas the h-Index was calculated as h number of publications with at least h citation, and the m-Index was measured as $\frac{h}{g}$ [42].

E. Data Analysis

The main techniques consisted of performance analysis and science mapping were used to analyze the data in this study [19]. Donthu *et al.* [19] argued that science mapping examined the relationships among research constituents whereas performance analysis examined the contribution of research constituents to the given field. In this study, performance analysis supported by the PoP software was used to provide publication-and-citation-related metrics and present publication and citation trends related to foreign language learning studies. Donthu *et al.* [19], meanwhile, revealed that science mapping consisted of citation analysis, co-word analysis, and co-author analysis. In addition, network analysis using clustering and visualization was carried out to enrich the science mapping [19]. VOSviewer software was used to carry out science mapping and network analysis [43], in which visualization analysis involved network and overlay visualization while clustering analysis employed hierarchical clustering [40], [44].

III. RESULTS AND DISCUSSION

A. Performance Analysis

1) Publication-and-citation-related metric

The selection process established 100 documents that were suitable for the inclusion criteria. By using PoP software, the

publication-and-citation-related metric of these documents is shown in Table III.

TABLE III: PUBLICATION AND CITATION METRICS

Description	Results
Publication years	2020 - 2022
Citation years	2020 - 2022
Total publication	100
Total citation	199
Authors	256
Cites/year	99,50
Cites/paper	1,99
Authors/paper	2,65
h-Index	8
g-Index	11
m-Index	0,73

Table III presents that between 2020 and 2022, there were 100 published documents related to technology-based foreign language learning in the COVID-19 pandemic in which overall these documents had been cited as many as 199 citations. In addition, the average citation per year was stated to be 99,50. It means that every year in the period 2020 – 2022 the documents are cited close to 100 times. Also, the average of citations per paper was stated to be 1,99 which indicates that every document is cited on the average nearly 2 times. The ratio value of authors per paper was stated to be 2,65 whereas the number of authors involved in publishing the documents was 256 individuals. It shows that every document is authorized by 3 authors of which nine authors authorize two documents. Further, the h-index of the document collection was 8 which means that there are 8 documents with at least 8 citations. Meanwhile, the g-index of the document collection was 11 which means that there are 11 highly cited papers with at least 121 citations. This implies that the m-index of the document collection was stated to be 0,73 which presents that the ratio between the h-index and g-index is 8:11. In addition, it indicates that the h-index is always lower than the g-index [42].

2) Publication and citation trend analysis

This analysis was used to provide the development of the number of publications and citations related to technology-based foreign language learning studies during the COVID-19 outbreak. The trend of publication and citation of the documents is presented in Fig. 1.

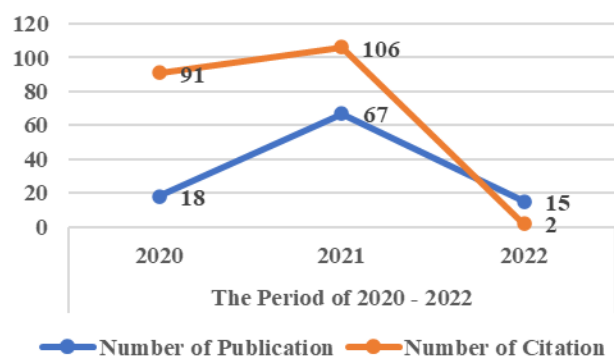


Fig. 1. Publication and citation trend of the documents from 2020 until 2022.

Fig. 1 shows that the development of publication moderately soared from 2020 to 2021 there were 18 documents published in 2020 and followed by 67 documents

in 2021. From 2021 to 2022, however, the development of publication moderately fell where there were only 15 documents published in 2022. These findings indicate that the publication development of the documents regarding the studies of technology-based foreign language learning during the COVID-19 pandemic relatively fluctuates. Some bibliometric analysis studies also revealed that the development of publication related to the use of computer technology in English learning relatively fluctuates [32]–[34]. It can be expected that the publication trend will increase until the end of 2022 because the studies related to the use of technology in language learning as a consequence of the COVID-19 outbreak will continue [45], [46].

Meanwhile, the development of citations slightly increased between 2020 and 2021 in which there were 91 citations in 2020 and followed by 106 citations in 2021. In contrast, in the period 2021 – 2022, the development of citations sharply decreased where there were only 2 citations in 2022. These reports show that there was an increase of citations as many as 16,48% citations in the period of 2020 – 2021 and a decrease of citations as many as 98,11% in citations. This indicates that from 2020 to 2022, the development of citations to the documents studying technology-based foreign language learning during COVID-19 adequately fluctuates. Chen et al. [31] also reported that during the period of 2000 – 2021, the documents of researches about the technology-enhanced language learning have been fluctuately cited. The number of citations to the documents will go up in the future because the studies about technology-based foreign language learning during COVID-19 are the trending topic in educational research [18], [47], [48].

Hereinafter, from 100 documents involved in this study, they consisted of the article, conference paper, review, and book chapter. In detail, the proportion of the number of documents in every type is presented in Fig. 2.

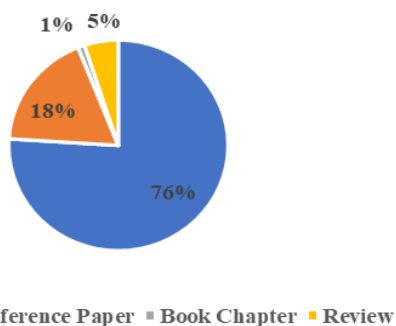


Fig. 2. Total papers by document type.

Fig. 2 presents that the documents consisted of 76 articles, 18 conference papers, 5 reviews, and 1 book chapter. It means that the document in articles is more dominant than the document in a conference paper, review, and book chapter. It indicates that many authors are more interesting to publish their documents in the article than in conference papers, reviews, and book chapters. Some bibliometric analysis studies also report that a lot of authors interest to publish their papers in journal articles than in other document types [22], [23], [25], [30], [49], [50].

B. Science Mapping and Network Analysis

1) Citation analysis

Citation analysis was used to analyze the relationship among publications by identifying the most influential publications [19]. As a consequence, the analysis was employed to present the most contributed documents, authors, countries, affiliations, journals, and publishers related to the studies of technology-based foreign language learning during the COVID-19 outbreak. Therefore, this analysis would provide the most influential documents, authors, countries, affiliations, journals, and publishers regarding the use of technology in language learning in the period 2020 – 2022. Particularly, every following unit was explained comprehensively. The most influential documents related to technology-based foreign language learning were measured from the h-index [42]. Table III shows that the h-index of the document collection was 8. It means that there are the eight most influential documents regarding technology-based foreign language learning. The most contributed documents are shown in Table IV.

TABLE IV: TOP 8 DOCUMENTS WITH THE HIGHEST CITATION

Total Citation	Author(s)	Title	Journal	Year
22	Mackey, T.K., Li, J., Purushothaman, V., Nali, M., Shah, N., Bardier, C., Cai, M., & Liang, B	Big data, natural language processing, and deep learning to detect and characterize illicit COVID-19 product sales: Infoveillance study on Twitter and Instagram	JMIR Public Health and Surveillance	2020
19	Alfadda, H. A., & Mahdi, H. S	Measuring students' use of zoom application in language courses based on the technology acceptance model (TAM)	Journal of Psycholinguistic Research	2021
19	Lie, A., Tamah, S. M., Gozali, I., Triwidayati, K. R., Utami, T. S. D., & Jemadi, F	Secondary school language teacher's online learning engagement during the COVID-19 pandemic in Indonesia	Journal of Information Technology Education Research	2020
14	Amin, F. M., & Sundari, H	EFL students' preferences on digital platforms during emergency remote teaching: Video conference, learning management system, or messenger application?	Studies in English Language and Education	2020
13	Cheung, A	Language teaching during a pandemic: A case study of zoom use by a secondary ESL	RELC Journal	2021

		teacher in Hong Kong		
10	Moorhouse, B. L., Li, Y., & Walsh, S	E-Classroom interactional competencies: Mediating and assisting language learning during synchronous online lessons	RELC Journal	2021
8	Yunus, M. M., Ang, W. S., & Hashim, H	Factors affecting teaching English as a second language (TESL) postgraduate students' behavioral intention for online learning during the COVID-19 pandemic	Sustainability (Switzerland)	2021
8	Inpeng, S., & Nomnian, S	The use of Facebook in a TEFL program based on the TPACK framework	LEARN Journal: Language Education and Acquisition Research Network	2020

Table IV shows that the document authorized by Mackey *et al.* [51], with the title "Big data, natural language processing, and deep learning to detect and characterize illicit COVID-19 product sales: Infoveillance study on Twitter and Instagram", was the most contributed document cited as many as 22 citations by other documents. It means that the document was cited on an average of nearly seven times in the period of 2020 – 2022. In addition, each author of the document is affiliated with the United States which indicates that the most contributed document related to technology-based foreign language learning during the COVID-19 pandemic is authorized by United States Researchers. Also, all documents including the top 8 documents with the highest score citation were journal articles. It means that the journal article dominates the eight most influential documents [24], [35].

Subsequently, from 8 documents there were 4 documents published in 2020 and followed by 4 documents in 2021. It indicates that the documents published in 2022 have not had a high influence on the studies related to technology-based foreign language learning during COVID-19. Of seven other documents, there were two documents authorized by Hong Kong researchers [52], [53], and followed by two documents authorized by Indonesia researchers [17], [54], one document authorized by Saudi Arabia researchers [55], one document authorized by Thailand researchers [56], and one document authorized by Malaysia researchers [57]. This shows that most of the top 8 documents with the highest citation score are dominated by Asian researchers.

Hereinafter, the most contributed authors related to technology-based foreign language learning were measured by the total publication and citations [19]. There were the three most influential authors with the highest publication and citation scores. The most influential authors are shown in Table V.

TABLE V: TOP 3 AUTHORS WITH THE HIGHEST PUBLICATION AND CITATION

Author	TP	TC	TC/TP	Affiliation
Khafaga, A. F	2	12	6,00	Prince Sattam bin Abdulaziz University
Yunus, M. M	2	8	4,00	Malaysia National University
Laborda, J. G	2	3	1,50	de Alcada University

Table V shows that Khafaga was the most productive and influential author in which he published two documents and the documents had been cited 12 times. The documents published by him had the titles such as "Mobile learning perception in the context of COVID-19: An empirical study of Saudi EFL majors" published in 2021 and "The perception of blackboard collaborate-based instruction by EFL majors/teachers amid COVID-19: A case study of Saudi universities" published in 2021 in which particularly every document had been cited six times. On the other hand, Yunus was the second most productive and influential author where he also published two documents but the documents had been cited eight times. The documents published by him had the titles such as "A systematic review of social media integration to teach speaking" published in 2021, and "Factors affecting teaching English as a second language (TESL) postgraduate students' behavioral intention for online learning during the COVID-19 pandemic" published in 2021 and cited eight times. Meanwhile, Laborda was the third most productive and influential author in which Laborda also published two documents and the documents had been cited three times. The documents published by Laborda had the titles such as "Online learning during the covid-19 pandemic: How has this new situation affected students' oral communication skills?" published in 2021, and "Foreign language pre-service teacher's attitudes towards integrated technology" published in 2020 and cited three times.

Thereafter, the most contributed countries related to technology-based foreign language learning were measured by the total publication and citations [19]. There were the seven most influential countries with the highest publication and citation scores. The most influential countries are shown in Table VI.

TABLE VI: TOP 7 COUNTRIES WITH THE HIGHEST PUBLICATION AND CITATION

Country	TP	TC	TC/TP
Indonesia	11	38	3,45
Hong Kong	9	34	3,78
Saudi Arabia	11	31	2,82
United States	9	26	2,89
China	8	13	1,63
Malaysia	8	11	1,38
Thailand	8	11	1,38

Table VI shows that Indonesia was the most productive and contributed country that had published 11 documents related to technology-based foreign language learning during the COVID-19 pandemic in which the documents had been cited 38 times. Of eight countries, seven countries are located in Asia such as Indonesia, Hong Kong, Saudi Arabia, China, Malaysia, and Thailand, and one country located in America that was the United States. This indicates that the countries located in Asia provided the most contribution to the studies of technology-based foreign language learning in the period 2020 – 2022. 45 countries were contributing to the studies

related to the use of technology in foreign language learning where they were distributed to some continents in the world such as Asia, Europe, America, Africa, and Australia (See Fig. 3).

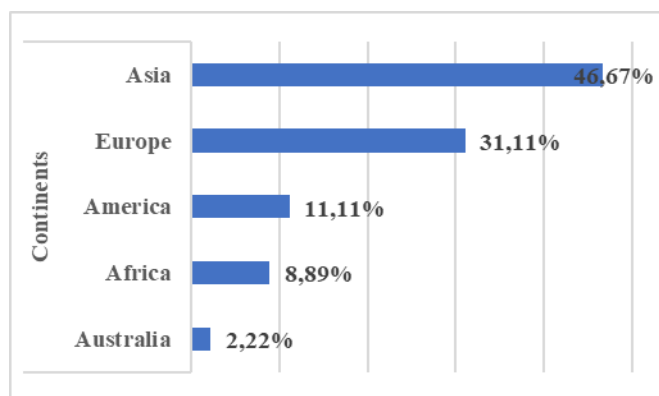


Fig. 3. The distribution of countries in every continent.

Fig. 3 presents that there were 21 countries in Asia contributing to the studies regarding technology-based foreign language learning during the COVID-19 outbreak, followed by 14 countries in Europe, five countries in America, four countries in Africa, and one country in Australia. It means that most of the countries contributing to the studies related to the use of technology in foreign language learning in the period of 2020 - 2022 are located in Asia. Liu and Zhang [34] also revealed in a bibliometric analysis study that many countries located in Asia provided the most influential publications and citations of the studies related to computer-based English learning.

Thereafter, the most contributed affiliations related to technology-based foreign language learning were measured by the total publication and citations [19]. There were the three most influential affiliations with the highest publication and citation scores. The most influential affiliations are shown in Table VII.

TABLE VII: TOP 3 AFFILIATIONS WITH THE HIGHEST PUBLICATION AND CITATION

Affiliation	TP	TC	TC/TP	Country
Malaysia National University	2	8	4,00	Malaysia
Prince Sattam bin Abdulaziz University	2	6	3,00	Saudi Arabia
Al-Ain University	2	3	1,50	United Arab Emirates

Table VII shows that Malaysia National University was the most productive and influential affiliation in which the institution published two documents and the documents had been cited 8 times. On the other hand, Prince Sattam bin Abdulaziz University was the second most productive and influential affiliation where the institution also published two documents but the documents had been cited six times. Meanwhile, Al-Ain University was the third most productive and influential affiliation in which the institution also published two documents and the documents had been cited three times. Overall, the affiliations are located in Asia. It indicates that the affiliations located in Asia have the highest publication and citation score related to the studies of technology-based foreign language learning COVID-19 outbreak. Chen *et al.* [31] also revealed in a bibliometric

analysis study that a lot of affiliations located in Asia provided the most influential publications and citations of the studies related to technology-enhanced language learning.

Subsequently, the most contributed journals related to technology-based foreign language learning were measured by the total publication and citations [19]. There were the six most influential journals with the highest publication and citation scores. The most influential journals are shown in Table VIII.

TABLE VIII: TOP 6 JOURNALS WITH THE HIGHEST PUBLICATION AND CITATION

Journal	TP	TC	TC/TP	Publisher
RELC Journal	3	23	7,67	SAGE Publication Ltd
Studies in English Language and Education Sustainability (Switzerland)	4	14	3,50	Syiah Kuala University
LEARN Journal: Language Education and Acquisition Research Network	7	12	1,71	MDPI
International Journal of Learning, Teaching, and Education Research	3	9	3,00	Language Institute, Thammasat University
International Journal of Learning, Teaching, and Education Research	3	4	1,33	Society for Research and Knowledge Management
XLinguae	3	4	1,33	Slovenska Vzdelavacia Obstaravacia

Table VIII shows that RELC Journal was the most productive and influential journal in which the journal published three documents related to the studies of technology-based foreign language learning during the COVID-19 pandemic and the documents had been cited 23 times. The documents had three titles that were such as "Language teaching during a pandemic: A case study of zoom use by a secondary ESL teacher in Hong Kong" published in 2021 and cited 13 times, "E-Classroom interactional competencies: Mediating and assisting language learning during synchronous online lessons" published in 2021 and cited 10 times, and "A pedagogical chatbot: A supplemental language learning tool" published in 2022. In addition, the RELC journal was supported by SAGE Publication Ltd as a publisher so the publisher helped to publish the documents regarding the use of technology in foreign language learning through RELC Journal.

Hereinafter, the most contributed publishers related to technology-based foreign language learning were measured by the total publication and citations [19]. There were the six most influential publishers with the highest publication and citation scores. The most influential publishers are shown in Table IX.

Table IX shows that Springer was the most productive and influential publisher in which the publisher published 12 documents related to the studies of technology-based foreign language learning during the COVID-19 pandemic and the documents had been cited 29 times. In addition, the publisher

published ten documents in 2021 and cited 29 times, and two documents in 2022. In the period 2020 – 2022, every year the publisher published an average of four documents and it was cited an average of nearly ten times. Also, the publisher supported some journals such as Journal of Psycholinguistic Research, Asia-Pacific Education Researcher, Language Testing in Asia, Education in the Asia-Pacific Region, Education and Information Technologies, and International Journal of Speech Technology in publishing some accepted documents in the journals. Yilmaz *et al.* [30] also revealed that Springer was the most productive publisher which had published many documents related to foreign language teaching in preschool education.

TABLE IX: TOP 6 PUBLISHERS WITH THE HIGHEST PUBLICATION AND CITATION

Publishers	TP	TC	TC/TP
Springer	12	29	2,42
MDPI	8	12	1,50
SAGE Publication Ltd	5	25	5,00
Emerald Ltd	5	5	1,00
Syiah Kuala University	4	14	3,50
Institute of Electrical and Electronics Engineers Inc	4	3	0,75

2) Co-word analysis

Co-Word analysis was employed to explore the existing or future topics in a research field by focusing on the written content of the publication [19]. As a result, the analysis was used to present the most frequently emerging keywords related to the studies of technology-based foreign language learning during the COVID-19 outbreak. In addition, the analysis was used to distribute the most emerging keywords in the current period. Firstly, the analysis unit of author keywords was used to present the most emerging keywords by selecting the minimum number of words of a keyword as many as three words appearing in 36 interconnected keywords in nine clusters such as red, green, blue, yellow, tosca, orange, purple, brown, and pink. (See Fig. 4).

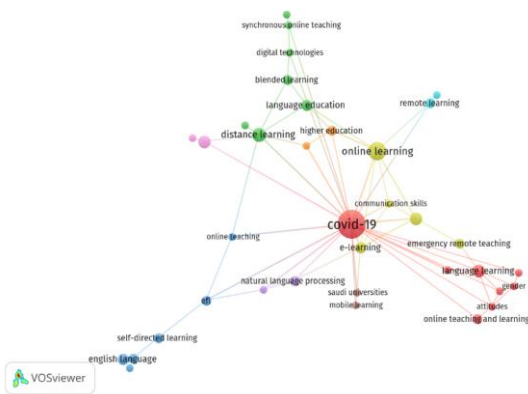


Fig. 4. Network visualization of co-word analysis.

Table X shows that there were eight keywords in the red cluster, followed by seven keywords in the green cluster, six keywords in the blue cluster, five keywords in the yellow cluster, and two keywords in purple, tosca, orange, and brown and pink cluster. In addition, the keyword "covid-19" was the most emerging keyword in the red cluster with 25 occurrences, followed by "distance learning" in the green cluster with six occurrences, "English language" in the blue

cluster with four occurrences, "online learning" in the yellow cluster with ten occurrences, "natural language processing" in the purple cluster with three occurrences, "remote learning" in tosca cluster with three occurrences, "higher education" in the orange cluster with three occurrences, "Saudi universities" in the brown cluster with two occurrences, and "social media" in the pink cluster with five occurrences. It means that generally the keyword "covid-19" is the most emerging keyword from nine existing clusters. Also, it indicates that the keyword "covid-19" emerges in no more than 25 different documents.

TABLE X: HIERARCHICAL CLUSTERING OF KEYWORDS

Cluster	Keyword	Number of Occurrences	Total Link Strength	
Cluster 1 (Red)	Covid-19	25	45	
	Language Learning	5	8	
	Online Teaching and Learning	3	2	
	English for Academic Purpose	2	6	
	Attitudes	2	5	
	Gender	2	4	
	Technology Acceptance Model	2	4	
	Barriers	2	3	
	Cluster 2 (Green)	Distance Learning	6	9
Language Education		4	5	
Blended Learning		3	3	
Digital Technologies		2	3	
Synchronous Online Teaching		2	3	
Learning Management System		2	1	
Technology-enhanced Language		2	1	
Cluster 3 (Blue)		English Language EFL	4	6
		EFL	3	6
	Educational Technology	3	6	
	Self-directed Learning	3	2	
	Online Teaching	2	5	
	Language Teaching	2	1	
Cluster 4 (Yellow)	Online Learning	10	13	
	English as A Foreign Language	5	10	
	E-learning	4	11	
	Emergency Remote Teaching	3	2	
	Communication Skills	2	6	
Cluster 5 (Purple)	Natural Language Processing	3	4	
	Artificial Intelligence	2	5	
Cluster 6 (Tosca)	Remote Learning	3	3	
	Digital Literacy	2	1	
Cluster 7 (Orange)	Higher Education	3	5	
	Learning Analytics	2	4	
Cluster 8 (Brown)	Saudi Universities	2	4	
	Mobile Learning	2	2	
Cluster 9 (Pink)	Social Media	5	6	
	Computer-mediated Communication	2	1	

From 36 keywords in nine clusters, there were some keywords interpreting the approach or model of learning and teaching used in teaching foreign languages during the COVID-19 outbreak such as "distance learning", "blended learning", "self-directed learning", "online learning", "e-learning", "mobile learning", "remote learning", "online

teaching and learning", "synchronous online teaching", "online teaching", and "emergency remote teaching". As a consequence of the COVID-19 pandemic in the education field, distance learning, online learning, and teaching especially synchronous online teaching, mobile learning, remote learning, and teaching, or e-learning were the alternative learnings used to prevent the deployment of COVID-19 in the educational institutions such as school and university. Some researchers also revealed that distance learning or online learning were a few solutions in holding the language learning process in the COVID-19 outbreak [46], [57]–[60]. Blended learning also could be implemented as an approach to learning in teaching a foreign language in which it could be carried out synchronously or asynchronously. Each and Suppasetserree [58] argued that blended learning was the famous approach to learning during the COVID-19 pandemic in teaching language learning. In addition, the limitation of the language learning process online required students to have self-regulated skills because students and teachers or lecturers had not many times to discuss by face to face virtually. Therefore, to train students' self-regulated skills, self-directed learning was implemented in foreign language learning. Jeong [61] also revealed that self-directed learning could support students to enhance their self-regulated skills in the language learning process. Mostly, some learning approaches or models such as distance learning, online learning, mobile learning, remote learning, blended learning, and self-directed learning are usually implemented in teaching foreign languages in the COVID-19 pandemic.

Subsequently, there were some keywords interpreting technologies used in the foreign language learning during the COVID-19 pandemic such as "technology acceptance model", "digital technologies", learning management system", technology-enhanced language", "educational technology", "social media", and "Computer-mediated communication". Nowadays, generally, digital technologies have been utilized widely in the education field. Alakrash and Razak [62] stated that digital technology is a tool that no longer uses human labor manually, but rather an automatic operating system with a computerized system or a format that can be read by a computer. Amin and Sundari [54] argued that a learning management system and social media application are some examples of digital platforms. In addition, the learning management system was also widely used in online or distance foreign language teaching and learning during the COVID-19 pandemic. Some learning management systems such as zoom meeting, google meeting, google classroom, Edmodo, and Moodle were often employed to implement the foreign language learning process [46], [55], [63]. Some social media applications such as WhatsApp, Facebook, Twitter, and Instagram were also utilized by language educators in teaching English [51], [56]. In general, digital technologies especially digital platforms such as learning management systems and social media applications are technologies used to support foreign language learning during the COVID-19 outbreak.

Hereinafter, there were several keywords interpreting foreign language studied in the documents related to technology-based foreign language learning during the

COVID-19 pandemic such as "English for academic purpose", "English language", "EFL", and "English as a foreign language". It shows that English was the most familiar language studied as a research topic in the COVID-19 outbreak in which some researchers focused their topic on the English language [18], [47], [64], [65], although some other foreign languages were also studied as a research topic such as Chinese [14], Japanese [11], Russian [9], and Arabic [12]. In addition, there were some keywords interpreting measured skills or abilities in the foreign language learning such as "communication skills" and "digital literacy". It shows that communication and digital literacy were the important skills that should be mastered by students in the language learning process involving digital technologies such as a digital platform. Some researchers stated that to exist in following online or distance language learning, student and teacher should have sufficient digital literacy skills [62], [66]. Penalver and Laborda [67] also revealed that communication skill was the fundamental skill in learning a language so they had to be mastered by students. Subsequently, there were some keywords interpreting the education level of the research subject studied in the documents related to technology-based foreign language learning during the COVID-19 pandemic such as "higher education" and "Saudi universities". It shows that some researchers were more interested to learn the use of technology in foreign language learning in higher education such as in universities [68]–[71].

Secondly, overlay visualization analysis was used to distribute the most emerging keywords in the current period. The analysis unit of author keywords was used to present the emerging keywords by selecting the minimum number of words of a keyword as many as one word appearing in 281 interconnected keywords. Fig. 5 presents some keywords such as "mobile learning", "English for academic purpose", "language and literacy teacher", "barriers", "academic difficulties", "gender", "rural areas", and "learning with ICT" were the most recently emerging keywords appearing in 2022. The interconnections of the keywords interpret that foreign language learning such as English implemented mobile learning supported by information and communication technology. Some pieces of the literature revealed that ICT platforms such as google meet were widely utilized to implement language learning during the COVID-19 pandemic [46], [47]. In implementing it, however, there are barriers, especially for teachers and students who live in rural areas because both teacher and student must have sufficient technical support. Kusuma [18] reported that some barriers such as internet connectivity and student-owned technology device were fought off by rural teachers in teaching English learning. In addition, they should have sufficient digital literacy skills to hold online language learning. Alakrash and Rozak [62] revealed that students' and teachers' use of digital technology was the lowest in reading skills. It means that the digital literacy skills of teachers and students are still low. As a predictable consequence of the conditions, students have academic difficulties in learning the language. Therefore, the implementation of online foreign language learning has to be supported by sufficient digital literacy skills so that some impacts such as academic difficulties can be minimized.

The distribution of the most emerging keywords related to technology-based foreign language learning during the COVID-19 pandemic is presented in Fig. 5.

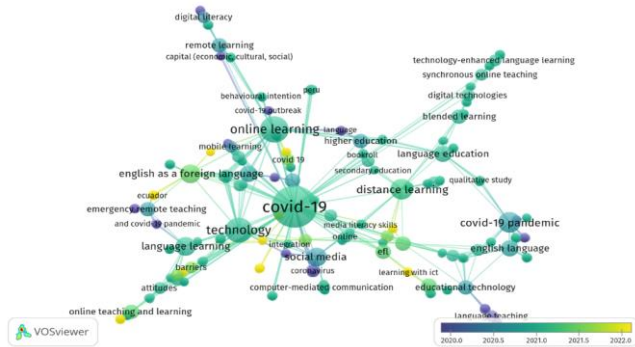


Fig. 5. Overlay visualization of co-word analysis.

3) Co-author analysis

Co-author analysis was employed to examine the social interactions or relationships among authors and their affiliations or countries and their equivalent impacts on the development of the research field [19]. As a consequence, the analysis was used to present the social relationship among authors and author countries related to the studies of technology-based foreign language learning during the COVID-19 outbreak. In addition, the analysis was used to distribute the most emerging authors in the current period. Firstly, the analysis unit of the author was used to present the social interaction among authors by selecting the minimum number of documents of an author as many as two documents appearing six authors in five clusters such as red, green, blue, yellow, and purple. (See Fig. 6).



Fig. 6. Network visualization of co-author analysis.

Fig. 6 presents that Kohnke and Zou are located in a red cluster, followed by Khafaga in the blue cluster, Laborda in the yellow cluster, Yunus in the purple cluster, and Huertas in the green cluster. Kohnke and Zou were two authors who had commonly social relationships in which they carried out the same research with the title "Reflecting on existing English for academic purposes practices: Lessons for the post-COVID-19 classroom" [72], but they also conducted a separate study where Kohnke performed research about pedagogical chatbot in language learning [73], and Zou performed research regarding synchronous computer-mediated in English language classes during the pandemic [74]. Meanwhile, other authors who were Laborda,

Khafaga, Yunus, and Huertas-Abril did not have social relationships with each other. They also did not have social interaction with Kohnke and Zou. Laborda had published two documents related to online learning during the COVID-19 pandemic [67] and foreign language pre-service teacher's attitude toward integrated technology [75], while Khafaga studied mobile learning in the context of COVID-19 [59] and blackboard collaborate-based instruction perception by EFL teacher in the COVID-19 pandemic [76]. Subsequently, Yunus studied factors affecting online teaching of English during the COVID-19 pandemic [57] and social media integration to teach speaking [77] whereas Huertas-Abril studied related the development of English speaking with 21st-century digital tools [78] and telecollaboration in emergency remote language teaching and learning [79]. Overall, most of the authors do not have a social relationship related to studies of technology-based foreign language learning during the COVID-19 pandemic except for Kohnke and Zou.

Secondly, overlay visualization analysis was used to distribute the most emerging authors in the current period. The analysis unit of the author was used to present the emerging authors by selecting the minimum number of documents of an author as many as one document appearing in 256 authors in 94 clusters (See Fig. 7).

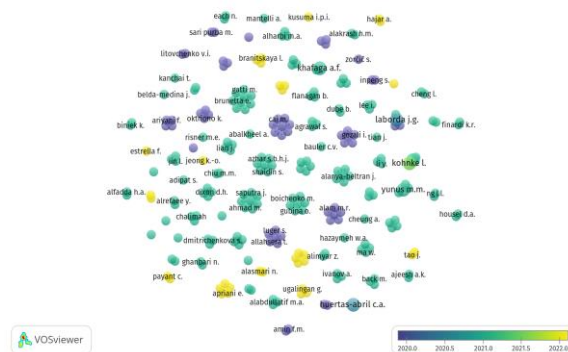


Fig. 7. Overlay visualization of co-author analysis.

Fig. 7 presents that there were a lot of authors who emerged in the current period related to studies of technology-based foreign language learning during the COVID-19 pandemic was Hajar and Manan affiliated in Kazakhstan, Ou Affiliated in Sweden, Gu, Kohnke, and Lee affiliated in Hong Kong, Payant and Zuniga affiliated in Canada, Ironsi affiliated in Cyprus, Apriani, Arsyad, Syafryadin, Kusuma, Supardan, Gusmuliana and Santiana affiliated in Indonesia, Estrella affiliated in Ecuador, Lu, Tao and Xu affiliated in China, Han affiliated in Australia, Jeong affiliated in South Korea, Dascalu, Ruseti and Trausan-Matu affiliated in Romania, McNamara affiliated in the United States, Valdez, Ugalingan and Garinto affiliated in Philippine, and Polyakova, Branitskaya and Zabolotskikh affiliated in Russian Federation. It shows that all authors who studied technology-based foreign language learning in 2022 came from 14 different affiliation countries and four different continents such as Asia, Europe, America, and Australia. It means that the studies have been conducted by many researchers in most of the countries in the world. Some bibliometric analysis studies also revealed that a lot of

researchers in most countries had carried out studies related to the use of technology in language learning [32]–[34].

Thirdly, network visualization analysis was used to present the social relationship among author countries related to the studies of technology-based foreign language learning during the COVID-19 pandemic. The analysis unit of the country was used to present the social interaction among author countries by selecting the minimum number of documents of a country as many as one document appearing in 12 author countries in four clusters such as red, green, blue, and yellow (See Fig. 8).

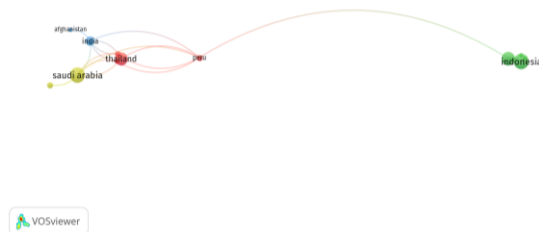


Fig. 8. Network visualization of co-author analysis in country unit.

Fig. 8 presents that 12 author countries were distributed in four clusters which red cluster consisting of Peru, Philippines, Sri Lanka, and Thailand, the green cluster consisting of Indonesia, Mali, Romania, and the United States, a blue cluster consisting of Afghanistan and India, and yellow cluster consisting of Yemen and Saudi Arabia. Each cluster showed social relationships among author countries, for example: in the green cluster, authors in Indonesia, Mali, Romania, and United States have social interactions in conducting research and publishing the documents related to technology-based foreign language learning during the COVID-19 pandemic. In addition, authors in Peru had social interactions with authors in India, Saudi Arabia, and the United States. It means that Peru is the author country connecting author countries in green, blue, and yellow clusters. It indicates that authors in Peru have the widest networking research related to the studies of the use of technology in foreign language learning from 2020 to 2022. Liu and Zhang [34] also found a similar report that authors in America had numerous networking researches with other authors in Africa, Asia, Europe, and Australia related to the studies of computer-assisted English learning. This was in line with Cheng and Yao [32] reporting that regarding wearable devices and their application to English education, many authors in most countries have interacted with authors in America. Thus, authors in America have wide networking research related to the use of technology in foreign language learning.

IV. CONCLUSION AND IMPLICATION

This bibliometric analysis study provides some information related to the trend and development of research on technology-based foreign language learning during the COVID-19 outbreak. In the period 2020 – 2022, there are 100 publications and 199 citations regarding the use of technology in foreign language learning in which the development of the number of publications and citations relatively fluctuates. Subsequently, the document authorized

by his partners and Mackey and published in 2020 with the title "Big data, natural language processing, and deep learning to detect and characterize illicit COVID-19 product sales: Inveveillance study on Twitter and Instagram" is the most influential document, followed by the most productive and influential author who publishes two documents cited 12 times is Khafaga. In addition, Indonesia is the most productive and contributed country that has published 11 documents cited 38 times while the most productive and influential affiliation which publishes two documents cited 8 times is Malaysia National University. On the other hand, RELC Journal is the most productive and influential journal which publishes three documents cited 23 times whereas Springer is the most productive and influential publisher which publishes 12 documents cited 29 times.

Hereinafter, the trending foreign language learning in the COVID-19 pandemic implements distance learning or online learning using some learning approaches or models such as blended learning, mobile learning, and remote learning. Digital platforms such as learning management systems (Zoom meeting, Google meeting, Google classroom, Edmodo, and Moodle) and social media applications (Facebook, WhatsApp, and Instagram) are the trending technologies supporting the foreign language learning process. The utilization of the technologies in the foreign language teaching process requires sufficient digital literacy skills, so some barriers obstructing academic achievements in language learning can be minimized. In addition, overall, most of the authors do not have social relationships related to studies of technology-based foreign language learning during the COVID-19 pandemic except for Kohnke and Zou. All authors studied technology-based foreign language learning in the current period come from 14 different affiliation countries and four different continents such as Asia, Europe, America, and Australia which indicates that the studies have been conducted by many researchers in most of the countries in the world.

This study specifically implicates the Indonesian language learning in which teachers or lecturers can implement distance or online learning in teaching the Indonesian language to prevent the deployment of COVID-19. Some learning approaches or models such as blended learning, mobile learning, and remote learning can be applied in the Indonesian language teaching process. A few learning management systems such as Zoom meeting, Google meeting, Google classroom, Moodle, and Edmodo are digital technologies that can be used to support the language learning process. Several social media applications such as WhatsApp, Instagram, and Facebook also can be utilized in Indonesian language teaching. Teachers or lecturers and also students, however, have to master sufficient digital literacy skills in operating and collaborating the technologies with the Indonesia language learning process to minimize some barriers such as internet connectivity and student and teacher-owned technology device, so students can obtain the best academic achievements in Indonesia language learning.

V. LIMITATIONS AND SUGGESTIONS

The data retrieval is carried out at the beginning of April

2020. As a consequence, the data related to studies of technology-based foreign language learning obtained from the Scopus database does not represent the total data in 2022. So, to take the data for bibliometric analysis study should be conducted at the end of the year, especially at the end of 2022. In addition, this study only involves one database having a lot of the best documents in research related to the use of technology in foreign language learning during COVID-19. It can implicate that the documents used in this study have not represented the presented results. Therefore, other credible databases such as Web of Science and PubMed should be involved to get representative data for the bibliometric analysis study.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Muhammad Fuad carried out initial search of documents. Edi Suyanto selected the initial documents using the established inclusion criteria. Sumarno provided some diagrams such as pie, bar, and line. Ulul Azmi Muhammad conducted performance analysis using the PoP software. Suparman carried out science mapping and network analysis using the VOSviewer software. All authors were involved in finishing the final manuscript.

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