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MAPPING INTERNATIONAL RESEARCH ON DIGITAL IN ARABIC LANGUAGE LEARNING: A BIBLIOMETRIC ANALYSIS

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Abstract: This study presents a bibliometric analysis of international research on the integration of digital in Arabic language learning, highlighting its trends and developments over the past two decades (2002-2024). The growing interest in digital learning tools, such as e-learning platforms, mobile applications, and online resources, has significantly reshaped traditional Arabic language education, offering greater flexibility, interactivity, and accessibility. However, the adoption of these technologies in Arabic language pedagogy remains relatively underexplored compared to other languages. To address this gap, the study examines 70 research articles from the Scopus database, providing an overview of publication trends, citation impact, geographic distribution, and collaborative networks between countries. Using tools such as Microsoft Excel and VOSviewer, the analysis identifies key focus areas, including natural language processing, machine learning, and deep learning. The findings suggest that while digital technology has started to enhance Arabic language learning, more research and cross-national collaboration are needed to optimize its educational impact. This study contributes to a better understanding of digital transformation in Arabic language education and offers strategic insights for future research directions.

Keywords: *Arabic language learning; bibliometric analysis; digital learning; publication trends; scopus database*

Abstrak: Penelitian ini menyajikan analisis bibliometrik terhadap riset internasional mengenai integrasi digital dalam pembelajaran bahasa Arab, dengan menyoroti tren dan perkembangannya selama dua dekade terakhir (2002–2024). Meningkatnya minat terhadap alat pembelajaran digital, seperti platform e-learning, aplikasi seluler, dan sumber daya daring, telah secara signifikan mengubah pendidikan bahasa Arab tradisional dengan memberikan fleksibilitas, interaktivitas, dan aksesibilitas yang lebih tinggi. Namun, penerapan teknologi-teknologi tersebut dalam pedagogi bahasa Arab masih relatif kurang dieksplorasi dibandingkan bahasa lainnya. Untuk mengatasi kesenjangan ini, penelitian ini mengkaji 70 artikel penelitian dari

	basis data Scopus, memberikan gambaran mengenai tren publikasi, dampak sitasi, distribusi geografis, dan jejaring kolaborasi antarnegara. Dengan menggunakan alat seperti Microsoft Excel dan VOSviewer, analisis ini mengidentifikasi beberapa fokus utama, termasuk pemrosesan bahasa alami, pembelajaran mesin, dan pembelajaran mendalam. Temuan penelitian menunjukkan bahwa meskipun teknologi digital mulai meningkatkan pembelajaran bahasa Arab, diperlukan lebih banyak penelitian dan kolaborasi lintas negara untuk mengoptimalkan dampak pendidikannya. Penelitian ini berkontribusi pada pemahaman yang lebih baik tentang transformasi digital dalam pendidikan bahasa Arab dan menawarkan wawasan strategis untuk arah penelitian di masa depan.
***Kata Kunci*:**	*Analisis bibliometric; basis data Scopus; pembelajaran bahasa Arab; pembelajaran digital; tren publikasi*

INTRODUCTION

The integration of digital technology in Arabic language learning has become an increasingly global topic of interest, particularly in efforts to enhance the accessibility and effectiveness of Arabic language education (Al-assaf, 2021; Alfayez, 2022). Technologies such as e-learning, mobile applications, and digital platforms offer more flexible, interactive, and accessible learning approaches. The use of these innovations has played a significant role in overcoming the limitations of traditional teaching methods, strengthening the teaching and learning experience (Safrudin, 2025). The increase in digital literacy in Arabic has greatly enhanced accessibility and inclusivity both within Arab communities and for non-native Arabic speakers. This shift spans multiple aspects, particularly in the application of Arabic in digital environments (Safrudin, Sanah, et al., 2024).

As one of the languages with significant influence in the realms of religion, culture, and geopolitics, Arabic also faces challenges in adapting to digital technology advancements in its teaching and learning processes (Berger et al., 2023; Buska et al., 2021). Nevertheless, the adoption of digital technology in Arabic language learning is relatively recent compared to other languages such as English, Spanish, and Mandarin, which have long been the subjects of academic research in educational technology (Safrudin, Nandang, et al., 2024). The lack of systematic studies mapping digital integration in Arabic language learning highlights a knowledge gap that needs to be addressed (Majid & Salam, 2021). Over the past three decades, research on the use of digital tools in Arabic language learning has developed, requiring a deeper understanding of the scholarly developments in this domain (Safrudin, 2025).

To explore, assess, and evaluate the trends in academic research and advancements related to digital Arabic language learning, bibliometric analysis serves as an

effective tool. This method offers a broad overview of extensive academic literature (van Nunen et al., 2018). It helps evaluate the research output and patterns of authors, journals, countries, and institutions, while also identifying and measuring collaboration trends among them (Li & Zhao, 2015). Accordingly, this bibliometric analysis aims to investigate global research trends in digital Arabic language learning, with a particular focus on publications indexed in the Scopus database.

Pritchard (1969), defines "bibliometrics" as the use of mathematical and statistical techniques to analyze books and other forms of communication. This indicates that bibliometric analysis, which is employed to study the characteristics of books or assess a specific body of literature in research, relies on bibliographic data as its basis. For example, one can quantify collections of literature. A growing number of researchers are adopting bibliometric analysis to gain a more comprehensive understanding of the broader research field (Ahmi & Mohamad, 2019). By classifying publications according to factors like publication year, authorship, institutional affiliation, or country of origin, emerging trends in research can be identified. Various metrics, including citation counts, annual citation averages, the h-index, and the g-index, are useful in assessing the impact and performance of academic works.

This study is expected to guide current and future research on the theme of digital integration in Arabic language learning, by examining research developments from 2002 to 2024. The analysis aims to uncover major research trends, researcher collaborations, research impact, and the most prominent directions within this field. Additionally, bibliometric analysis provides a comprehensive overview of the evolution and changes in digital Arabic language learning over the past two decades, highlighting knowledge gaps and areas in need of further exploration (Kamila & Jasrotia, 2023; Mora et al., 2017). Consequently, this research not only sheds light on the evolution of ideas and research trajectories in the field of digital Arabic language learning but also provides strategic recommendations for future research directions. In addition, the study makes a significant contribution to the academic community and supports practical advancements in the field of education.

Research Questions

This article provides an extensive bibliometric analysis of digital integration in Arabic language learning and reviews the relevant literature in this area. To fulfill this objective, the following research questions are posed:

1. What are the citation trends for digital in Arabic language learning during the study period?
2. How do countries geographically distribute, and what collaboration patterns emerge among them in the field of digital Arabic language learning?

3. What is the distribution of journal rankings that publish research on digital Arabic language learning according to quartile rankings?
4. What are the main research focuses related to digital integration in Arabic language learning?

METHOD

To gather data on "digital in Arabic language learning," the author utilized the Scopus database. Scopus was chosen for its broad multidisciplinary coverage, frequent updates, and ongoing improvements, making it one of the most widely used abstract and citation databases for academic research, alongside Web of Science and Google Scholar (Jasrotia et al., 2022; Mora et al., 2017). In the data collection process from Scopus, several important steps were followed to refine the dataset, as shown in Figure 1 (Moher, 2009). The first step was identification, where the researcher used the keywords (digital AND "Arabic language" AND learning) in the Scopus search, which initially yielded 84 publications relevant to the topic.

The second step involved screening the data, during which book and book chapter publications were excluded. Following this process, 70 articles met the inclusion criteria. The data for this research were gathered on September 17, 2024, during the inclusion stage. Descriptive methods will be employed to analyze publication trends related to digital Arabic language learning, using bibliometric analysis of data from the Scopus database. The annual number of relevant publications from 2002 to 2024 will be displayed graphically using Microsoft Excel.

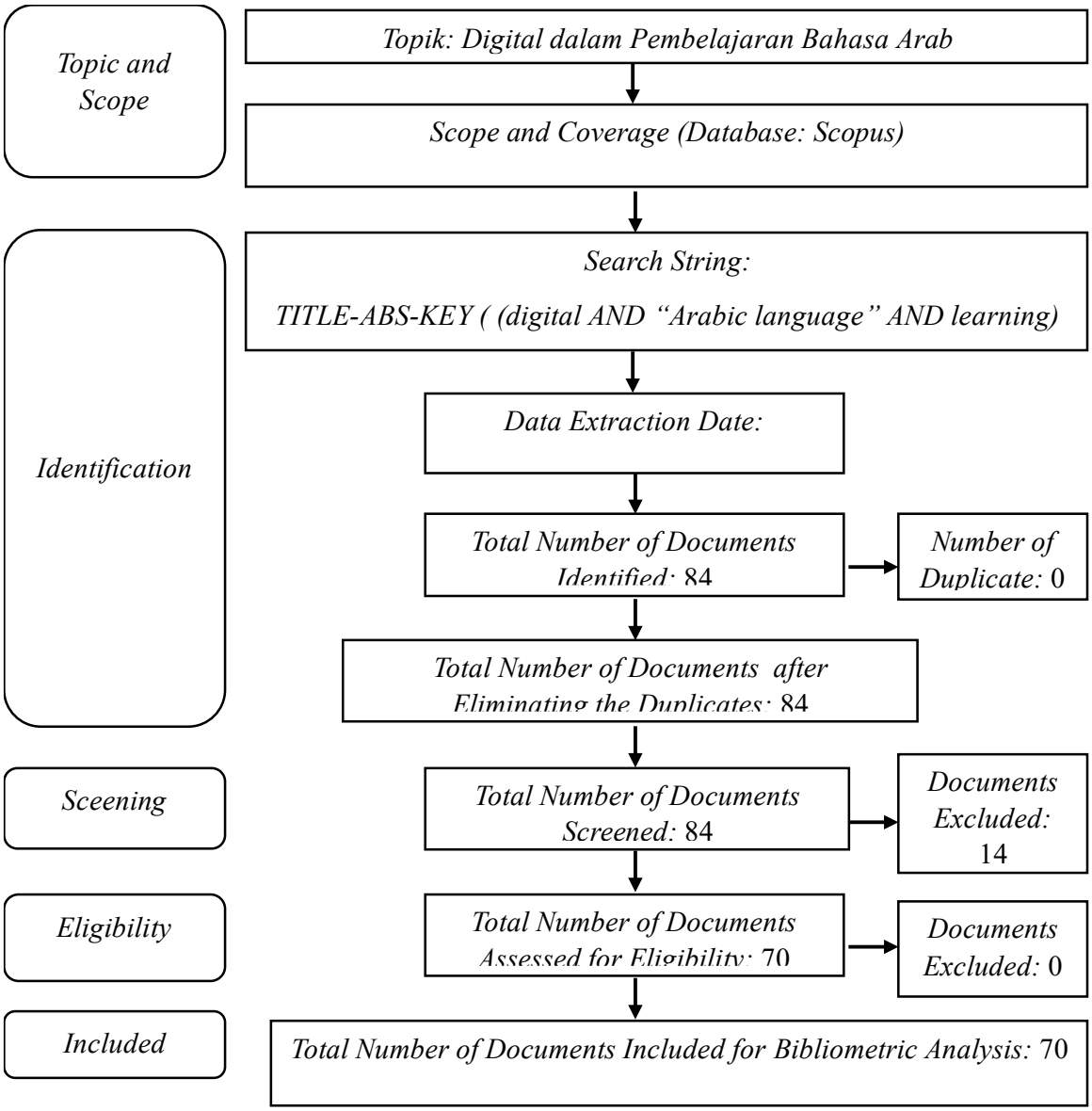

Figure 1. Data Collection Process

Data Analysis

The publication and citation trends in digital Arabic language learning from 2002 to 2024 will be analyzed using tools and methodologies to ensure a comprehensive assessment. The authors will employ Microsoft Excel and RStudio software to calculate and visualize the annual number of publications and the average citations per year. Additionally, Publish or Perish (PoP) software will be utilized to determine the h-index and g-index for each publication, which will help assess both the productivity and citation impact of the research. To depict the geographical distribution of the data, Microsoft Excel will be used, providing insights into the regions that have contributed most to the field.

To examine international collaborations, VOSviewer software will be employed. This tool allows for the construction and visualization of bibliometric networks, revealing the patterns of co-authorship and collaborations among researchers across different countries. This will provide a clearer understanding of how global research communities engage in digital Arabic language learning.

Furthermore, using Microsoft Excel, the study will classify journals based on their quartile rankings (Q1, Q2, Q3, Q4). The 70 publications retrieved from the Scopus database will be sorted according to these quartiles, which reflect the quality and impact of the journals, with Q1 representing the highest standards. This classification will help assess the prominence and influence of the journals publishing research in this field.

By combining these methods, the study will provide a detailed analysis of the trends in digital Arabic language learning research, including publication volumes, citation impacts, geographical contributions, international collaborations, and journal quality. This multifaceted approach will offer a comprehensive overview of the field, spanning nearly two decades of scholarly activity.

RESULT AND DISCUSSION

Publications on digital Arabic language learning have gone through several stages in the data collection process. As a result, the author identified 70 relevant publications from 2002 to 2024 that meet the research criteria. The next phase involves conducting a descriptive bibliometric analysis, which will examine publication trends, citation patterns, geographical distribution, journal rankings, and key research focuses in the subsequent analysis.

RESULT

Publication and Citation Trends Related to Digital in Arabic Language Learning

The publication trends in digital Arabic language learning from 2002 to 2024 will be displayed in Figure 2. Data from the 70 publications, categorized by their year of publication, will be presented in a table format, as demonstrated in Figure 2. The detailed breakdown of this data is provided below.

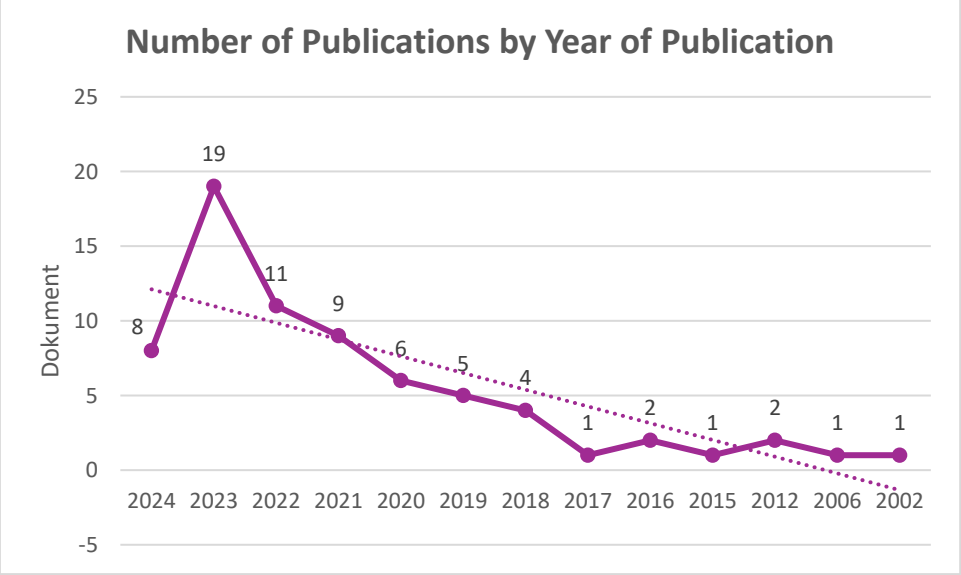

Figure 2. Number of Publications by Year of Publication

From the graph above, it is evident that 19 documents were published in 2023. The first article related to digital Arabic language learning was published in the Scopus database in 2002. However, in the years 2003, 2004, 2005, 2007, 2008, 2009, 2010, 2011, 2013, and 2014, there were no publications related to this research.

The citation trends related to digital Arabic language learning from 2002 to 2024 will be presented in Table 1. The total of 70 publications collected will show the number of publications per year, categorized by parameters such as TP (Total Publications), NCP (Number of Cited Publications), TC (Total Citations), C/P (Citations per Publication), h-index, and g-index. This information will be presented in the following Table 1.

Table 1. Citation Analysis of Publications

Year	TP	NCP	TC	C/P	h	g
2024	8	4	3	0,38	2	2
2023	19	12	55	2,89	4	6
2022	11	9	64	5,82	5	7
2021	9	7	85	9,44	3	9
2020	6	3	25	4,17	2	5
2019	5	3	7	1,40	2	2
2018	4	3	5	1,25	1	2

2017	1	0	0	0,00	0	0
2016	2	2	7	3,50	2	2
2015	1	1	1	1,00	1	1
2012	2	1	13	6,50	1	2
2006	1	1	3	3,00	1	1
2002	1	1	45	45,00	1	1

Notes. TP=total of publication, NCP=number of cited publication, TC=total citations, C/P=average citations per publication, , h=h-index, g=g-index

As shown in Table 1, the highest number of total publications (TP) and cited publications (NCP) occurred in 2023, with 12 out of 19 documents receiving citations. However, the year with the most citations in a single year between 2002 and 2024 was 2021, with 85 citations. While 2023 had the largest number of publications (19), 2021 stands out for having the greatest research impact. It's also noteworthy that several years had no publications or citations, including 2003, 2004, 2005, 2007, 2008, 2009, 2010, 2011, 2013, 2014, and 2017. Furthermore, the highest h-index and g-index were recorded in 2021, with an h-index of 3 and a g-index of 9, indicating a strong impact from the research published in that year. In 2021, there were 7 cited publications, with a total of 85 citations, resulting in an average of approximately 9 citations per publication.

Table 2 will identify the 10 most-cited articles from 2002 to 2024. The article with the highest number of citations received 50 citations, indicating its strong influence in the development of research on digital Arabic language learning. These articles reflect increasing interest in the topic and have played a crucial role in shaping the direction of future research. Furthermore, these highly cited articles highlight the importance of digital integration in Arabic language learning and demonstrate how this research contributes to improving the quality of education through the use of digital technology. Table 2 will identify the top 10 most-cited articles from 2002 to 2024, offering insights into the contributions of research in this field on an international scale.

Table 2. 10 Articles with the most citations

Paper/Year	DOI	TC	TC/Year	Normalized TC
(Alomari et al., 2021)	10.3390/s21092993	50	12.50	5.29

(Mowlaei et al., 2002)	10.1109/ICDSP.2002.1028240	45	1.96	1.00
(Faris et al., 2021)	10.1016/j.imu.2021.100513	26	6.50	2.75
(Al-Azani & El-Alfy, 2020)	10.1109/ACCESS.2020.3011977	22	4.40	5.28
(Omar & El-Hafeez, 2023)	10.1038/s41598-023-44113-7	15	7.50	5.18
(Adeeb & Kabudian, 2022)	10.1109/ACCESS.2022.3201019	14	4.67	2.41
(Ritonga et al., 2022)	10.1155/2022/7090752	14	4.67	2.41
(Sahrir & Yusri, 2014)	NA	13	1.00	2.00
(Lakim et al., 2022)	NA	10	3.33	1.72
(Al Ghamdi, 2022)	10.1007/s13369-021-06163-9	7	2.33	1.20

Geographic Distribution and Collaborative Relationship Between Countries

The geographical distribution of authors' countries of origin in publications concerning digital Arabic language learning is shown in Figure 3. Authors from 22 different countries are represented, and the figure below visualizes this distribution.

Figure 3. Geographical Distribution of Publications

Figure 3 illustrates the geographical distribution of publications on digital Arabic language learning, with the Middle East and North Africa (MENA) region as the primary contributor. Saudi Arabia leads with 15 publications, followed by Malaysia (8), Iraq (7), Jordan (7), Egypt (6), Indonesia (6), and the UAE (6). Other contributors include Algeria (4), Kuwait (3), Tunisia (3), Iran (2), and Morocco (2). Western countries such as the US, Canada, the UK, France, and Italy each contributed 1 publication, as did Australia and Brazil. This global interest highlights the widespread engagement in digital Arabic language learning research across diverse regions.

Figure 4. Collaboration between countries

Figure 4 illustrates the pattern of collaboration between countries. In analyzing the relationships, no specific threshold was applied by the researchers, meaning countries with just one document are also included, even if they haven't collaborated with others. Overall, 17 countries are represented in Figure 4.

Distribution of Journal Rankings with the Most Journals on Digitalization in Arabic Language Learning

Journal rankings related to digitalization in Arabic language learning, based on quartile values (Q), can be accessed on the Scimagojr website. These rankings are depicted in the following figure.

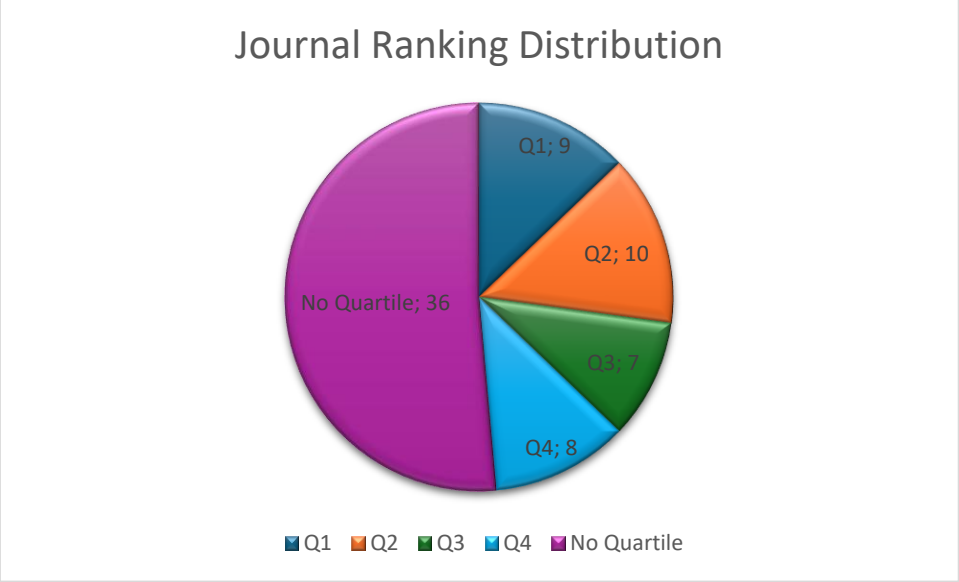

Figure 5. Ranking based on journal quartile values

According to Figure 5, it can be seen that the majority of publications related to digitalization in Arabic language learning are published in journals with no quartile ranking (No Quartile), totaling 36 publications. The second place is occupied by journals in the Q2 category with a total of 10 publications. Additionally, there are 9 publications in Q1 journals, 8 in Q4 journals, and 7 in Q3 journals. The low number of publications in Q1 journals is likely due to several factors, one of which is the large number of articles published in conference proceedings. Proceedings are generally not included in the journal quartile rankings (No Quartile), although their scientific contributions remain important. However, publications in proceedings do not always receive the same recognition as articles in Q1 journals, particularly in terms of academic impact and international reputation.

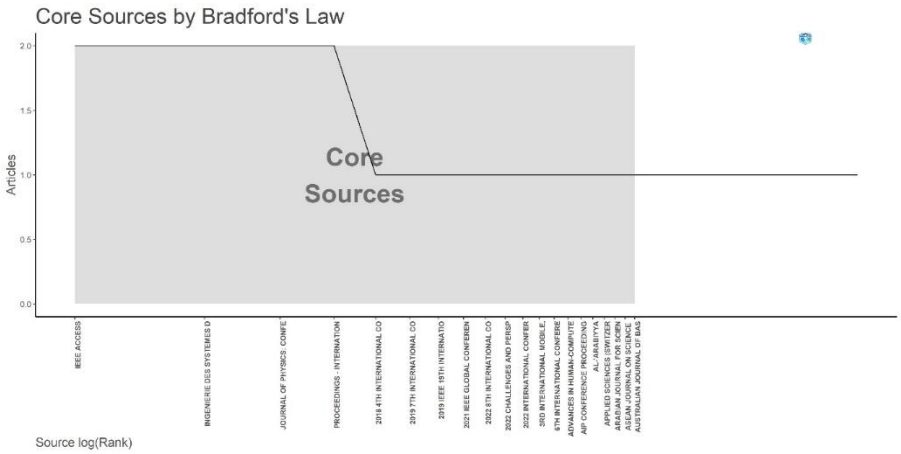

Figure 6. Core Sources by Bradford's Law

Figure 6 shows the distribution of core sources based on Bradford's Law, which identifies the most productive journals in digital Arabic language learning. The "Core Sources" shaded area represents journals with the highest number of publications, with "IEEE Access" being the most prolific. As per Bradford's principle, a small number of journals contribute the majority of articles in this field, while others publish fewer. This highlights the key journals that serve as significant references in the digitalization of Arabic language learning.

Research Focus Related to Digitalization in Arabic Language Learning

At this point, the authors established a threshold, mandating that each keyword must appear in at least three publications. Using this criterion, all relevant keywords were identified and visualized through VOSviewer. A total of 35 keywords were identified, as illustrated in Figure 7 below.

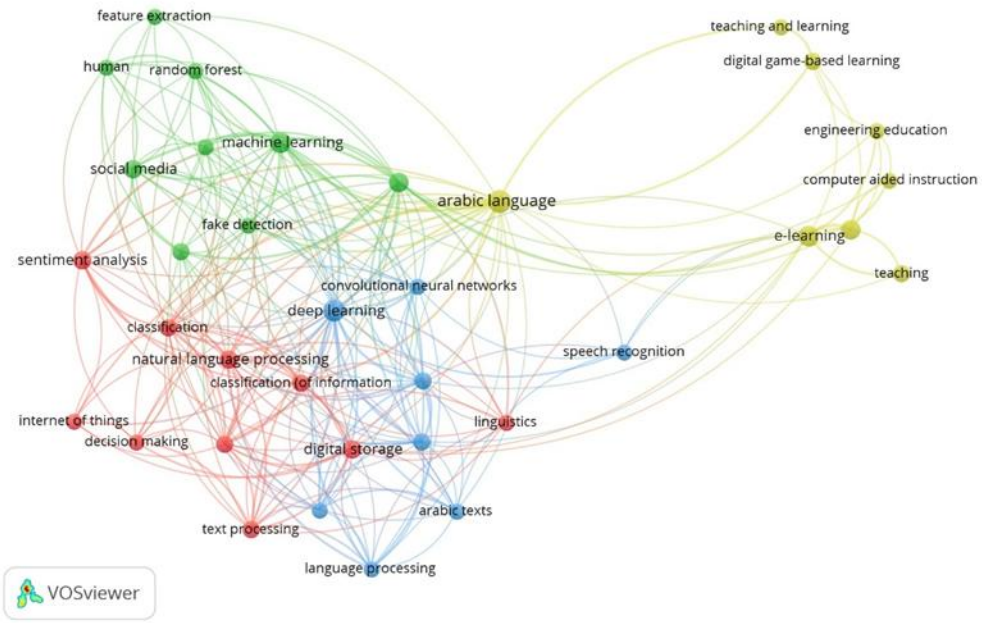

Figure 7. Research Focus

DISCUSSION

What are the Publication and Citation Trends in the scientific literature on Digital in Arabic Language Learning during the specified period?

The publication trends in digital Arabic language learning from 2002 to 2024 are shown in Figure 2, with data from 70 publications categorized by their year of publication, presented in a table format. The analysis reveals that the first article related to digital Arabic language learning was published in the Scopus database in

2002, while 19 documents were published in 2023. However, there were no publications on this topic in the years 2003, 2004, 2005, 2007, 2008, 2009, 2010, 2011, 2013, and 2014. The detailed breakdown of this data is provided below.

The citation trends related to digital Arabic language learning from 2002 to 2024 reveal several notable patterns and shifts in research focus. As presented in Table 1, the total of 70 collected publications illustrates the annual distribution of research outputs, categorized by key bibliometric indicators such as Total Publications (TP), Number of Cited Publications (NCP), Total Citations (TC), Citations per Publication (C/P), h-index, and g-index. These indicators provide a comprehensive overview of the impact and development of scholarly contributions in this field.

A closer examination of Table 1 indicates that 2023 saw the highest number of publications (19), yet the most significant citation impact occurred in 2021, with a total of 85 citations. This suggests that while publication activity increased over time, the influence of research varies, with some years producing more impactful studies than others. Notably, 2021 recorded the highest h-index (3) and g-index (9), highlighting the depth of impact from research published in that year. However, several years, including 2003, 2004, 2005, 2007, 2008, 2009, 2010, 2011, 2013, 2014, and 2017, had no publications or citations, indicating fluctuations in research interest and funding allocation over time.

Further insights can be drawn from Table 2, which lists the ten most-cited articles between 2002 and 2024. The most-cited article, Alomari et al. (2021), with 50 citations, underscores the growing importance of big data applications in Arabic language learning. This study introduced Iktishaf+, a tool leveraging machine learning and big data analytics to process Arabic-language Twitter data for event detection. Its high citation count reflects the increasing integration of artificial intelligence in language-related research.

The second most-cited study, by Mowlaei et al. (2002), focused on handwriting recognition using wavelet transform, garnering 45 citations. This research highlights the long-standing interest in digital applications for Arabic script recognition, an essential component of automated language processing. Despite being an older study, its continued relevance suggests that foundational research in character recognition remains highly valuable for advancements in Arabic digital learning tools.

Similarly, Faris et al. (2021) contributed significantly to medical informatics by developing an intelligent diagnostic system for Arabic-speaking patients. With 26 citations, this study underscores the broader applications of Arabic language processing beyond traditional learning environments, demonstrating its role in healthcare and telemedicine. The challenges of Arabic dialect variations and limited

datasets were key obstacles addressed by this research, reinforcing the need for further work in computational linguistic resources for Arabic.

Another influential study, conducted by Al-Azani & El-Alfy (2020), explored multimodal sentiment analysis, integrating textual, auditory, and visual data. With 22 citations, this research illustrates the expanding role of Arabic language technology in sentiment detection and user interaction, which has implications for education, media, and social analysis. The findings emphasize the necessity of incorporating multiple data modalities to enhance the accuracy of sentiment classification for Arabic speakers.

Finally, the study by Omar et al. (2023) examined the application of quantum computing in Arabic sentiment classification, receiving 15 citations. This research compared quantum computing with classical machine learning approaches, revealing that while quantum computing showed promise for handling large datasets, classical ML methods remained superior for smaller-scale applications. These findings suggest that future advancements in computational power could further refine Arabic language learning and analysis methodologies.

Collectively, the five most-cited studies highlight the intersection of Arabic language learning and cutting-edge technologies, such as machine learning, big data analytics, handwriting recognition, and quantum computing. Their contributions extend beyond traditional educational settings, impacting fields such as social media analysis, telemedicine, and artificial intelligence applications. The variations in citation impact across different years suggest that while interest in Arabic digital learning remains strong, certain technological breakthroughs drive higher scholarly engagement and influence. Future research should explore how emerging technologies, including generative AI and natural language processing, can further enhance Arabic language education and applications in diverse domains.

How are the relevant scientific publications geographically distributed, and what trends exist in international collaboration on Digital in Arabic Language Learning?

The geographical distribution of authors' countries of origin in publications concerning digital Arabic language learning is shown in Figure 3. Authors from 22 different countries are represented, and the figure below visualizes this distribution.

Based on Figure 3, the geographical distribution of publications related to digital Arabic language learning spans several countries worldwide. The Middle East and North Africa (MENA) region serves as the primary contributor, with significant participation. Saudi Arabia leads with the highest number of publications, totaling 15 documents. Other countries in the region, such as Jordan and Iraq, contributed 7 documents each, followed by Egypt and the United Arab Emirates with 6 documents

each, and Algeria with 4 documents. Countries like Kuwait, Tunisia, Iran, and Morocco contributed fewer, with 2 to 3 documents each. In Asia, Malaysia (8 documents) and Indonesia (6 documents) are key contributors, highlighting their crucial role in Arabic language education, especially in the context of religious education. Their participation reflects a strong commitment to the development of digital Arabic language learning.

From the West, the United States, Canada, the United Kingdom, France, and Italy each contributed 1 document. Although contributions from these countries are smaller, they reflect academic and diplomatic interest in Arabic language teaching in the West. Countries like Australia and Brazil also participated, each contributing 1 document. This indicates a global interest in the digitalization of Arabic language learning, even from non-native or non-majority Muslim countries. Overall, Figure 3 demonstrates significant involvement from countries in the Middle East and North Africa, along with notable participation from Asia, Europe, the Americas, and Oceania in research related to digital Arabic language learning.

In this geographical distribution, seven countries emerge as having the highest number of publications on digital Arabic language learning: Saudi Arabia, Malaysia, Iraq, Jordan, Egypt, Indonesia, and the United Arab Emirates. Notably, Saudi Arabia leads with 15 publications. This finding is consistent with the research of Al-abdullatif & Alsubaie. (2022), who explored digital learning in Saudi Arabia and emphasized the growing adoption of digital platforms for teaching Arabic, particularly in the aftermath of the COVID-19 pandemic. One of their notable findings was the significant impact of the "I Read Arabic" (IRA) platform in enhancing Arabic literacy skills among primary school students. With interactive and engaging content, the platform enhances students' reading, listening, speaking, and writing skills while motivating teachers to continue its use. Factors such as hedonic motivation, habits, performance expectations, and perceived value were found to significantly influence teachers' intentions to adopt the technology. However, the study also revealed various challenges faced by teachers, including a lack of technological infrastructure support and adequate training. These findings align with Saudi Arabia's Vision 2030, which prioritizes the digitalization of education and integrates digital technology as a key component of the country's educational transformation.

In Figure 4, countries such as the United Arab Emirates (UAE), Saudi Arabia, Kuwait, Canada, and Algeria have noticeably larger circles compared to others. These larger circles indicate a higher degree of collaboration with other nations in the context of digital Arabic language learning research. Based on the VOSviewer visualization, UAE has collaborated with 10 countries, followed by Saudi Arabia with 8 countries.

Meanwhile, Kuwait, Canada, and Algeria have collaborated with 6 countries each in this field.

These findings highlight the importance of international collaboration in advancing digital Arabic language learning research. Countries with high collaboration levels, such as the UAE and Saudi Arabia, demonstrate that significant progress in this area often occurs through the exchange of ideas and resources between nations with similar expertise or interests. This trend presents opportunities for other countries to enhance international cooperation and accelerate innovations in digital Arabic language learning.

What are the journal ranking distributions for publications on Digitalization in Arabic Language Learning, based on quartile rankings?

The distribution of journal rankings is based on quartile values (Q), as shown in the data collected from a total of 70 publications. Of these, 9 were published in top-tier journals (Q1). This information is visualized using Biblioshiny from RStudio, which displays the quartile distribution of journals publishing articles on the digitalization of Arabic language learning, offering valuable insights into the quality and reputation of these journals.

Increasing the number of publications in high-ranking journals, particularly Q1 journals, is essential for enhancing the international prominence of digital studies in Arabic language learning. Q1 journals typically publish research of higher quality and have a significant impact on the development of both educational theory and practice. As digital technology continues to advance in education, research focusing on the integration of technology in Arabic language learning must be prioritized, as it has been proven to improve learning outcomes. However, the current number of publications in Q1 journals remains limited, indicating the need for more efforts to promote high-quality research in this field. This includes fostering collaboration between academics and education practitioners. By improving both the quality and quantity of research, we can enhance Arabic language teaching methods and increase global competitiveness in Arabic language education.

Figure 6 illustrates the distribution of core sources based on Bradford's Law, emphasizing the journals that publish the majority of articles in the field of digital Arabic language learning. The graph clearly identifies "Core Sources," which are the journals that contribute the highest number of publications. "IEEE Access," positioned on the far left of the graph, is the most prolific journal, publishing a substantial volume of articles compared to others. Moving to the right, the number of articles published by each journal gradually decreases, consistent with Bradford's principle, which posits that a small number of journals publish the majority of articles in a specific research area. This distribution pattern underscores the

importance of these core journals in shaping the academic landscape of digital Arabic language learning. Researchers can prioritize publishing in these influential journals to maximize their impact and contribute to the ongoing advancements in the field.

What are the primary research focuses in the scientific literature on Digitalization in Arabic Language Learning from 2002 to 2024?

The research focus can be observed from the division into four clusters, as seen in Figure 7. Each cluster represents research related to digitalization in Arabic language learning and is marked with a different color: red, green, blue, and yellow. These four clusters reflect the division of research focus into four main aspects. Below is an explanation of each cluster:

1. Cluster One (Red): Comprising 10 items, this cluster includes the keyword "natural language processing" as a central element, indicating that this keyword, related to digitalization in Arabic language learning, is the main focus of research in this cluster.
2. Cluster Two (Green): Consisting of 9 items, this cluster highlights the keyword "machine learning" as its focal point. This indicates that the research in this cluster is centered around "machine learning" in the context of digitalization in Arabic language learning.
3. Cluster Three (Blue): Made up of 8 items, the keyword "deep learning" plays a central role in this cluster, suggesting that the research in this cluster focuses primarily on "deep learning" as a key component of digitalization in Arabic language learning.
4. Cluster Four (Yellow): Comprising 8 items, this cluster emphasizes the keyword "e-learning" as its central focus. This shows that the research in this cluster is concentrated on "e-learning" in the context of promoting digitalization in Arabic language learning.

These clusters illustrate the key research areas, providing insight into the different focal points within the field of digitalization in Arabic language learning, and offering a deeper understanding of the diverse approaches researchers are taking to address this growing field.

The first research focus is **natural language processing (NLP), as demonstrated by the study conducted by Kaddoura & Nassar (2024). In this article, it was found that the dataset compiled for Word Sense Disambiguation (WSD) in Arabic made a significant contribution to the development of NLP in the Arabic language. This dataset focuses on one hundred polysemous words commonly used in Modern Standard Arabic, with a total of 367 unique meanings supported by 3,670 contextual

sentence examples. The data was collected from various online sources, such as news, finance, and medical domains, covering multiple fields, making it relevant for various NLP applications, including sentiment analysis and text classification. The article also emphasizes the importance of datasets in improving the performance of machine learning models involved in NLP tasks, particularly in addressing the challenges of Arabic's rich morphological and syntactic complexities.

The second research focus is machine learning (ML), as highlighted in the study by Omar & El-Hafeez (2023). This article explains the findings that both quantum computing and machine learning show promising results in the classification of Arabic document sentiment, especially in social media. In a dataset containing 213,465 Arabic tweets, quantum computing slightly outperformed classical ML in terms of speed and accuracy. Quantum computing completed the task in about 59 minutes, faster than classical ML, which took around one hour. Additionally, quantum computing achieved slightly higher precision, recall, and F1 scores, demonstrating its effectiveness in analyzing positive sentiment in large-scale data. However, with a smaller dataset (44,000 tweets), the performance difference between the two methods was negligible, though classical ML was slightly more accurate. These findings indicate the potential of quantum computing in processing large data with high accuracy, but ML remains effective and faster for smaller datasets.

The third research focus is deep learning (DL), as evidenced by the study by Albayari et al. (2024). This article presents significant findings related to the use of DL in detecting cyberbullying in Arabic text, which is still an under-researched area. In the context of digital learning, these findings are relevant as DL can be used to identify negative behaviors such as cyberbullying on digital platforms frequently used by students in Arabic language learning. By evaluating the performance and comparing various DL algorithms such as LSTM, GRU, and CNN, the researchers propose a hybrid DL model that improves accuracy in detecting cyberbullying in Arabic text data. This model is expected to be integrated into social media to automatically mitigate negative impacts such as self-isolation and depression, which can affect students, while also paving the way for cutting-edge technology in Arabic language education in the digital era.

The last research focus is e-learning, as reflected in the study by Zubaidah et al. (2021). The article, titled "Web-based e-learning Application for Learning Arabic Language," highlights the role of digital technology in Arabic language education, particularly through web-based e-learning platforms. The main findings show that web-based learning can overcome the limitations of traditional learning, which relies heavily on face-to-face interaction between lecturers and students. E-learning offers greater flexibility, allowing students to access materials anytime and

anywhere, and enhances independent learning. In the context of Arabic language learning, e-learning helps students improve their communication skills, such as reading, writing, listening, and speaking. Challenges in the implementation of e-learning include a lack of awareness of its benefits, unclear understanding, and limitations in technological infrastructure in various regions.

CONCLUSION

Conclusions should answer the objectives of research. Tells how your work advances the field from the present state of knowledge. Without clear Conclusions, reviewers and readers will find it difficult to judge the work, and whether or not it merits publication in the journal. Do not repeat the Abstract, or just list experimental results. Provide a clear scientific justification for your work, and indicate possible applications and extensions. You should also suggest future experiments and/or point out those that are underway.

This study provides a comprehensive bibliometric analysis of international research on digital integration in Arabic language learning, examining publication trends, geographic distribution, and key thematic areas between 2002 and 2024. The findings reveal that digital tools, such as e-learning platforms and artificial intelligence applications, have significantly enhanced accessibility, flexibility, and interactivity in Arabic language education. Although the adoption of digital approaches in Arabic language learning has lagged behind other languages, recent years have witnessed considerable growth, with Saudi Arabia, Malaysia, and Indonesia emerging as major contributors to this research domain.

The analysis identifies key research clusters, including natural language processing, machine learning, deep learning, and e-learning, which reflect the evolving technological landscape shaping Arabic language learning. However, the study also highlights a disparity in research impact, as a substantial proportion of publications appear in lower quartile journals. This underscores the need for increased efforts to enhance the quality and global visibility of scholarly contributions in this field. Moreover, greater international collaboration, particularly involving institutions from underrepresented regions such as Indonesia, is crucial to fostering a more robust and impactful research ecosystem.

The findings of this study carry several important implications for researchers, educators, and policymakers involved in Arabic language education. First, the growing role of digital technologies suggests that future research should explore the integration of emerging innovations, such as quantum computing, virtual reality, and adaptive learning systems, to further improve the effectiveness of Arabic language instruction. Second, efforts should be directed toward publishing in high-impact

journals to elevate the scholarly reputation of research in this field. Third, international collaboration should be actively promoted to facilitate knowledge exchange, funding opportunities, and interdisciplinary research, particularly among researchers from diverse linguistic and technological backgrounds. Lastly, policymakers and educational institutions should consider investing in the development of localized digital tools that cater to the specific needs of Arabic language learners, ensuring inclusivity and cultural relevance in digital education.

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