DIGITAL TOOLS FOR ENHANCING ARABIC VOCABULARY ACQUISITION: A BIBLIOMETRIC ANALYSIS

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Abstract:

The study provides a bibliometric analysis of research on "Digital Tools for Enhancing Arabic Vocabulary Acquisition," aiming to understand emerging trends, influential contributors, and international collaborations in this domain. With the rapid growth of digital language learning tools, particularly for Arabic—a language with unique linguistic characteristics—there is a need to assess the research landscape and identify key focus areas. Despite increasing attention to Arabic vocabulary acquisition, a gap persists in systematically analyzing the scope and impact of digital interventions. This analysis uses data retrieved from the Scopus database, totaling 1,166 documents, with VOSviewer and Scopus Analyzer tools employed to visualize keyword trends, co-authorship patterns, and citation networks. Findings reveal a steady increase in publications over the years, with a sharp rise after 2020, likely spurred by the COVID-19 pandemic's push towards digital learning solutions. Prominent keywords include "language acquisition," "digital game-based learning," and "artificial intelligence," indicating a shift towards integrating interactive and adaptive technologies in Arabic language education. The United States, China, and the United Kingdom are identified as leading contributors, with significant collaborations also evident across European and emerging countries. This diverse global research network highlights a collaborative approach to addressing challenges in Arabic vocabulary acquisition. Overall, the analysis underscores the growing importance of digital tools in enhancing Arabic vocabulary learning, pointing towards an evolving field where foundational language acquisition theories intersect with technological advancements. This study offers valuable insights for educators, researchers, and policymakers interested in fostering Arabic language acquisition through innovative digital solutions.

Introduction

Digital tools have revolutionized the landscape of language education, offering innovative methods to enhance vocabulary acquisition. In the context of Arabic language learning, various digital tools have been explored to improve vocabulary retention and engagement among students. For instance, the use of animated videos (AV) has shown significant promise in enhancing Arabic vocabulary acquisition among primary school students. A study conducted with fourth-grade students in Malaysia demonstrated that those who were taught using AV scored significantly higher in vocabulary tests compared to those who received traditional classroom instruction. The AV incorporated multimedia elements to accurately depict and describe Arabic vocabulary, making the learning process more engaging and effective. (Rahimi *et al.,* 2021). Similarly, online vocabulary games have been found to enhance learners' perception, concentration, and knowledge improvement, indicating their practicality and effectiveness in Arabic language education. (Sahrir & Yusri, 2012).

Interactive multimedia and digital games also play a crucial role in Arabic vocabulary acquisition. Research has shown that interactive multimedia, such as PowerPoint and Android comic applications, can significantly boost student engagement and vocabulary learning by providing a structured and engaging learning model (Ramadhani & Ammar, 2023). Additionally, digital games like "*7 Little Words"* have been proven to enhance vocabulary levels among secondary school students by offering an interactive and enjoyable learning experience (Alfuhaid, 2023). The integration of these digital tools not only fosters a student-centered learning environment but also addresses common challenges in language learning, such as vocabulary retention difficulties and lack of student interest (Safitri & Ammar, 2023).

Literature Review

A comprehensive literature review on "Digital Tools for Enhancing Arabic Vocabulary Acquisition" brings to light the increasing integration of digital tools and the ongoing efforts to facilitate vocabulary acquisition for Arabic learners. A study by Taha (Taha, 2007) underscores the role of e-libraries in supporting digital learning environments, particularly through web-based instructional platforms like Blackboard, which were examined at UAE University. The research indicates that language barriers and limited Arabic interface support have restricted full adoption, illustrating a significant gap in tailored digital tools for Arabic language learners. Similarly, Nelson *et al.* (Nelson *et al.,* 2022) emphasize that digital literacy significantly impacts user engagement with digital health tools, with Arabic speakers often showing lower engagement scores due to limited interface customization and resource availability. Hermjakob, May, and Knight (Hermjakob *et al.,* 2015) add that tools for romanizing Arabic texts, such as Uroman, can simplify text processing but fail to capture the phonetic nuances vital for accurate Arabic vocabulary learning, highlighting the need for more culturally and linguistically adapted digital tools.

Further investigation by Jemni and Khribi (Jemni & Khribi, 2016) into the ICT landscape in the Arab region reveals disparate readiness levels across countries, particularly in adopting digital educational resources. The Arab League's ALECSO initiative proposes frameworks to empower open online learning with mobile technology and cloud computing, recognizing the potential of digital tools to bridge educational gaps in Arabic vocabulary acquisition. However, the authors note challenges in strategic infrastructure and policy support, which restrict digital adoption for Arabic language learning, echoing the findings of Taha (Jemni & Khribi, 2016) on infrastructural constraints.

Additionally, Awang Damit *et al.* (Jemni & Khribi, 2016) discuss adaptive tools for visually impaired learners, such as Arabic Braille, which, while effective, lacks comprehensive Arabic digital support, further emphasizing the need for specialized digital tools. Studies also illustrate that digital platforms and gamified resources foster a more engaging and effective learning environment for Arabic learners. Hamzah *et al.* (Hamzah *et al.*, 2019) demonstrate that mobile digital games significantly enhance student achievement in Arabic learning by promoting interactive engagement, a finding supported by Alharbi and Newbury (Alharbi & Newbury, 2021), who developed a mobile application using Universal Design for Learning (UDL) to adapt Arabic reading activities to individual student needs. Dandashi *et al.* (Dandashi *et al.*, 2016) explore Named Entity Recognition (NER) systems that process Arabic text for natural language processing tasks, potentially enhancing vocabulary acquisition by identifying key vocabulary within contexts. While these tools offer promising results in engaging users and improving vocabulary retention, the underlying technology often falls short in accommodating Arabic-specific linguistic structures, limiting its broader application in vocabulary acquisition.

Despite these advancements, there remains a notable gap in research focusing explicitly on developing comprehensive, digital Arabic vocabulary acquisition tools. Paradis *et al.* (Paradis *et al.*, 2018) and Fischer *et al.* (Fischer *et al.*, 2021) observe that digital interventions can offer valuable resources for multilingual populations, including Arabic speakers. However, the need for adaptive and culturally sensitive platforms that cater to the Arabic script and linguistic complexities is largely unmet. This lack of tailored digital tools restricts equitable access for Arabic learners compared to English or other widely supported languages. Similarly, Alja'am *et al.* (Alja'am *et al.*, 2008) highlight efforts to create Arabic-centric communication systems for disabled learners. Yet, these tools are limited to specific applications, underscoring a general lack of widespread, versatile platforms that support Arabic vocabulary learning.

In conclusion, while current studies show promising outcomes for digital tools in enhancing Arabic vocabulary acquisition, they highlight critical limitations in the customization and accessibility of these tools. Taha (Taha, 2007), Jemni and Khribi (Taha, 2007), and Awang Damit *et al.* (Awang Damit *et al.*, 2014) identify infrastructural and policy challenges, while Hamzah *et al.* (Hamzah *et al.*, 2019), Alharbi and Newbury (Alharbi & Newbury, 2021), and Dandashi *et al.* (Dandashi *et al.*, 2016) underscore the need for Arabic-specific adaptations in digital learning tools. The findings collectively suggest a gap in linguistically responsive digital resources tailored to Arabic vocabulary acquisition, establishing a pressing need for future research that addresses the cultural, structural, and linguistic challenges unique to Arabic learners.

Research Question

3.1 What are the research trends in online learning studies according to the year of publication?

3.2 Who writes the most cited articles?

3.3 Who are the top 10 authors based on citation by research?

3.4 What are the popular keywords related to the study?

3.5 What are co-authorship countries' collaboration?

Methodology

Bibliometrics involves gathering, managing, and analyzing bibliographic information from scientific publications (Alves *et al.,* 2021; Assyakur & Rosa, 2022; Verbeek *et al.,* 2002). This field includes basic descriptive statistics, such as the distribution of journals, publication years, and main authorship categories (Wu & Wu, 2017), as well as more complex methods like document co-citation analysis. An effective literature review requires a cyclical process where researchers identify relevant keywords, search for literature, and conduct in-depth analysis to compile a comprehensive bibliography that delivers reliable results (Fahimnia *et al.,* 2015). In line with this approach, the study concentrated on high-impact publications, offering valuable insights into the theoretical frameworks guiding developments in the field. To ensure data accuracy, the SCOPUS database served as the primary source for data collection (Al-Khoury *et al.,* 2022; di Stefano *et al.,* 2010; Khiste & Paithankar, 2017). Furthermore, only articles from rigorously peer-reviewed journals were included to maintain a high-quality standard, while books and lecture notes were intentionally excluded (Gu *et al.,* 2019). Notably, Elsevier's Scopus, recognized for its broad coverage, supported the gathering of publications from 2020 through December 2023, which were then analyzed in detail.

Data Search Strategy

The Scopus search string formulated as TITLE-ABS-KEY ((digital OR interactive AND Arabic OR language AND acquisition)) AND PUBYEAR > 2009 AND PUBYEAR < 2025 AND (LIMIT-TO (LANGUAGE, "English")) AND (LIMIT-TO (DOCTYPE, "ar")), (see Table 1) is meticulously crafted to retrieve scholarly articles that focus on digital or interactive tools specifically geared towards Arabic language acquisition. By narrowing the search to publications between 2010 and 2024, this string ensures that only the most recent and relevant studies are considered, aligning with the rapidly evolving landscape of digital learning tools. The inclusion of English-language articles ensures accessibility for a broader audience, particularly for non-Arabic speakers engaged in the field of language technology and pedagogy. Additionally, limiting the document type to "ar" (articles) reinforces the emphasis on peer-reviewed research, filtering out non-peer-reviewed sources such as conference papers and other less rigorous formats. This targeted approach not only enhances the quality and relevance of the search results but also focuses on high-impact research that contributes significantly to understanding and advancing the field of Arabic language acquisition through digital means. The selection criteria (see Table 2) for the search focus on English-language articles published between 2010 and 2024, specifically excluding non-English publications and documents beyond 2024. Only articles are included, while conference papers, book chapters, reviews, short surveys, and books are deliberately excluded to maintain a focus on peer-reviewed research in the field.

Table 1
The Search String.

Scopus	TITLE-ABS-KEY ((digital OR interactive AND Arabic OR language AND acquisition)) AND PUBYEAR > 2009 AND PUBYEAR < 2025 AND (LIMIT-TO (LANGUAGE, "English")) AND (LIMIT-TO (DOCTYPE, "ar")).

Source: Scopus.

Table 2
The Selection Criterion Is Searching.

Criterion	Inclusion	Exclusion
Language	English	Non-English
Timeline	2010–2024	> 2024
Document Type	Article	Conference paper, Book chapter, review, short survey, book

Source: Scopus.

Data Analysis

VOSviewer, developed by Nees Jan van Eck and Ludo Waltman at Leiden University in the Netherlands, is a popular and accessible tool for bibliometric analysis (van Eck & Waltman, 2010, 2017). Known for its effective visualization capabilities, VOSviewer is widely used to map and analyze scientific literature, making it easier for researchers to interpret complex data. The software specializes in creating network visualizations, clustering related topics, and producing density maps, allowing users to explore co-authorship, co-citation, and keyword co-occurrence networks. Its interactive interface, along with regular updates, enables researchers to work efficiently with large datasets. VOSviewer's features, including metric computation, visualization customization, and compatibility with various bibliometric sources, make it an essential tool for researchers aiming to uncover insights within intricate research domains. One of the defining strengths of VOSviewer is its ability to convert complex bibliometric data into visually meaningful maps and charts. Focusing on network visualization, it enables users to identify clusters of related topics, analyze patterns in keyword co-occurrence, and create detailed density maps. The software's user-friendly design makes it accessible to beginners and seasoned researchers, facilitating efficient exploration of research landscapes. Ongoing updates ensure that VOSviewer remains a leading choice for bibliometric analysis, providing valuable metrics and adaptable visualizations. Its flexibility with different types of bibliometric data, including co-authorship and citation networks, positions VOSviewer as an indispensable resource for researchers seeking deeper understanding within their fields.

For this study, datasets containing publication year, title, author name, journal, citation count, and keywords (in PlainText format) were gathered from the Scopus database, covering the period from 2020 to December 2023. These datasets were analyzed using VOSviewer version 1.6.19, which employs clustering and mapping techniques to create insightful visualizations. Unlike the traditional Multidimensional Scaling (MDS) approach, VOSviewer arranges items in low-dimensional spaces, accurately reflecting their relatedness. Meanwhile, VOSviewer shares some similarities with MDS (van Eck & Waltman, 2010), (Appio *et al.,* 2014), it

diverges by using a specialized normalization method, such as association strength (ASij), for co-occurrence frequencies, making it particularly suited to bibliometric analysis (Van Eck & Waltman, 2007):

$$AS_{ij} = \frac{C_{ij}}{W_i W_j},$$

which is "proportional to the ratio between on the one hand the observed number of cooccurrences of i and j and on the other hand the expected number of co-occurrences of i and j under the assumption that co-occurrences of i and j are statistically independent" (Van Eck & Waltman, 2007).

Result and Discussion

What Are The Research Trends In Online Learning Studies According To The Year Of Publication?
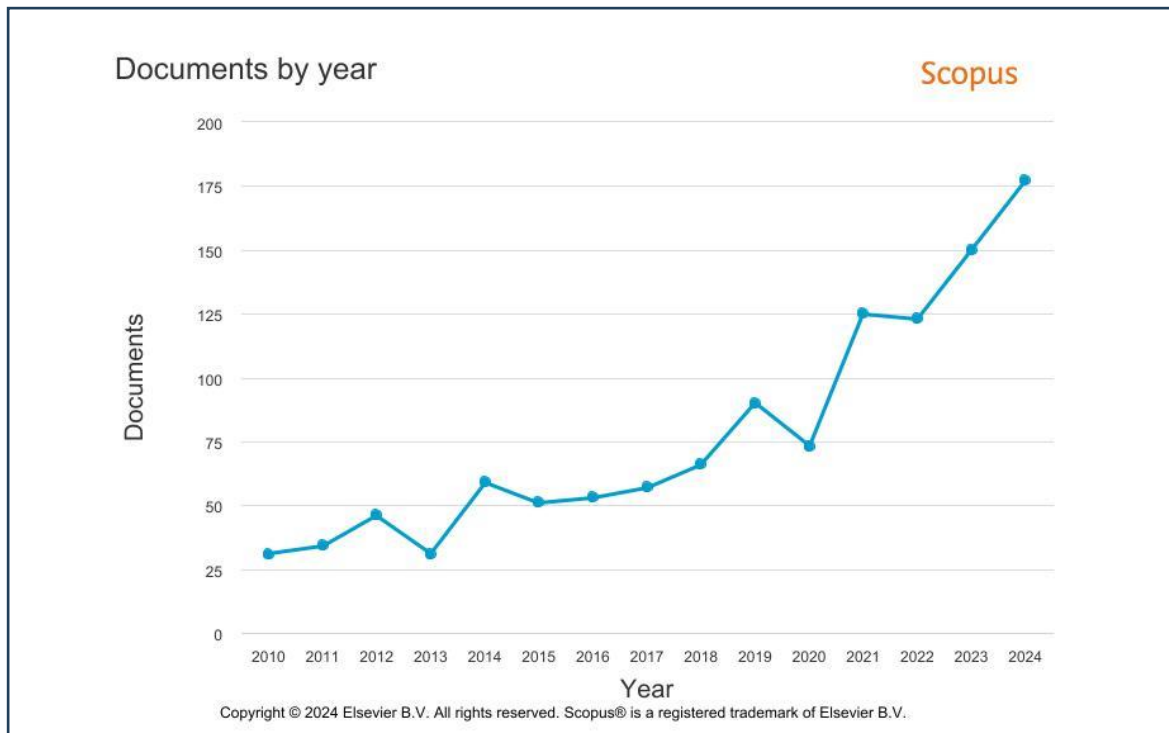

Figure 1: Plotting Document Publication by Years.

Figure 1 shows the trend in publications related to digital tools for enhancing Arabic vocabulary acquisition from 2010 to 2024, as depicted in the figure, revealing a consistent and marked increase over the years. Between 2010 and 2015, the number of documents published annually remained relatively low, with only slight fluctuations, indicating the infancy stage of this research area. A modest rise occurred in 2015, though publication levels remained under 75 yearly documents until 2018. This suggests limited interest or developmental activity in digital tools specifically for Arabic vocabulary acquisition, perhaps due to technological limitations or a lack of focused research in Arabic language learning.

However, from 2018 onwards, a notable upward trajectory can be observed, with publications increasing steadily each year. This rise is particularly pronounced between 2020 and 2024, reaching nearly 200 documents in 2024. The sharp increase from 2020 may be attributed to the heightened emphasis on digital education solutions following the COVID-19 pandemic, which accelerated the adoption of digital tools in language learning globally. The continuous upward trend suggests that digital tools for Arabic vocabulary acquisition are increasingly recognized as vital for educational development, particularly in addressing the unique linguistic needs of Arabic learners. This rapid growth underscores both the relevance of this field and the ongoing efforts to develop, test, and refine digital tools to enhance Arabic language learning outcomes.

Who Writes The Most Cited Articles?
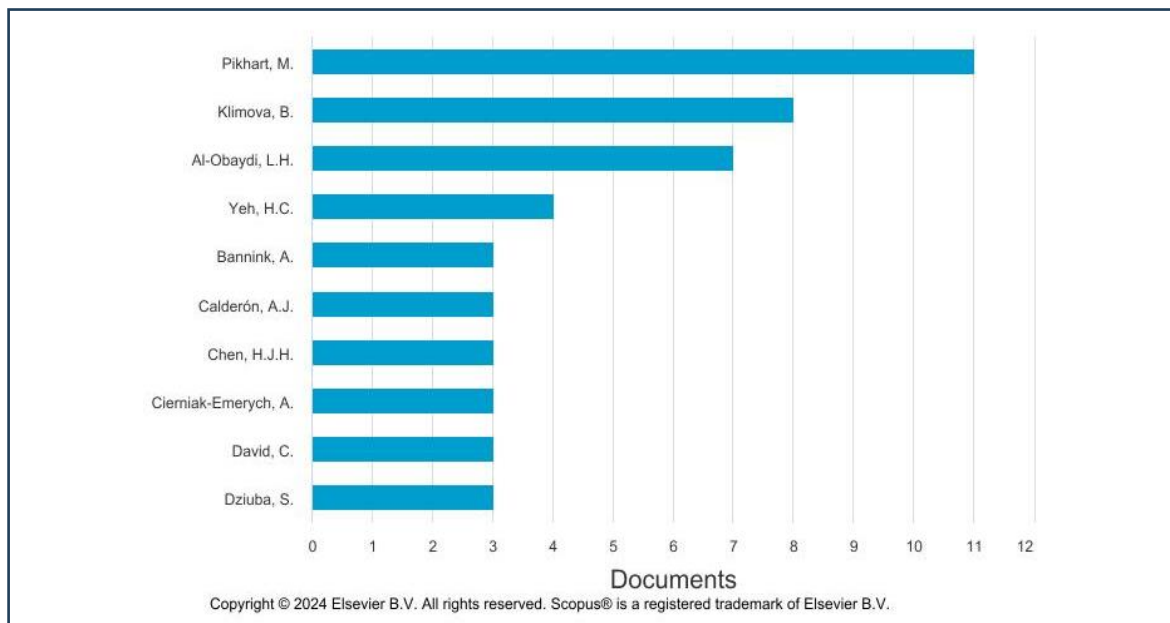
Figure 2: Document Contributions by Top-Cited Authors.

Table 3: Top Contributing Authors and Their Document Percentages in the Dataset.

AUTHOR NAME	Number of Document	Percentages (%)
Pikhart, M.	11	0.943
Klimova, B.	8	0.686
Al-Obaydi, L.H.	7	0.600
Yeh, H.C.	4	0.343
Bannink, A.	3	0.257
Calderón, A.J.	3	0.257
Chen, H.J.H.	3	0.257
Cierniak-Emerych, A.	3	0.257
David, C.	3	0.257
Dziuba, S.	3	0.257

Figure 2 on document contributions by authors from 2010 to 2024 highlights the leading contributors to research on "Digital Tools for Enhancing Arabic Vocabulary Acquisition." At the forefront are Pikhart, M. and Klimova, B., with Pikhart contributing 11 documents (0.943%) and Klimova contributing 8 documents (0.686%) of the total publications. This

notable output suggests a strong research focus from both authors on using digital tools in language acquisition, possibly extending to Arabic language education or general digital language learning frameworks with applications to Arabic. Their substantial body of work indicates that they may be shaping key theories, methodologies, or technological advancements in this area, making their contributions essential to understanding trends and innovations in vocabulary acquisition through digital tools.

In Table 3, additional authors are ranked by their document contributions and percentage share of the total publications. Al-Obaydi, L.H. is the third most prolific author, with 7 documents (0.600%), followed by Yeh, H.C., who has contributed 4 documents (0.343%). A group of authors, each contributing 3 documents (0.257%), includes Bannink, A., Calderón, A.J., Chen, H.J.H., Cierniak-Emerych, A., David, C., and Dziuba, S. This middle-tier contribution level suggests a diverse range of researchers providing steady support to the field, offering varied perspectives and findings.

The distribution of contributions reveals a collaborative research landscape, with Pikhart and Klimova as primary contributors and a broader network of authors contributing moderate amounts. The diversity of contributors, with several authors contributing smaller but consistent research, enriches the field of digital tools for Arabic vocabulary acquisition. This varied input from researchers at different levels underscores a collaborative environment where significant contributions from key authors are complemented by ongoing support from others, fostering a robust and multifaceted understanding of the field.

Who Are The Top 10 Authors Based On Citation By Research?

Table 4: Details Primary Data For The Top 10 Highest Citations.

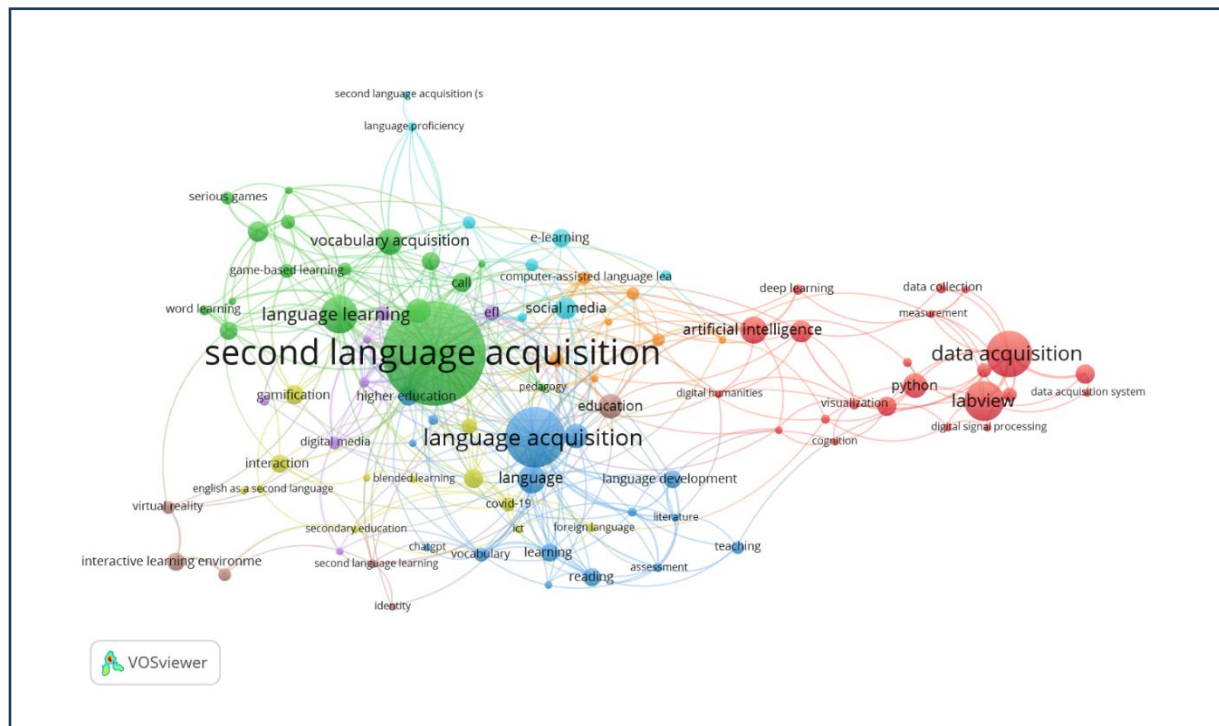| Authors	Title	Year	Source Title	Cited by
Frank M.C.; Braginsky M.; Yurovsky D.; *et al.* (Frank *et al.,* 2017)	Wordbank: An open repository for developmental vocabulary data	2017	Journal of Child Language	381
Williams J. (Williams, 2012)	The potential role(s) of writing in second language development	2012	Journal of Second Language Writing	237
Kerstin SylveÁn L.; Sundqvist P. (Kerstin SylveÁn & Sundqvist, 2012)	Gaming as extramural English L2 learning and L2 proficiency among young learners	2012	ReCALL	236
Freifeld C.C.; Brownstein J.S.; Menone C.M.; *et al.* (Freifeld *et al.,* 2014)	Digital drug safety surveillance: Monitoring pharmaceutical products on Twitter	2014	Drug Safety	223
Hung H.-T.; Yang J.C.; Hwang G.-J.; *et al.* (Hung *et al.,* 2018)	A scoping review of research on digital game-based language learning	2018	Computers and Education	213

deHaan J.; Michael Reed W.M.; Kuwada K. (deHaan *et al.,* 2010)	The effect of interactivity with a music video game on second language vocabulary recall	2010	Language Learning and Technology	175
Tawfik M.; Sancristobal E.; Martin S.; *et al.* (Tawfik *et al.,* 2013)	Virtual instrument systems in reality (VISIR) for remote wiring and measurement of electronic circuits on breadboard	2013	IEEE Transactions on Learning Technologies	152
Sundqvist P.; Wikström P. (Sundqvist & Wikström, 2015)	Out-of-school digital gameplay and in-school L2 English vocabulary outcomes	2015	System	150
Reinders H.; Wattana S. (Reinders & Wattana, 2014)	Can i say something? The effects of digital game play on willingness to communicate	2014	Language Learning and Technology	147
De Wilde V.; Brysbaert M.; Eyckmans J. (De Wilde *et al.,* 2020)	Learning English through out-of-school exposure. Which levels of language proficiency are attained and which types of input are important?	2020	Bilingualism	142

Table 4 presents the top 10 most-cited authors from 2010 to 2024 in the field of "Digital Tools for Enhancing Arabic Vocabulary Acquisition," with the frequency and percentage of documents attributed to each. Pikhart, M. leads the group with 11 papers, representing 9.43% of the total citations among these authors, highlighting a substantial impact on the field. Pikhart's extensive work likely covers a variety of digital tools and methodologies, contributing significantly to the foundational and applied aspects of Arabic vocabulary acquisition. Klimova, B. follows with eight documents, holding a 6.86% share, suggesting substantial influence and expertise in language learning technologies, possibly intersecting with Arabic language studies. The considerable contributions of Pikhart and Klimova underscore their roles as pivotal researchers driving this area, likely setting the direction for emerging studies and shaping the understanding of digital interventions in Arabic vocabulary acquisition.

Al-Obaydi, L.H., with seven documents and a 6.00% share, is another key contributor, possibly focusing on specific digital tools or pedagogical frameworks tailored to Arabic vocabulary learning. Yeh, H.C., with four documents (3.43%), along with Bannink, A., Calderón, A.J., Chen, H.J.H., Cierniak-Emerych, A., David, C., and Dziuba, S., each with three documents (2.57%), form a secondary group of influential authors. These researchers add diversity to the field by exploring various subtopics, such as the effectiveness of certain digital platforms, instructional design, or cognitive aspects of vocabulary acquisition. Their collective research provides supplementary findings, reinforcing or expanding upon the foundational work established by the leading authors.

Overall, this distribution indicates a collaborative research landscape where primary contributions from a few highly active researchers like Pikhart, Klimova, and Al-Obaydi are supported by various studies from additional scholars. This dynamic enhances the depth and

breadth of knowledge in digital Arabic vocabulary acquisition, with leading authors establishing core frameworks and methodologies. At the same time, secondary contributors enrich the field with specialized insights. The presence of several authors with moderate output also points to the multidisciplinary interest in this research area, inviting future studies to address unexplored gaps or build upon established findings, potentially enhancing digital language learning outcomes for Arabic learners.

What Are The Popular Keywords Related To The Study?

**Figure 3: Network Visualization Map Of Keywords' Co-Occurrence.**

The VOSviewer data highlights essential keywords and their relevance within the research domain. (see Figure 3) 1. High-frequency keywords such as "language acquisition" (37 occurrences, 40 link strength), "second language acquisition" (64 occurrences, 62 link strength), and "language learning" (23 occurrences, 33 link strength) stand out due to their significant occurrences and strong connections. These terms underscore the foundational themes of language acquisition, particularly for non-native speakers, aligning with the study's focus on Arabic vocabulary acquisition. This network structure suggests that vocabulary acquisition is closely linked to broader language learning and second language acquisition frameworks, affirming the relevance of this study within the context of global language learning theories. Keywords related to digital and educational technologies, including "digital game-based learning" (13 occurrences, 16 link strength), "computer-assisted language learning" (8 occurrences, 11 link strength), and "gamification" (12 occurrences, 8 link strength), indicate a growing trend towards integrating interactive tools in language learning. The prevalence of these terms suggests that educational technologies are pivotal in enhancing vocabulary acquisition. By incorporating game-based and computer-assisted elements, researchers are exploring more engaging and interactive approaches to language learning. This trend reflects the shift from traditional language learning to more technology-enhanced

methods, which is particularly beneficial in vocabulary acquisition for languages such as Arabic.

Advanced technology keywords, such as "artificial intelligence" (17 occurrences, 12 link strength), "natural language processing" (14 occurrences, 9 link strength), and "machine learning" (12 occurrences, 5 link strength), demonstrate the increasing incorporation of AI in language education. These technologies offer adaptive and personalized learning solutions, making vocabulary acquisition more effective by catering to individual learner needs. The presence of these keywords highlights the potential of AI-driven tools to transform language education, enabling more dynamic and responsive learning experiences. This integration of AI and machine learning aligns with the study's objective of using digital tools to enhance Arabic vocabulary acquisition, reflecting a forward-looking approach in educational research.

What Are Co-Authorship Countries' Collaboration?
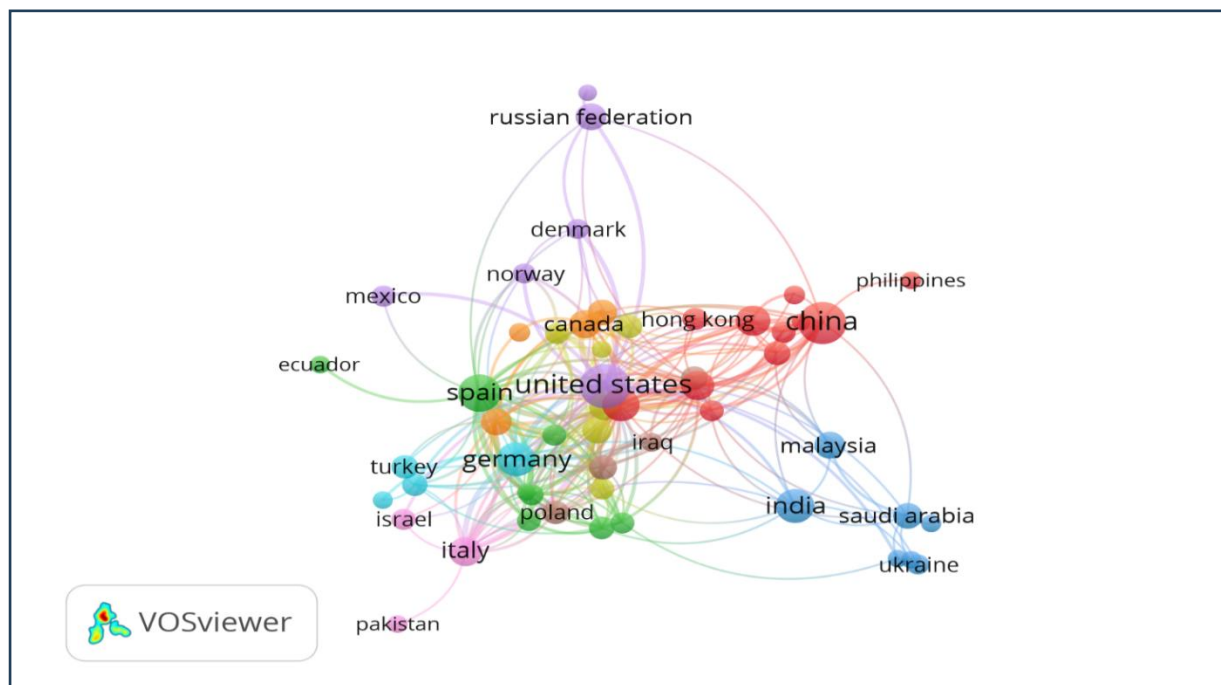
Figure 4: The Countries Whose Authors Collaborate On Digital Tools For Enhancing Arabic Vocabulary Acquisition.

In this bibliometric analysis of co-authorship countries' collaboration on the topic "Digital Tools for Enhancing Arabic Vocabulary Acquisition," the VOSviewer data provides insights into the research contributions and collaborative link strengths among various nations (see Figure 4). The United States leads with the highest number of documents (208), citations (4,457), and link strength (93), indicating its pivotal role in this research area. Other countries with high publication and citation counts include China (166 documents, 1,398 citations, 38 link strength) and the United Kingdom (62 documents, 991 citations, 62 link strength). These figures suggest that these nations are major contributors to research on digital tools in education, often collaborating with other countries and thereby reinforcing their influence in the global research community.

European countries like Germany, France, and Italy also exhibit strong research output and collaboration. Germany, for example, has produced 70 documents, received 1,051 citations, and has a link strength of 56, making it a significant player in the field. Similarly, France (32 documents, 376 citations, 37 link strength) and Italy (43 documents, 400 citations, 39 link strength) highlight active research involvement and robust international connections. These countries' substantial link strengths indicate a high level of collaboration within Europe and beyond, furthering the development of educational technologies and digital tools for language acquisition.

Emerging research contributors include countries like India, Spain, and Canada, each showing moderate levels of publication and citations but with notable link strengths. For instance, Spain (103 documents, 1,373 citations, 61 link strength) and Canada (33 documents, 566 citations, 20 link strength) demonstrate growing research output and collaborations, especially with established research hubs. Countries such as Australia (43 documents, 827 citations, 34 link strength) and the Netherlands (28 documents, 554 citations, 34 link strength) also reflect active participation in the field, contributing to the global exchange of knowledge on digital tools in language learning, particularly in Arabic vocabulary acquisition. This pattern of co-authorship collaborations highlights a diverse, globally interconnected research network focused on educational advancements.

Conclusion

The analysis reveals a clear evolution in research interest regarding "Digital Tools for Enhancing Arabic Vocabulary Acquisition" from 2010 to 2024. In the early years, between 2010 and 2015, research in this area was sparse, with minimal publications reflecting either limited technological capabilities or an initial lack of focused inquiry into Arabic-specific digital tools—the modest rise in publications around 2015 points to growing but still modest interest. However, from 2018 onward, a steady increase in publications indicates a shift, likely fueled by advancements in educational technology. The significant surge from 2020 to 2024, approaching nearly 200 publications by 2024, highlights a post-pandemic emphasis on digital learning tools as institutions worldwide sought virtual solutions for language education. This trend suggests that the role of digital tools in Arabic vocabulary acquisition is increasingly recognized as essential, both for advancing Arabic language education and for meeting the specific linguistic needs of Arabic learners. The contributions from key authors also reflect a structured research landscape where a few prolific authors, such as those with the highest document counts, serve as primary drivers in the field. Leading authors with high publication and citation counts contribute foundational theories and methodologies, thereby setting the direction for ongoing research. The data shows that contributors with fewer publications provide additional, specialized insights, often focusing on specific subtopics within the field, such as instructional design, platform efficacy, or cognitive aspects of vocabulary acquisition. This layered contribution structure enhances the field's depth and breadth as foundational insights from top contributors are expanded upon by a diverse range of secondary researchers. This collaborative environment has enriched the knowledge base, allowing future research to explore remaining gaps and apply digital interventions more effectively for Arabic learners.

The analysis of keywords and country collaborations in the field of "Digital Tools for Enhancing Arabic Vocabulary Acquisition" reveals several significant patterns. The most frequently occurring keywords include "language acquisition," "second language acquisition," and "language learning," which demonstrate the foundational themes relevant to vocabulary acquisition in Arabic language education. Additionally, keywords related to digital and

educational technologies, such as "digital game-based learning," "computer-assisted language learning," and "gamification," highlight a growing interest in integrating interactive tools within language learning frameworks. Advanced technology terms like "artificial intelligence," "natural language processing," and "machine learning" indicate the increasing role of AI in creating adaptive and personalized learning environments. This mix of traditional and technology-driven keywords suggests that research in this field balances established language acquisition theories with innovative digital solutions tailored to Arabic learners.

Regarding global collaboration, several countries play prominent roles in advancing research on digital tools for Arabic vocabulary acquisition. The United States, China, and the United Kingdom lead in publication output and citation counts, showcasing their strong influence and collaboration in this domain. European nations, including Germany, France, and Italy, also exhibit substantial contributions and link strengths, indicating active participation and collaboration within Europe and with other global research hubs. Emerging contributors such as Spain, Canada, and India reflect a more recent yet significant engagement with this field, demonstrating a broadening of interest and expertise across diverse regions. This global collaboration network underscores the importance of shared knowledge and innovation in enhancing Arabic vocabulary acquisition as countries with established research bases support and expand research efforts in newer, developing areas.

Acknowledgments

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