ASEAN Journal of Educational Research and Technology

Journal homepage: https://ejournal.bumipublikasinusantara.id/index.php/ajert

Bibliometric Mapping of Global Research Trends on Technology Integration in Japanese Language Education

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ABSTRACT

This study aims to map global trends in technology integration research in Japanese language learning using a bibliometric approach. Data were collected from the Scopus database and analyzed using VOSviewer to display network visualization, topic evolution, and keyword clusters. The results show a significant increase in publications since 2022, driven by the acceleration of post-pandemic digital transformation. Authors from China, Japan, and Indonesia dominate the contributions, with regional and international collaboration patterns. Keyword analysis identified three main clusters: conceptual approaches, digital learning experiences, and learning system development. Topics such as artificial intelligence, mobile learning, and NLP have become new trends that have been increasingly researched in the past two years. However, research is still limited to higher education and traditional pedagogical approaches. In conclusion, technology research in Japanese language teaching is developing dynamically, but there are still gaps that need to be bridged. The implication is that further research is needed at the elementary-secondary education level, collaborative approaches, and exploration of cutting-edge technologies to create adaptive and sustainable learning systems in the digital era.

ARTICLE INFO

Article History:
Submitted/Received 02 Aug 2024
First Revised 28 Sep 2024
Accepted 06 Nov 2024
First Available online 07 Nov 2024
Publication Date 01 Dec 2024

Keyword:
Bibliometric,
Education,
Japanese language,
Technology,
Tren.

1. INTRODUCTION

Digital technology has revolutionized the world of education (Al Husaeni *et al.*, 2024a), including foreign language teaching. The use of technology in language learning, known as Computer-Assisted Language Learning (CALL), allows for personalization of learning, increased student engagement, and diversification of pedagogical approaches (Otto, 2017; Kessler, 2018). With the advancement of artificial intelligence (AI), natural language processing (NLP), and big data, traditional approaches to language teaching are starting to be replaced by more interactive and intelligent technology-based models (Steel & Levy, 2013). In this context, learning Japanese as a foreign language is one of the areas undergoing significant transformation, especially in the Asian region. However, amidst this progress, there have been few systematic studies that comprehensively map how research on technology integration in Japanese language learning has developed globally. Despite a surge in research in recent years, the distribution of research focus and direction is still fragmented, making it difficult to get a complete picture of trends, geographic contributions, or dominant technologies used. This is a crucial issue, especially considering the importance of Japanese in regional and global contexts, as well as the increasing interest in learning this language in various non-native speaker countries (Liddicoat & Kirkpatrick, 2020).

Several previous studies have highlighted the use of digital media in Japanese language learning, such as chatbots for vocational students (Haristiani *et al.,* 2022), NLP in university-level teaching, and mobile learning and gamification (Huang *et al.,* 2021; Dewanty *et al.,* 2024). However, these studies are separate and focus on micro contexts, so they have not been able to describe the research landscape at a macro level. In addition, most studies are still focused on higher education, while primary and secondary education levels have received relatively less attention (Li & Liu, 2024).

From the results of the literature search, there is a research gap in terms of comprehensive bibliometric mapping, especially related to the evolution of topics, collaboration between researchers, and the adoption of new technologies such as large language models, the Internet of Things (IoT), or augmented reality in Japanese language learning. Bibliometric mapping can help researchers and policymakers to identify patterns, trends, and opportunities for collaboration in language education research (Zhang *et al.,* 2017; Al Husaeni & Al Husaeni, 2022a). The urgency of this research is even stronger when associated with the need for inclusive, digital, and sustainable education as emphasized in the Sustainable Development Goals (SDGs), especially in the aspects of literacy and technology. With a deep understanding of the global research map, educational institutions and researchers can design Japanese language teaching strategies that are more adaptive and relevant to current developments.

Based on this background, this study aims to analyze global trends in technology integration research in Japanese language learning bibliometrically, focusing on publication distribution, institutional and country affiliations, dominant keywords, and topic evolution, to identify research gaps and future development directions. This study uses a data-based bibliometric approach from Scopus, which is analyzed using VOSviewer software. The analysis includes network visualization, term evolution overlay, topic clustering, and keyword relevance identification. This method has been widely used to map research dynamics in various fields (Al Husaeni & Nandiyanto, 2022a; Zhang *et al.,* 2017) and has proven effective in revealing the direction of research development quantitatively and visually. **Table 1** shows several studies that have used bibliometric analysis methods. The novelty of this study lies in its special focus on technology-based Japanese language learning from a bibliometric perspective, which has not been done comprehensively before. With this approach, this study not only presents a visual map and publication statistics but also provides

a conceptual and strategic basis for further research and development of Japanese language education policies in the digital era.

Table 1. Previous study about bibliometric analysis.

No	Title	References
1	The research trend of statistical significance test: Bibliometric analysis	Al Husaeni *et al.* (2024b)
2	A Bibliometric Analysis of Global Trends in Engineering Education Research	Susilawati (2024)
3	Bibliometric Analysis using VOSviewer with Publish or Perish of Chinese Speaking Skills Research	Phuangthanasan and Wongsaphan (2024)
4	Bibliometric analysis using VOSViewer with Publish or Perish of metacognition in teaching English writing to high school learners	Damkam and Chano (2024)
5	Computational bibliometric analysis of research on science and Islam with VOSviewer: Scopus database in 2012 to 2022	Al Husaeni and Al Husaeni (2022)
6	Bibliometric analysis of educational research in 2017 to 2021 using VOSviewer: Google Scholar indexed research	Al Husaeni *et al.* (2023)
7	The role of science and technology fields in education and journal publications at Universitas Pendidikan Indonesia: Bibliometric analysis from 2021 to 2024	Al Husaeni and Nandiyanto (2024)
8	Sustainable packaging: Bioplastics as a low-carbon future step for the sustainable development goals (SDGs)	Basnur *et al.* (2024)
9	Computational bibliometric analysis on publication of techno-economic education.	Ragadhita and Nandiyanto (2022)
10	Assessment of student awareness and application of eco-friendly curriculum and technologies in Indonesian higher education for supporting sustainable development goals (SDGs): A case study on environmental challenges	Djirong *et al.* (2024)
11	Low-carbon food consumption for solving climate change mitigation: Literature review with bibliometric and simple calculation application for cultivating sustainability consciousness in facing sustainable development goals (SDGs)	Nurramadhani *et al.* (2024)
12	Sustainable development goals (SDGs) in science education: Definition, literature review, and bibliometric analysis	Maryanti *et al.* (2022)
13	Management information systems: bibliometric analysis and its effect on decision making.	Santoso *et al.* (2022)
14	Nutritional research mapping for endurance sports: A bibliometric analysis	Firdaus *et al.* (2023)
15	A bibliometric analysis of chemical engineering research using vosviewer and its correlation with Covid-19 pandemic condition.	Nandiyanto *et al*. (2021)
16	Bibliometric computational mapping analysis of publications on mechanical engineering education using vosviewer	Al Husaeni and Nandiyanto (2022b)
17	Bibliometric analysis of engineering research using vosviewer indexed by Google Scholar	Nandiyanto and Al Husaeni (2022)
18	Bibliometric data analysis of research on resin-based brake-pads from 2012 to 2021 using VOSviewer mapping analysis computations	Nandiyanto *et al*. (2023)
19	Strategies in language education to improve science student understanding during practicum in laboratory: Review and computational bibliometric analysis	Fauziah *et al*. (2021)
20	How language and technology can improve student learning quality in engineering? Definition, factors for enhancing students comprehension, and computational bibliometric analysis	Al Husaeni *et al*. (2022)

2. METHODS

2.1. Research Design

This study used a descriptive bibliometric study, aiming to map and analyze global research trends on technology integration in Japanese language education (Al Husaeni & Al Husaeni, 2022a). Detailed information regarding the use of bibliometric is explained elsewhere (Rochman et al., 2024; Al Husaeni & Nandiyanto, 2022a; Al Husaeni & Al Husaeni & Al Husaeni, 2022b). This study used a systematic approach referring to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) as described in previous studies (Zhang *et al.*, 2017). The PRISMA approach was used to ensure that the process of data identification, selection, and inclusion is carried out transparently and can be replicated. Because this study only uses secondary data in the form of publication metadata from scientific databases, this study does not involve interventions on human subjects and does not require approval from the institutional ethics committee.

2.2. Search Strategy and Data Sources

Bibliometric data were collected from the Scopus database, which is one of the largest and most reputable scientific literature databases. The search was conducted using the following Boolean search formula: *TITLE-ABS-KEY ("Japanese language") AND TITLE-ABS-KEY (technology).* This search string is designed to capture articles that discuss the topic of technology integration (e.g., computers, internet, digital applications, AI) in the context of Japanese language education or learning. The search was conducted in the title, abstract, and keywords fields of the articles to ensure that the results obtained are relevant and comprehensive. The initial results of this search yielded 282 documents.

2.3. Inclusion and Exclusion Criteria

To maintain the quality and relevance of the data, a multi-level selection process was carried out based on strict inclusion and exclusion criteria. This selection procedure is visualized in the PRISMA Flowchart shown in **Figure 1**.

The inclusion criteria used in this study include the following:

(i) The article is written in English.
(ii) The article was published between 2020 and 2024.
(iii) The type of document is a scientific article (article).
(iv) The publication source is from a scientific journal (journal), not proceedings, editorials, or other non-journal publications.
(v) The article is in the final publication stage.
(vi) The article is available in an open-access format.
(vii) The content of the article is relevant to the integration of technology in Japanese language education, either explicitly or implicitly.

Meanwhile, the exclusion criteria used include:

(i) Articles written in languages other than English.
(ii) Articles published outside the 2020 to 2024 period.
(iii) Document types other than journal articles, such as review articles, conference proceedings, or editorials.
(iv) Articles that are not available in open access.
(v) Articles that only mention Japanese or technology topics separately without any direct link between the two.
(vi) Duplicate articles or those with incomplete metadata.

Based on the application of these criteria, the following selection results were obtained:

(i) A total of 282 articles were obtained from the initial search results in the Scopus database.
(ii) A total of 166 articles were excluded because they did not meet the language and publication period criteria.
(iii) A total of 103 articles were eliminated because they did not meet the criteria for document type and publication source.
(iv) A total of 24 articles were filtered because they were not in the final publication stage or were not available in open access.
(v) A total of 5 articles were excluded because they were considered irrelevant after a thorough review of the title, abstract, and content.

Thus, the final total of articles used in this bibliometric analysis was 34 articles.

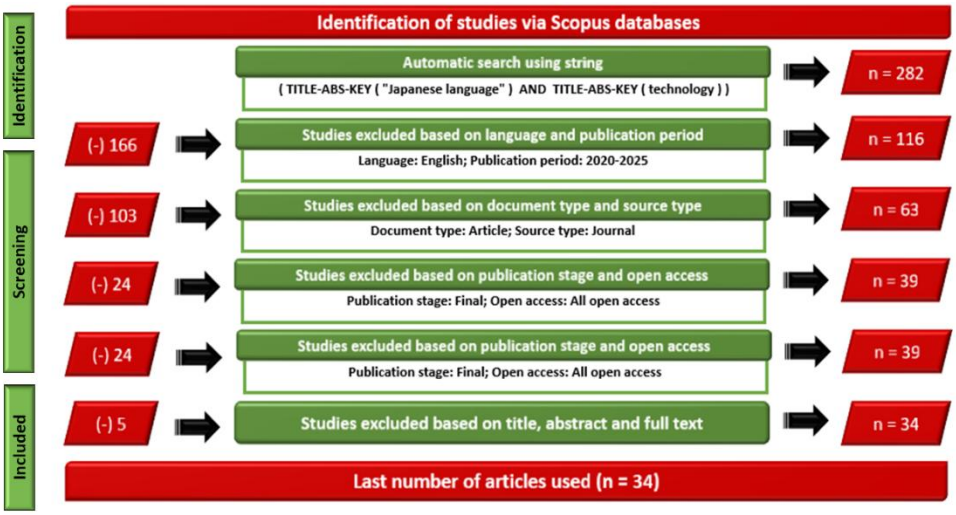


Figure 1. PRISMA flow diagram.

2.4. Data Extraction and Processing

Data from 34 articles that passed the selection process were exported from the Scopus database in CSV format for further analysis. The stages of data extraction and processing were carried out systematically. The first step is metadata cleaning, namely the removal of duplicate data, empty entries, and synchronization of terms to avoid inconsistencies during the analysis process. For example, terms that refer to the same concept, such as "e-learning" and "e-learning," are equated to maintain the accuracy of the visualization results.

After the data is cleaned, an initial data organization process is carried out to ensure that all important information from each article has been systematically documented. The metadata collected includes: article title, author name and affiliation, year of publication, keywords (both author keywords and indexed keywords), number of citations, journal source, and author country of origin.

2.5. Bibliometric Analysis and Data Visualization

Bibliometric analysis in this study was conducted by utilizing two main tools, namely VOSviewer and Microsoft Excel. VOSviewer is used to build and display various types of scientific relationship maps between bibliometric elements in the dataset. In addition, Microsoft Excel is used as a tool to compile and present descriptive statistics, such as trends in the number of publications per year, the geographical distribution of author institutions, and the calculation of the average number of citations per article.

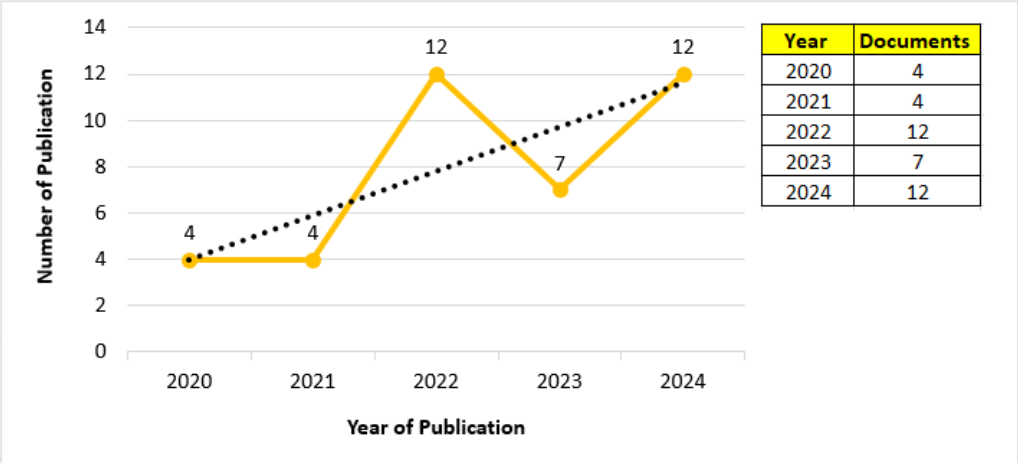
Visualization of the analysis results is displayed in several forms, including network visualization which illustrates the strength of the relationship between nodes (authors, keywords, institutions),

density visualization to see the frequency and density of certain terms or authors, and overlay visualization to show the evolution or temporal trends of research topics (Al Husaeni & Nandiyanto, 2022a; Al Husaeni & Nandiyanto, 2024).

3. RESULTS AND DISCUSSION

3.1. Publication Distribution by Year (2020-2024)

Figure 2 shows the distribution of the number of publications from 2020 to 2024. However, since no publications were recorded, the analysis only covers the period from 2020 to 2024. During this period, dynamics are seen that reflect the academic community's response to global changes, especially in the context of technology integration in Japanese language learning.



Year	Documents
2020	4
2021	4
2022	12
2023	7
2024	12

Figure 2. Publication distribution from 2020-2024.

In the first two years, namely 2020 and 2021, the number of publications was relatively stagnant, each recording only four documents. This condition was most likely influenced by the COVID-19 pandemic situation, which disrupted academic activities globally and forced a sudden shift to an online learning system without adequate infrastructure readiness. The uncertainty and limited adaptation to digital technology at that time contributed to the low productivity of research in this field.

The year 2022 marked a significant turning point, with a significant jump to 12 publications. This increase shows that researchers are starting to actively explore the use of educational technology in Japanese language teaching. Some of the approaches that are starting to be studied include the use of learning applications, learning management systems (LMS), and the application of cutting-edge technologies such as artificial intelligence (AI) and natural language processing (NLP). This reflects a shift in research focus from responding to the crisis to innovating and strengthening technology-based learning methods.

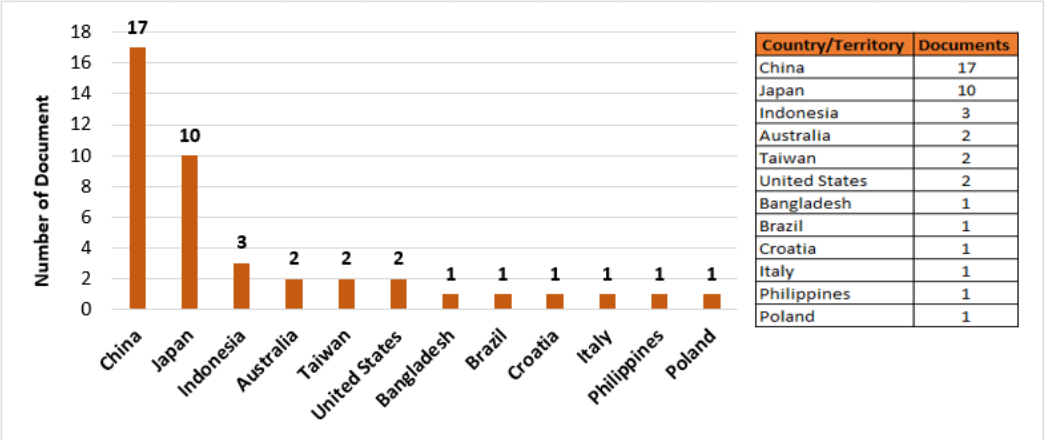
In 2023, the number of publications decreased to seven documents. This decrease can be interpreted as a transition or reflection phase, when researchers evaluate the effectiveness of the technology that has been implemented, while developing new approaches based on previous research results. This temporary decrease can also be caused by the continued process of adaptation to pedagogical changes and the need to refine technology-based learning designs.

Interestingly, in 2024, the number of publications increased again significantly to 12 documents, matching the highest number reached in 2022. This indicates the achievement of a new stable phase in research, where technology integration has become an integral part of Japanese language learning practices. This trend is also in line with the findings of several recent bibliometric studies. Other studies (Dewanty *et al.*, 2024) noted an increasing global interest in the use of technology and media in Japanese language learning. In addition, previous reports (Li &

Liu, 2024) demonstrated the use of large language models for automated assessment in the context of foreign language learning, while other reports developed an innovative NLP-based teaching model for higher education. These findings strengthen the argument that technology has become a major catalyst in the transformation of Japanese language education. Overall, this distribution pattern of publications not only reflects quantitative growth but also indicates a paradigm shift in the pedagogical approach to Japanese language teaching globally.

3.2. Geographical Distribution of Authors

Figure 3 illustrates the geographical distribution of authors involved in publications on technology integration in Japanese language learning. The data shows that the largest contribution came from China, with a total of 17 documents, followed by Japan with 10 documents. The third position is occupied by Indonesia with 3 documents, followed by several other countries such as Australia, Taiwan, and the United States, each contributing 2 documents. Meanwhile, several other countries, such as Bangladesh, Brazil, Croatia, Italy, the Philippines, and Poland, each contributed one document. China's dominance as the main contributor indicates the high attention of academics in the country to foreign language learning, including Japanese, as well as interest in the application of innovative technology in the educational process. This is in line with the findings (Liu *et al.*, 2021), who noted that EFL educators in China showed a high interest in the application of task-based learning approaches and technology in the context of higher education. In addition, the use of Japanese language learning applications by Chinese students has also been studied (Huang *et al.*, 2021), which showed a positive tendency towards the integration of digital technology in foreign language learning.



Country/Territory	Documents
China	17
Japan	10
Indonesia	3
Australia	2
Taiwan	2
United States	2
Bangladesh	1
Brazil	1
Croatia	1
Italy	1
Philippines	1
Poland	1

Figure 3. Geographical distribution of authors.

Interestingly, although Japan is the country of origin of the language studied, the contribution of authors from Japan is actually in second place, below China. This shows that research related to the integration of technology in Japanese language learning is actually mostly carried out by researchers outside Japan, especially from East and Southeast Asian countries. This phenomenon indicates the importance of Japanese as a foreign language in the Asian region and the increasing global awareness of cross-country pedagogical innovation. This is in line with the previous study (Liddicoat & Kirkpatrick, 2020), which explains that language education policies in Asia are now shifting, from previously nationalistic to a more open and collaborative regional approach.

The involvement of researchers from Southeast Asian countries, such as Indonesia and the Philippines, also strengthens the narrative that Japanese language learning is an important part of foreign language education policy in the region. Other studies (Rohiyatussakinah, 2021), in the context of the MBKM policy in Indonesia, note the importance of technology integration and

flexible curriculum in supporting foreign language learning. In the context of Japan itself, some papers (Lida & Chamcharatsri, 2022) highlight the importance of emotional and creative approaches in learning English as a foreign language, which can also reflect local approaches in foreign language learning, including Japanese. Meanwhile, representation from Europe and North America appears more limited. Each only contributed one to two documents, such as Poland, Italy, and the United States. This indicates that the main focus of research on technology integration in Japanese language learning is still centered on the Asian region, both as a user area and a producer of research content.

In the context of digital learning, contributions from authors from different countries reflect the diversity of approaches and implementation contexts. Another study (Nishioka, 2020), for example, shows how social media can be utilized in Japanese writing learning by non-native speakers, especially considering the affordances and limitations of technology. This study illustrates that despite the differences in geography and learner contexts, challenges in using technology remain a globally relevant focus. Overall, the geographical distribution of authors shows that despite Japan being a language center, scholarly production related to technology integration in Japanese language learning actually comes from other countries, especially in Asia. This reflects the globalization of language education and the importance of cross-national collaboration in developing technology-based pedagogical approaches.

3.3. Most Productive Institutions and Authors

Figure 4 and **Table 2,** respectively, show the list of the most productive authors and institutions in publications related to technology integration in Japanese language learning. Based on the data, the most active institution is the University of Tokyo, with a total of 3 documents. Below are Soochow University (Taipei), National Taiwan Normal University, Chung Yuan Christian University, Indonesia Education University (UPI), and Yulin Normal University, each contributed 2 documents. The rest are institutions with one document contribution, including Changzhou Vocational Institute of Mechatronic Technology, Zhuhai City Polytechnic, Inner Mongolia Minzu University, and Kimura Information Technology Co., Ltd.

The presence of institutions from Taiwan, Japan, China, and Indonesia in the top list shows that regional collaboration in East and Southeast Asia is very dominant in the development of this research. One study that illustrates the significant contribution of Taiwanese institutions is the previous study (Huang *et al.*, 2021), which explores the strengthening of Japanese vocabulary learning based on information technology in Taiwan. On the other hand, the contribution from UPI (Indonesia) is also prominent, as presented in the previous study (Haristiani *et al.*, 2022), which discusses the use of chatbots for independent Japanese language learning for vocational high school students. This shows that institutions from developing countries are also starting to actively contribute to cross-language educational technology-based research.

From the author side, there are 10 most productive authors, with Chueh, H.E., Dewanty, V.L., Haristiani, N., He, X., Huang, D.H., Huang, H.T., Kao, C.Y., and Shi, L. each contributing 2 documents. Meanwhile, two other authors, Alam, M.J., and Betriana, F., each contributed one document. These data show that most of the productive authors are affiliated with institutions in Taiwan, China, and Indonesia, reinforcing the finding that Asian dominance is very prominent in this field (see **Figure 4**).

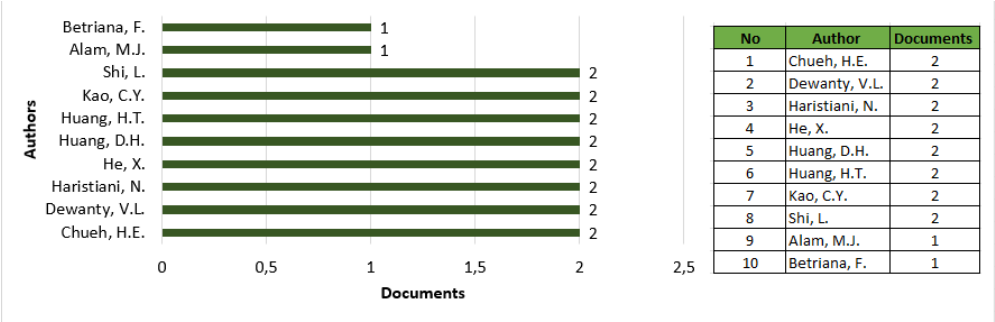
Interestingly, the pattern of author collaboration in these publications shows a strong tendency towards cross-institutional team collaboration, both nationally and internationally. This is evident in the previous work (Huang *et al*., 2021), which includes collaboration between five authors from different institutions, as well as in the other studies (Haristiani *et al*., 2022), which involve collaboration between authors from domestic institutions. This finding is reinforced by the

previous studies (Amini Farsani & Jamali, 2023), who examined collaboration networks in applied linguistics articles and concluded that cross-institutional collaboration improves the quality and visibility of research results.

Furthermore, academic networks in this field show that collaborative approaches are becoming increasingly important, especially in fields that are highly dependent on technology and pedagogical innovation. Previous studies (Wang & Liang, 2024) through a social network analysis approach revealed that intensive academic collaboration not only expands the reach of publications but also strengthens the influence of a field of study in international literature. This is in line with previous reports (Su & Zou, 2022), who stated that technology-based language learning is now moving towards collaboration, both in terms of application development, curriculum design, and academic research.

Table 2. Ten affiliates with the most publications on Japanese language technology and education.

No	Affiliation	Documents
1	The University of Tokyo	3
2	Soochow University, Taipei	2
3	National Taiwan Normal University	2
4	Chung Yuan Christian University	2
5	Universitas Pendidikan Indonesia	2
6	Yulin Normal University	2
7	Changzhou Vocational Institute of Mechatronic Technology	1
8	Zhuhai City Polytechnic	1
9	Inner Mongolia Minzu University	1
10	Kimura Information Technology Co., Ltd	1



No	Author	Documents
1	Chueh, H.E.	2
2	Dewanty, V.L.	2
3	Haristiani, N.	2
4	He, X.	2
5	Huang, D.H.	2
6	Huang, H.T.	2
7	Kao, C.Y.	2
8	Shi, L.	2
9	Alam, M.J.	1
10	Betriana, F.	1

Figure 4. Ten authors with the most publications on Japanese language technology and education.

3.4. Keyword and Cluster Analysis

The keyword analysis in this study reveals the dominant direction of research on technology integration in Japanese language learning. Based on the frequency data, the words “students” (8), “teaching” (7), and “natural language processing” (7) ranked first as the most frequently used keywords, followed by words such as “human” (5), “learning systems” (4), “humans” (4), and “artificial intelligence” (4). These keywords represent the main focus of learner-oriented research, the use of natural language processing (NLP) technology, and the application of artificial intelligence (AI) in educational contexts. Other keywords such as “e-learning” (3), “language learning” (3), “Japanese language” (3), “technology” (3), and “big data” (3) indicate that the

technological approaches used in Japanese language teaching are digital, data-driven, and closely connected to global trends such as online learning and content personalization. The existence of words such as "virtual reality" (2) and "attention mechanisms" (2) also reflects the exploration of cutting-edge technology in learning, in line with the shift towards experience-based and adaptive learning.

Furthermore, the emergence of keywords such as "colleges and universities" (3), "teachers" (2), and "teaching models" (2) indicates that most of the research is conducted in higher education settings, focusing on the development of innovative learning models and the role of teachers in implementing technology. On the other hand, the emergence of keywords such as "social media" (2), "informal language learning" (2), and "multimedia systems" (2) indicates that the Japanese language learning process also takes place outside the formal classroom, utilizing broader and more interactive digital platforms (see **Table 3**).

As shown in **Table 3**, the keywords can be grouped into several main research focuses:

(i) Learning technologies and systems, including AI, NLP, learning systems, big data, virtual reality, and computational linguistics.
(ii) Learning contexts and actors, including students, teachers, colleges and universities, and informal learning.
(iii) Language and linguistic processes, including Japanese learning, language processing, semantics, translation, and lingua franca.
(iv) Teaching methodologies and approaches, including teaching modes, teaching models, computer-aided instruction, and decision trees.

The correlation between these keywords suggests that research in this field has evolved from a conventional approach towards the integration of adaptive and AI-based technologies. This is in line with a historical study (Steel & Levy, 2013), which revealed that since the mid-2000s, the use of technology by language learners has increased significantly, especially among those who are mobile and personal. More broadly, previous studies through a 44-year bibliometric analysis concluded that the Computer-Assisted Language Learning (CALL) approach has evolved towards more complex and contextual forms, including the use of big data, augmented reality, and chatbot-based learning.

Other reports (Kessler, 2018) also emphasized that the future of language teaching will be largely determined by the extent to which technology can be utilized to create meaningful and personalized learning experiences. Meanwhile, other reports (Otto, 2017) emphasized that the journey of technology in second language (L2) learning has moved from the use of simple aids to intelligent technology that enables natural, contextual, and interactive interactions between learners and systems. Thus, this keyword analysis not only illustrates the current research direction but also reflects a paradigm shift towards advanced technology-based and learner-centered Japanese language learning, supported by multidisciplinary approaches from the fields of linguistics, computer science, and education.

Table 3. 50 keywords frequently used in research related to the topic of Japanese language technology and education.

Keyword	Freq.	Keyword	Freq.
Students	8	Teachers'	2
Teaching	7	Syntactics	2
Natural Language Processing	7	Social Media	2
Human	5	Multimedia Systems	2
Learning Systems	4	Medical Information	2
Humans	4	Lingua Franca	2
Artificial Intelligence	4	Language Education	2

Table 3 (Continue). 50 keywords frequently used in research related to the topic of Japanese language technology and education.

Technology	3	Japanese Language Teaching	2
Semantics	3	Japanese (language)	2
Natural Languages	3	Japan	2
Natural Language Processing Systems	3	Informal Language Learning	2
Language Processing	3	Decision Trees	2
Language Learning	3	Data Technologies	2
Language	3	Computer-Aided Instruction	2
Japanese Learning	3	Computational Linguistics	2
Japanese Language	3	Attention Mechanisms	2
E-learning	3	Attention Mechanism	2
Colleges And Universities	3	Artificial Intelligence Technologies	2
Big Data	3	Forensic Science	1
Article	3	Foreign Language Learning	1
Virtual Reality	2	Foreign Language Environment	1
Translation (languages)	2	Forecasting	1
Teaching Systems	2	Female	1
Teaching Modes	2	Feature Function	1
Teaching Model	2	Factor Weight	1

3.5. VOSviewer Mapping and Topic Evolution

Visualization using VOSviewer in **Figure 5** and **Figure 6** depicts a network visualization and a topic evolution map (overlay visualization) of the most dominant keywords in publications related to technology integration in Japanese language learning. In the network map visualization (**Figure 5**), it can be seen that the keywords in publications on technology integration in Japanese language learning are divided into three main clusters, each of which shows a different but interrelated thematic focus. The first cluster is marked in red and contains keywords such as analysis, paper, model, research, university, college, and Japanese language. This cluster illustrates the conceptual and academic foundations of research in this field. These terms indicate that most early studies focused on traditional institutional-based approaches and scientific studies, emphasizing theory development, formulation of learning models, and data collection in academic settings such as universities and colleges. This focus emphasizes the importance of methodological validity and in-depth analysis in early studies on technology-based Japanese language learning.

The second cluster, shown in green, illustrates the expanding focus towards digital learning experiences and applied technologies. The dominant keywords in this cluster include technology, student, study, teacher, learner, use, and artificial intelligence. This cluster reflects the close connection between technological innovation and educational actors such as students and teachers. The term artificial intelligence, appearing together with use and learner, indicates the increasing attention to intelligent technologies that support personalization, automation, and effectiveness of learning. In addition, the words student and teacher being in the same network indicate that research is also evaluating how their roles are changing due to the use of technology, both in the context of traditional classrooms and in online or hybrid learning models.

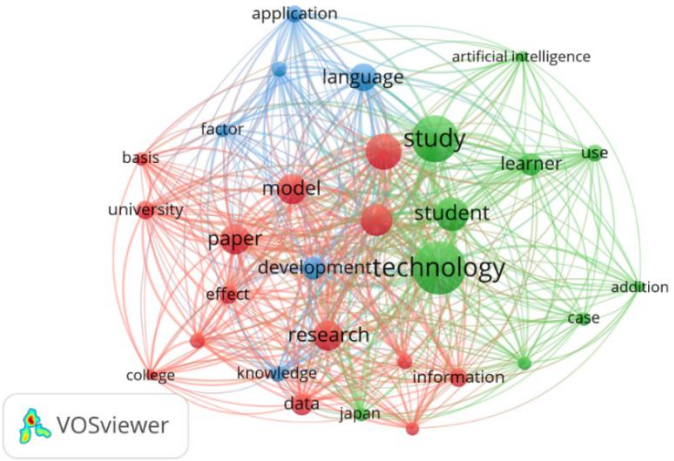


Figure 5. Network visualization.

Meanwhile, the third cluster, shown in blue, places more emphasis on the technical and systemic dimensions of technology-based learning. Keywords such as language, application, development, factor, effectiveness, and knowledge indicate a focus on the design and development of media and learning systems. This cluster tends to represent research that evaluates the effectiveness of using certain applications or platforms to support Japanese language learning. The presence of the words application and development indicates that many studies discuss the process of creating and implementing digital tools, whether in the form of software, chatbots, or mobile applications. In this context, the blue cluster also reflects an exploration of factors that influence the success of technology implementation, including the technical, pedagogical, and psychological aspects (see **Table 4**).

Overall, these three clusters complement each other in mapping the current research landscape. The red cluster presents the academic foundation and methodological framework, the green cluster reflects the transition towards smart technologies that directly involve learning actors, and the blue cluster shows attention to the design, implementation, and evaluation of concrete learning tools. This mapping shows the natural evolution of language education research from being initially concept-based to developing practices supported by advanced technologies and interdisciplinary approaches.

Figure 6 visualizes the temporal dimension (2022-2023) of the emerging keywords. Keywords such as paper, model, university, and data are marked in darker colors (blue), indicating that these terms were more frequently used in early publications (around 2022). In contrast, terms such as artificial intelligence, use, learner, and application appear in lighter colors (greenish yellow), indicating that they are newer topics and developed in 2023 and beyond. This evolution shows a shift in research focus from theoretical-conceptual aspects to the application of current technologies in learning practices. One of the terms that stands out from the current phase is artificial intelligence, which has a high relevance (1.96) according to **Table 5**, and is included in Cluster 2.

Table 5 indicates the relevance level per keyword. The terms with the highest relevance values are addition (4.17), use (2.90), artificial intelligence (1.96), and case (1.88). Although their frequencies are not as high as words such as technology or student, their high relevance values reflect the increasing thematic importance of these terms in current discourse. In contrast, general terms such as student (19 occurrences) and technology (34 occurrences) show a wide range but with lower relevance (0.24 and 0.45, respectively), indicating that despite their high frequency, they are already basic terms and are not specific in distinguishing new research directions.

Analysis of overlay visualization and keyword relevance confirms the emergence of new trends in Japanese language teaching, including the use of AI, NLP, and adaptive learning applications. Other reports (Li & Liu, 2024) study, for example, showed the use of large language models (LLM) for automatic assessment of Japanese writing. Similar findings were developed, which integrated NLP technology into a Japanese language teaching model in higher education. Another study (Maeda-Minami *et al.*, 2023) emphasized the development of an NLP-based information system in the context of teaching and providing drug information, proving that this approach is cross-disciplinary and highly applicable. Other studies (Nishioka, 2020) have previously explored the use of social media as a vehicle for developing independent Japanese writing skills, demonstrating the potential of non-formal platforms in the context of technology-based language learning.

Thus, visualization using VOSviewer successfully reveals the semantic structure and thematic evolution of technology integration research in Japanese language teaching. The data shows a significant shift from institutional and conceptually based approaches to application-based approaches, intelligent technology, and adaptive personalized learning. The dominance of keywords such as artificial intelligence, use, and learner in the last year shows that the focus of research is moving towards technological innovation and its relevance in improving the quality of Japanese language learning in the digital era.

Table 4. Cluster group per item based on network visualization.

Cluster 1	Color	Cluster 2	Color	Cluster 3	Color
analysis	Red	addition	Green	application	Blue
basis	Red	artificial intelligence	Green	development	Blue
college	Red	case	Green	effectiveness	Blue
data	Red	japan	Green	factor	Blue
effect	Red	learner	Green	knowledge	Blue
information	Red	student	Green	language	Blue
japanese language	Red	study	Green		
Japanese language teaching	Red	teacher	Green		
model	Red	technology	Green		
number	Red	use	Green		
order	Red				
paper	Red				
research	Red				
university	Red				

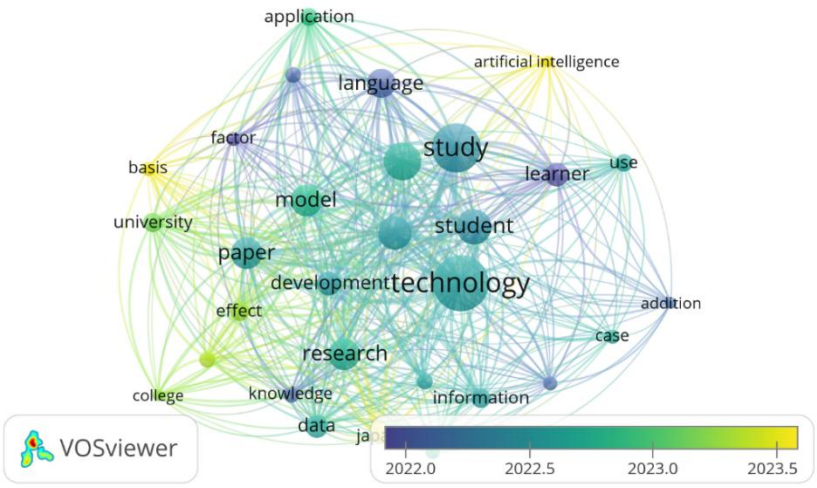


Figure 6. Overlay visualization.

Table 5. Number of relevance per item.

Term	Occurrences	Relevance	Term	Occurrences	Relevance
addition	5	4.17	effect	9	0.66
use	8	2.90	order	7	0.65
artificial intelligence	5	1.96	information	9	0.62
case	6	1.88	knowledge	7	0.54
college	5	1.74	study	29	0.53
teacher	6	1.67	paper	17	0.46
learner	12	1.58	technology	34	0.45
basis	6	1.14	data	11	0.44
university	9	1.07	Japan	6	0.43
application	8	1.05	research	17	0.40
number	6	0.95	Japanese language	18	0.39
Japanese language teaching	7	0.94	model	17	0.36
factor	6	0.80	analysis	21	0.29
effectiveness	7	0.73	development	12	0.24
language	15	0.68	student	19	0.24

3.6. Synthesis of Research Findings and Implications

The synthesis of the bibliometric analysis reveals several key patterns that stand out in research on technology integration in Japanese language learning. First, there has been a significant increase in the number of publications since 2022, reflecting the growing global attention to post-pandemic language learning innovations. This trend is consistent with the previous studies (Al Husaeni & Nandiyanto, 2022), which showed a surge in digital learning articles in the pre- and post-COVID-19 periods. Second, the majority of publications come from Asian countries, especially China and Japan, followed by Taiwan and Indonesia. This is in line with the pattern of regional linguistic collaboration in Asia (Liddicoat & Kirkpatrick, 2020), as well as the shift in the focus of language education from a nationalistic approach to a transnational collaborative model.

From the thematic side, dominant keywords such as technology, student, language learning, natural language processing, and artificial intelligence indicate that research is moving towards digital and adaptive technology-based language learning. The evolution of this topic is visible in the VOSviewer overlay visualization, which shows a shift from old keywords such as paper, university, and model to new terms such as artificial intelligence, application, and learner. This finding is in line with the results of the studies (Otto, 2017), which map the evolution of CALL (Computer-Assisted Language Learning) over the past few decades towards the integration of AI, chatbots, and big data-based learning.

The contribution of this study to the field of Japanese language education is significant. The use of cutting-edge technologies such as NLP, LLM (Li & Liu, 2024), and social media learning (Nishioka, 2020) has expanded the scope of learning contexts from formal classrooms to informal and personal realms. In addition, findings (Dewanty *et al.*, 2024; Haristiani *et al.*, 2022) show that technology integration also strengthens autonomous learning through chatbots and mobile applications, making it relevant to both vocational and higher education contexts.

In the context of foreign language learning in general, this trend is in line with the development of research in the fields of English and Korean language learning. For example, Steel and Levy (2013) observed that English learners have been utilizing mobile technology and social media since the early 2010s, while other papers (Su & Zou, 2022) emphasized the importance of technology-

based collaborative learning in developing language skills. This suggests that Japanese is now following a similar developmental pattern, but with a culturally and structurally tailored approach to the characteristics of Japanese as an L2.

From an implication perspective, these findings suggest the need for curriculum reform and learning design in Japanese language education institutions, both in Japan and abroad. Educational institutions are encouraged to strengthen teachers' digital competencies, utilize technologies such as VR, AI, and NLP in teaching, and design adaptive, collaborative, and data-driven learning models. This is also closely related to the achievement of the Sustainable Development Goals (SDGs), especially in providing quality and equitable technology-based education.

In addition, from a research perspective, this bibliometrics identifies further research opportunities in several areas: the development of multilingual AI applications (Qiu *et al.,* 2024), the application of gamification in Japanese language teaching, and the evaluation of the impact of technology on foreign students' motivation and learning outcomes. Cross-country and cross-disciplinary collaborative research is also key to broadening the impact and strengthening academic contributions in this field (Amini Farsani & Jamali, 2023; Wang & Liang, 2024).

3.7. Research Gaps and Future Research Directions

The results of the bibliometric analysis show that although the integration of technology in Japanese language learning continues to experience rapid development, there are still a number of gaps that open up space for further research. These gaps are related to the imbalance of attention to certain types of technology, levels of education, and pedagogical approaches used in the context of technology-based Japanese language learning.

One of the most prominent gaps is the lack of exploration of current technologies such as AI-based chatbots, adaptive gamification, augmented reality (AR), and the Internet of Things (IoT) in Japanese language teaching. Although studies (Haristiani *et al.*, 2022) have investigated the use of chatbots in self-paced learning, similar research is still very limited both in quantity and application context. Similarly, the use of augmented reality to support language competence has not been widely adopted in Japanese language teaching, even though this technology offers a multimodal approach that is rich in sensory and cognitive aspects.

In terms of education level, most studies focus on higher education, as shown in the previous studies (Dewanty *et al.*, 2024), while the implementation of learning technology at the primary and secondary education levels is still lacking. The application of technology from an early age has been shown to have a positive impact on foreign language acquisition, especially if carried out through an approach that is in accordance with the characteristics of child development. In this context, the previous study emphasized the importance of developing sustainable digital innovation to support language learning goals within the SDGs framework.

In addition, there is a need to expand the pedagogical approaches used. Currently, many studies still rely on traditional strategies or focus on conventional computer-assisted language learning (CALL). Approaches such as task-based learning, collaborative learning, or technology-based experiential learning are still relatively rarely used. As stated in previous studies (Su & Zou, 2022; Kessler, 2018), collaborative and experiential learning models can significantly increase the engagement and meaningfulness of language learning, especially when combined with the support of the latest technology.

From a methodological perspective, most studies are still quantitative or descriptive, with few studies adopting a long-term experimental approach, classroom action research, or mixed-methods to examine the impact of technology holistically. Zhang *et al.* (2017) emphasized the importance of systematic reviews to identify such gaps in other disciplines, and a similar approach could be adopted in the field of technology-based language education.

To fill this gap, some relevant proposed further research topics include:

(i) Implementation of AI-based learning models (LLM/chatbot) in high school students to improve Japanese speaking skills.
(ii) Development of AR-based learning media for Japanese vocabulary and grammar at the elementary and junior high school levels.
(iii) Experiment of online collaborative learning using NLP-based social platforms in Japanese language learning.
(iv) Longitudinal analysis of the effectiveness of adaptive gamification in maintaining motivation to learn Japanese.
(v) Utilization of IoT in contextual Japanese language learning, for example, for location-based or real-world instruction.

Future research should also aim for multidisciplinary collaborations that combine the fields of education, linguistics, information technology, and instructional design. As reported in previous studies (Otto, 2017), the evolution of language learning no longer relies solely on teaching materials but also on a technology ecosystem that supports personalization, mobility, and continuity of learning. Given these gaps, future research directions should focus not only on technology itself but also on how it is used strategically and contextually to improve the experience, outcomes, and access of Japanese language learning globally. This study adds new information regarding Japanese language education, as reported in **Table 6**.

Table 6. Previous studies on Japanese language education.

No	Title	References
1	Gairaigo derived from English in Japanese advertising: Benefits, drawbacks, and global implications	Fitri (2023)
2	Sherpur's students perception of Yeats themes representing Ireland and its' connection to Japan's Noh	Karmaker and Malaker (2023)
3	Slang abbreviation in Japanese and Indonesian written language: Origins, process, similarities, and differences	Widyastuti and Haristiani (2023)
4	Advancing 21st-century creativity and innovation into Japanese educational system	Adeoye (2023)
5	The construction of complex sentences with predicative phrases of transitive verbs in Japanese language learners utterances: A transformational generative grammar study	Mintarsih (2023)
6	Yoga: An exploration of its cultural adaptation and practice in Japan	Kamraju and Sonaji (2023)
7	The use of Padlet to enhance Japanese learners' collaborative learning of basic composition writing skills (Sakubun)	Aneros and Herniwati (2023)
8	The acquisition of Japanese case particles by Indonesian learners of Japanese: Focusing on the concept of kou "argument" of verb	Maarif (2023)
9	The concept of Japanese culture in lean production of the Toyota automobile company: Its scientific development and application in higher education and agriculture	Glushchenko (2023)
10	Discourse structure analysis of making request in Japanese conversation	Nishfullayli *et al.* (2023)
11	Japan's success story in fostering collective responsibility in suicide prevention: The power of unity	Adeoye and Akinnubi (2023)
12	Utilizing Japanese community engagement: Understanding Malaysian traditional music therapy for children with special needs	Ahmad and Abu Bakar (2023)
13	Morphological analysis of compound form (fukugoudoushi) verb + ageru in Japanese	Febriliani *et al.* (2023)

Table 6 (Continue). Previous studies on Japanese language education.

No	Title	References
14	A critical discourse analysis on the representation of female idols in the "Idol" song lyric by Yoasobi: From the feminism point of view	Farisya and Dewanty (2023)
15	A comparative analysis of Japanese-English machine translation outputs using neural and statistical systems: Google Translate vs. Systran	Ramlan (2024)
16	Multilingualization on the current Japanese prefectural government web pages: The support status of easy Japanese for foreigners	Suzuki *et a*l. (2024)
17	Indonesian grammatical interference in translating relative clauses in Japanese comic strips	Puspitosari and Setiawati (2024)
18	Japanese language education and examination for Indonesian specified skilled worker (SSW) candidates: An analysis of the pre-departure program	Ramdani *et al*. (2024)
19	The utilization of the OJAD website to improve Japanese speaking skills in vocational high school	Yuliani and Hernawati (2024)
20	The development of "Manabu Bunpou" smartphone application for basic Japanese grammar learning	Herniwati *et al*. (2024)
21	Utilizing cognitive illustration as a kanji memorization strategy in kanji learning	Sutedi and Juangsih (2024)

4. CONCLUSION

This study maps the global trends of research on technology integration in Japanese language learning bibliometrically. The analysis shows a significant surge in publications since 2022, as the digital transformation post-pandemic accelerates. The focus of research has shifted from traditional approaches to the use of cutting-edge technologies such as AI, NLP, big data, and online learning systems. Geographically, research originates from China and Indonesia, rather than Japan, reflecting the globalization of the issue and increasing cross-border collaboration in East and Southeast Asia. The VOSviewer visualization reveals three main clusters: (1) academic approaches, (2) digital learning experiences, and (3) learning application development. The emergence of keywords such as artificial intelligence, learner, and application indicates a new focus on personalization and intelligent technologies. However, there are still research gaps, especially on primary and secondary education levels, collaborative pedagogical approaches, and strong long-term methodological design.

Based on these findings, future research is suggested to expand the focus to primary and secondary education levels to reach a wider age group of learners. Innovative technologies such as augmented reality, LLM-based chatbots, adaptive gamification, and the Internet of Things (IoT) need to be explored more deeply in the context of Japanese language learning to enhance more interactive and personalized learning experiences. Furthermore, task-based, collaborative, or project-based pedagogical approaches can be effective alternatives to strengthen active learner engagement. On the other hand, strengthening research methodology with a more robust and longitudinal design can provide a more complete picture of the long-term impact of technology implementation in language education. Finally, encouraging interdisciplinary collaboration between the fields of education, linguistics, information technology, and instructional design is crucial in creating an adaptive, sustainable, and 21st-century language education system.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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