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Digital Learning to Prevent Arabic Language Fossilization: A Systematic Review

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ABSTRACT

Fossilization is one of the main problems in learning Arabic as a foreign language. It happens when phonological, lexical, and grammatical errors stay in the learner's language even after many corrections. At the same time, the use of digital learning is growing, but its direct potential to prevent fossilization has not been fully explained. This study aims to analyze the role of digital learning strategies in preventing fossilization through a Systematic Literature Review of 30 selected publications from 2015 to 2024. The results show three main trends. The first is the use of LMS and e learning platforms. The second is the integration of artificial intelligence-based tools, such as translanguaging chatbots. The third is the readiness of institutional policies. Further analysis reveals that digital learning can help prevent fossilization through automatic feedback that enhances noticing, adaptive practice that breaks repeated error patterns, and learning environments that provide rich input. The main contribution of this study is the mapping of the direct relationship between digital features such as automatic correction, learning analytics, and AI-based translanguaging and the cognitive mechanisms that support the restructuring of the learner's interlanguage. These findings give a conceptual basis for teachers and institutions to design digital Arabic learning that is more effective and more responsive to linguistic errors.

1. Introduction

Language fossilization is one of the primary challenges in second language acquisition, including the learning of Arabic. The term refers to the tendency of persistent language errors and a lack of progress in language skills, even after continuous teaching or feedback (Burhanuddin, 2024a; Han, 2004a; Selinker, 1972). In Arabic language learning, standard forms of fossilization include mistakes in *nahwu* (grammar structure), changes in pronunciation, and errors in choosing vocabulary and sentence construction (Faiz & Afrita, 2024). This can impede the attainment of complete communicative competence and make spoken and written interactions in the target language less smooth.

Learning Arabic is not only about understanding grammar and pronunciation. It also involves deep spiritual and cultural values. Because of this, language mistakes are not just technical problems. They can also affect the meaning in religious practices and artistic communication. If errors in pronunciation and word use are not corrected early, they may become part of the learner's interlanguage and be hard to fix (Asmara & Mustofa, 2024; Vavilova & Broadbent, 2019). That is why preventing fossilization is an essential step in helping learners develop correct, communicative, and lasting language skills.

The idea of interlanguage, introduced by Selinker (1972), explains that second language learners create their own language system (Selinker, 1972). This system keeps changing, but it can also stop developing and become fossilized. In teaching, it is sometimes forgotten that learners actively build their knowledge. They need support through teaching strategies that address their needs and correct their mistakes effectively (Han, 2004b). Adaptive teaching is essential in preventing the development of a rigid interlanguage system. One method often used is the cognitive approach, which focuses on helping learners understand deeply and provides direct feedback on their errors (Annisa & Safii, 2023). However, many strategies to prevent fossilization remain theoretical and have not been studied in detail, especially in Arabic instruction that uses digital tools.

As technology in education continues to evolve, numerous new digital methods for teaching languages have appeared. E-learning platforms, mobile apps, and interactive media are now widely used in Arabic language classes (Burhanuddin, 2024b). Digital learning offers flexibility, personalized learning, and interactive features, such as multimedia and instant feedback. These elements are believed to help stop repeated language errors from becoming permanent (Faiz & Afrita, 2024). It also allows learners to practice more, fix mistakes quickly, and learn collaboratively (Bahy et al., 2024).

Although digital learning and the issue of fossilization have been widely discussed in the literature, a significant research gap remains in exploring their direct connection, especially in the context of language learning. For this reason, this study aims not only to review the effectiveness of digital strategies but also to map their potential contributions to preventing language fossilization, especially in Arabic, through a systematic literature review. Most existing studies still focus on evaluating media or general learning effectiveness, without directly linking them to the linguistic and pedagogical aspects of fossilization (Faiz & Afrita, 2024; Li & Liu, 2022; Ritonga et al., 2024).

However, some literature tends to offer solutions based on optimistic assumptions about technology without strong empirical validation or a critical map of the factors that affect the success of digital strategies (Prihatini et al., 2023). In addition, conventional approaches that still

dominate teaching practices are often not responsive to promptly identifying and correcting errors, increasing the risk of fossilization (Annisa & Safii, 2023).s

Based on this gap, the current study is designed as a Systematic Literature Review (SLR), a method that enables researchers to produce a clear, transparent, and repeatable synthesis of the academic literature (Carrera-Rivera et al., 2022; Randles & Finnegan, 2023). To ensure the completeness and focus of this review, the PICOC framework (Population, Intervention, Comparison, Outcome, Context) is used to formulate specific research questions, as shown in Table 1.

Table 1. PICOC *(Population, Intervention, Comparison, Outcome, and Context)*

Element	Description	(PICOC)	(Synonyms)
Population	The target group or area of focus of the study.	Arabic Language Learner	1) Arabic language students 2) Arabic language university students 3) Arabic language class students
Intervention	The approach, strategy, or technology used to solve the problem.	Adaptive Digital Learning	1) E-learning 2) Arabic language apps 3) Educational technology 4) Blended Learning 5) Digital Language Learning Tools
Comparison	The comparison approach, if available, can include traditional methods or no intervention.	Conventional learning	1) Lecture 2) Traditional method 3) Face-to-face class 4) Non-digital approach
Outcome	The result or impact of the intervention on the group being studied.	Prevention of language fossilization	1) Reduction of linguistic errors 2) Improvement of communicative competence 3) Arabic language mastery 4) Effectiveness of language learning
Context	The situation or setting where the intervention and comparison take place.	Formal and non-formal Arabic language education institutions	1) Islamic boarding school 2) *Madrasah* (Islamic school) 3) University 4) Language class 5) Islamic educational institution

Based on the PICOC formulation as shown in Table 1, this study will answer the following research questions (RQ):

1) RQ1: What are the trends and main focuses of research related to the use of digital learning in Arabic language education?

2) RQ2: What types of linguistic errors are more likely to become fossilized in Arabic learning, and how have teaching approaches responded to them so far?
3) RQ3: What is the potential link between digital learning strategies and the prevention of fossilization in Arabic language education, based on the existing literature?

This study is expected to make a conceptual contribution by connecting linguistic theory, pedagogy, and digitalization. It also aims to provide practical benefits for teachers, curriculum developers, and educational institutions by enabling them to design Arabic language learning strategies that are more adaptive, innovative, and aligned with learners' needs, thereby helping to prevent or reduce fossilization in language learning.

2. Method

This study uses the Systematic Literature Review (SLR) approach, a method for systematically collecting, evaluating, and synthesizing previous research in a structured and focused way. This approach was chosen to gain a comprehensive understanding of language fossilization in Arabic language learning and the role of digital learning spaces in addressing it. By following a structured process, SLR enables researchers to build a clear, evidence-based understanding from relevant academic sources (Carrera-Rivera et al., 2022; Randles & Finnegan, 2023).

The literature search was conducted using Google Scholar, SINTA, Garuda, Publish or Perish (PoP), Research Rabbit, and Litmaps. The search strings were developed using Boolean combinations based on PICOC-related synonyms as follows:

("*fosilisasi bahasa*" OR "language fossilization"), ("*Pembelajaran Bahasa Arab*" OR "Arabic Language Learning"), and ("*pembelajaran digital*" OR "*media pembelajaran*" OR "E-learning" OR "*aplikasi interaktif*"

The selection of articles was based on several inclusion criteria, as shown in Table 2:

Table 2. Inclusion and exclusion criteria

Criteria	Inclusion	Exclusion
Year of Publication	2015 – 2025	Before 2015
Language	Arabic, Indonesian, or English	Other languages
Topic	Fossilization in Arabic language learning and digital learning	Not relevant to the main topic
Type of Document	Journal articles, conference proceedings, theses/dissertations, peer-reviewed	Popular articles, blogs, textbooks, not peer-reviewed
Document Access	Full text available	Only the abstract is available or not accessible
Journal Quality	Published in reputable journals (SINTA 1–4, DOAJ, Scopus, etc.)	Not indexed or from predatory publishers

Each article that passed the initial screening was evaluated against four criteria, with a score ranging from 0 to 1, as shown in Table 3. Articles with a total score of less than 2.5 out of 4 were excluded from the analysis stage.

Table 3. QA assessment checklist

No	Assessment Criteria	Score
1	Does the article explain a goal that matches the focus of this study?	0-1
2	Does it include precise empirical data or a strong theoretical basis?	0-1
3	Are the learning strategies or media explained clearly and in detail?	0-1
4	Does the article present results and limitations with critical reflection?	0-1

The final stage of this method is the data extraction process. In this step, essential information from each article, such as research objectives, approach, primary findings, and learning recommendations, is collected and organized by theme. From the screening process, around 30 main articles were selected for further analysis. These articles were taken from publications within the last ten years to reflect recent developments in the use of digital technology in Arabic language learning and in strategies to handle language fossilization. Because of this, the review is expected to provide a comprehensive and relevant picture of how digital learning can help prevent fossilization in Arabic language education. The steps below explain how the researcher selected and reviewed the articles using the PRISMA method:

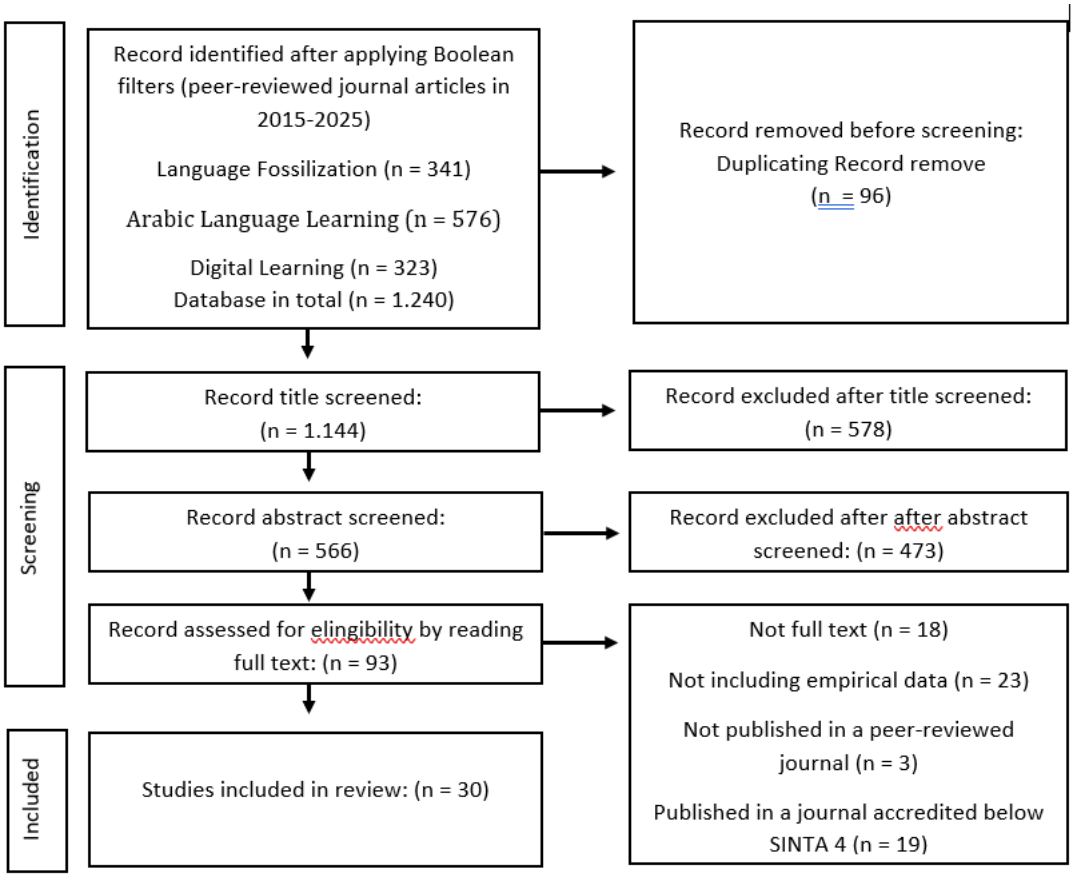

Figure 1. PRISMA Flow Diagram

The PRISMA flow, as shown in Figure 1 in this study, demonstrates that the selection process was conducted carefully to ensure that only publications genuinely relevant and of high quality were included in the final synthesis. In the first identification stage, 1,240 publications were found through Google Scholar, SINTA, Garuda, Publish or Perish, Litmaps, and Research Rabbit by using

keyword combinations related to fossilization, Arabic language learning, and digital learning. After removing 96 duplicate articles, 1,144 unique documents remained and were screened based on their titles. At this stage, 578 publications were removed because they did not align with the study's focus. Many of the removed articles discussed fossilization in other languages, such as English, Mandarin, and Japanese, and were therefore not relevant to Arabic language acquisition. There were also many titles on general digital learning, language learning other than Arabic, Islamic education without linguistic content, early childhood education, and non-academic publications such as opinions, activity reports, or popular writings. After this process, 566 articles continued to the abstract screening stage.

In the abstract screening stage, 473 publications were removed after a deeper review of their content. Many articles appeared relevant from the title, but the abstract did not discuss fossilization or linguistic errors, or mentioned them only briefly, without a clear research goal or analysis. Some publications discussed digital learning only in an administrative or managerial context, without explaining its pedagogical mechanisms or its impact on Arabic language competence. Others focused on motivation, perception, or media effectiveness with no link to linguistic aspects. Articles on languages other than Arabic were also removed, even if they appeared because of similar keywords. Based on these considerations, only articles that clearly explained the link between Arabic learning, digital strategies, and linguistic errors were kept for full-text assessment.

Of the 93 articles read in full, 63 were removed because the full text was not accessible, they did not provide empirical data or a strong theoretical basis, they were not published in accredited journals, or they were published in journals under SINTA 4. Following this rigorous process, 30 articles met all inclusion criteria and were included in the final synthesis. The distribution of selected articles is balanced. Eight articles are related to fossilization or error analysis, fourteen are related to Arabic learning, and eight are related to digital Arabic learning. This category of digital learning does not refer to general education technology but specifically to the use of LMS, e learning, digital media, or artificial intelligence-based tools in Arabic as a foreign language learning.

This distribution shows that even though research on Arabic learning and digital learning is quite extensive, studies that combine all three domains at the same time, Arabic learning, digital strategies, and fossilization or linguistic errors, are still limited. Therefore, the small number of final articles is not due to a weak search process, but is a logical result of strict PICOC-based selection criteria that ensure relevance, quality, and focus match the research questions. The stringent selection criteria enhance the validity of the SLR findings, ensuring that the final synthesis is based on credible and meaningful literature.

3. Results and Discussion

From all the literature found during the initial identification stage, 30 articles were selected as the primary sources relevant to the focus of this study. These articles were chosen based on the inclusion and exclusion criteria set earlier. The selected articles discuss topics such as fossilization in Arabic language learning, the use of digital learning, and teaching strategies that can help prevent fixed language errors. Data extraction was systematically carried out for these 30 articles using the PICOC framework as the basis for categorization. The extracted data was then presented in a table. This table presents key information, including the author, year of publication, study goals, methods, main contribution, and conceptual or methodological notes.

Based on the synthesis of these articles, the following discussion is structured to address the three research questions (RQs) in a step-by-step manner. It begins with trends in digital learning (RQ1), then examines the types of linguistic errors and how they are addressed (RQ2), and concludes with an analysis of the potential link between digital strategies and the prevention of fossilization (RQ3).

The literature review reveals that research on Arabic language learning has evolved in various directions. The main themes include the use of digital technology, pedagogical approaches, error analysis, and strategies for motivating and accommodating learning preferences. Some studies focus on digital platforms as the primary tool for learning. Budiarti et al. (2022) studied the use of Padlet as an LMS. They found that its ease of access and comprehensive features increase learning motivation and provide more equal opportunities (Budiarti et al., 2022). Nasution et al. (2023), Adang Asdari et al. (2022), and Nur Salsabila & Ardiansyah (2020) also showed that E-learning supports learning during the pandemic (Asdari et al., 2022; Nasution et al., 2023; Jasni & Ardiansyah, 2020). However, its use remains limited due to low teacher skills, low motivation, and limited devices. Hilmi & Ifawati (2020) noted that the blended learning model is effective when combined with monitoring of language habits; however, it still faces challenges related to teacher readiness and infrastructure (Hilmi & Ifawati, 2020).

Several studies highlight the role of smart technology and innovative media. Zaimah et al. (2024) found that AI-based chatbots give instant feedback, improve writing skills, and create an interactive learning experience (Zaimah et al., 2024). Anwar & Ahyarudin (2023) confirmed that AI in the era of Society 5.0 can provide adaptive, personal, and flexible learning through the Internet of Things (Anwar & Ahyarudin, 2023). In line with this, Mohideen (2024) from India explored the opportunities of using AI in Arabic learning for non-native speakers (Mohideen, 2024). He explained that the complex structure of Arabic and the variety of dialects necessitate new solutions, and that AI can offer personalization, chatbots, text generation, and even virtual reality to enhance learner engagement globally. Al-Obaydi & Pikhart (2022) also demonstrated

that visual media, such as pictures, can improve student motivation and confidence in taking risks in online learning. However, anxiety remains (Al-Obaydi & Pikhart, 2022).

In addition to technology, there is also a strong focus on pedagogical approaches and learning environments. Syamsu et al. (2023) proposed an integrative model combining listening, speaking, reading, and writing skills with linguistic, communicative, and cultural competences (Syamsu et al., 2023). Ilyas et al. (2024) supported this view by showing that Language Improvement Centres (LICs) in modern Islamic boarding schools are effective at creating an immersive environment that helps students use Arabic in daily life (Ilyas et al., 2024).

At the same time, error analysis remains an important focus. Zulaeha (2022) found many errors in the use of *ḥarf jar* (prepositions), *tarkib iḍafi* (genitive construction), *tarkib wasfi* (adjectival phrase), as well as *jumlah ismiyyah* (nominal sentence) and *fi'liyah* (verbal sentence) (Zulaeha, 2022). Mukroji et al. (2022) reported similar weaknesses in student academic writing, especially in the use of prepositions and nominal sentences (Mukroji et al., 2022). Wildi Adila (2019) also showed that grammatical errors, including subject–verb agreement errors, are frequently caused by first-language interference and overgeneralization (Adila, 2019). Jamil & Maulidah (2023) studied phonetic errors among junior high school students when reading Arabic texts, particularly in the pronunciation of hijaiyyah letters (Jamil & Maulidah, 2023). Hassan & Rami (2024) and Rajan et al. (2022) explained that second-language errors are not solely caused by first-language interference but also by cognitive, psychological, and intralingual factors (Hassan & Rami, 2024; Rajan et al., 2024).

Finally, some studies focus on motivation and learning preferences. Elvia Susanti et al. (2020) found that using PowerPoint increased student interest in learning Arabic by 25.7% because it was familiar and attractive (Susanti et al., 2020). Brosh (2019) added that students prefer practical strategies, such as interacting with teachers, speaking practice, and using flashcards (Brosh, 2019). Arifin et al. (2021) gave a different perspective by studying non-Muslim students, who prefer classroom-based strategies over independent learning outside class (Arifin et al., 2020).

Overall, this research map shows three main trends: first, the exhaustive exploration of digital technologies, from LMSs to AI, chatbots, and VR; second, the development of integrative pedagogical models and immersive environments; and third, the use of error analysis to improve teaching methods and support more contextual approaches. These studies confirm that Arabic learning in the digital era is not only about media but also about how technology, techniques, and understanding of linguistic errors are combined to build a learning process that is more effective, adaptive, and useful.

3.1. Trends and Main Focuses of Research on the Use of Digital Learning in Arabic Language Education

Based on a systematic review of 30 relevant articles, it can be identified that the main trends in Arabic digital learning research focus on the use of online platform-based media, innovations using artificial intelligence, and institutional policies that support E-learning.

One of the dominant trends is the use of Learning Management Systems (LMS) and Arabic learning websites. Studies show that platforms like Padlet can improve interaction between teachers and students in writing skills and digital presentations. Padlet provides features such as images, videos, and text, which help support different ways of delivering material (Budiarti et al., 2022). At the same time, websites for Arabic teachers, such as E-learning, have gained attention because they offer a variety of Arabic materials. These include reading, listening, and grammar structure activities, which are seen as suitable tools for online learning, especially during the pandemic (Asdari et al., 2022; Jasni & Ardiansyah, 2020).

Other studies show that AI-based methods and translanguaging are increasingly used in digital Arabic learning. Using bilingual chatbots has been shown to help students improve their writing skills by providing flexible, two-way interaction (Zaimah et al., 2024). This method combines the native and target languages, utilizing AI to provide automatic feedback. It shows strong potential to support personalized learning.

In addition to these main trends, recent research also points to the use of visual tools and real-life experiences in the design of online learning. Al-Obaydi and Pikhart (2022) explain how a visually based second-language learning approach, grounded in Kolb's experiential learning theory, works in online environments (Al-Obaydi & Pikhart, 2022). Their study found that using pictures during learning not only increases student motivation and confidence but also helps learners remember new words more naturally and meaningfully. These results show that visual tools can play an essential role in building communicative skills in online Arabic learning.

Besides focusing on learning tools and strategies, some studies also discuss policy issues and the challenges of applying E-learning at the institutional level. For example, a study at UIN North Sumatra found a gap between policy documents (such as the rector's decrees and technical guidelines) and the real implementation of digital Arabic learning in the field (Nasution et al., 2023). This shows that adopting technology is not only about using digital tools, but also about preparing the entire system and the people involved. The COVID-19 pandemic also pushed institutions to embrace technology more rapidly in Arabic instruction. A study at UIN Jakarta showed that E-learning was not only used as an emergency response but later developed into a strategic solution, with high student participation and satisfaction, even though technical problems and differences in teaching methods persisted (Asdari et al., 2022).

Institutional policy and digital infrastructure readiness are essential factors for the success of Arabic E-learning. Research by Hanifah et al. (2022) showed that the success of the Arabic Teacher Professional Education Program depended heavily on institutional support through platforms like SPADA and SPACE LMS, as well as students' readiness to use digital devices, access the internet, and learn through online materials (Hanifah et al., 2022). The study highlights that the effectiveness of online learning depends not only on technology but also on the system, the curriculum, and teachers' digital skills.

From these findings, the main trends in Arabic digital learning research can be grouped into three areas: (1) the use of digital platforms such as LMS, websites, and apps to support language skills; (2) the integration of new technology like artificial intelligence and translanguaging to personalize learning; and (3) the role of policy and infrastructure readiness in supporting successful E-learning. Even though these innovations show strong potential to improve Arabic learning, current studies do not clearly explain how digital strategies can help prevent language fossilization, a common challenge in language education. In addition, technical problems, limited access, and the gap between policy and practice remain serious issues that need more attention in future research. Therefore, Arabic digital learning should not only focus on improving teaching quality and effectiveness, but also address language fossilization to help learners become more skilled and adaptable.

In line with these findings, several additional studies further expand the understanding of digital learning trends in Arabic education. Ilmiani and Miolo (2021) emphasize the use of social media platforms such as WhatsApp, Instagram, Facebook, and YouTube in supporting the four language skills (listening, speaking, reading, and writing) (Ilmiani et al., 2021). Their research highlights the role of digital literacy and the creative use of social media as alternative tools for interactive Arabic learning. Anwar (2023) focuses on the integration of artificial intelligence in the era of Society 5.0, demonstrating how AI enables adaptive, interactive, and personalized learning experiences while laying the foundation for responsive curricula (Anwar & Ahyarudin, 2023). Similarly, Mohideen (2024) explores theoretical frameworks for implementing AI in Arabic instruction for non-native speakers, noting its contributions through instant feedback, chatbots, and even virtual reality applications (Mohideen, 2024).

Meanwhile, research by Arifin et al. (2020) highlights the strategies used by non-Muslim students in learning Arabic at Universiti Kebangsaan Malaysia (Arifin et al., 2020). Although not specifically digital, their findings underscore the importance of learner diversity and the role of learning strategies both inside and outside the classroom, reminding us that digital initiatives must also accommodate different learner backgrounds. Hilmi and Ifawati (2020) add another critical dimension through blended learning, which proved effective during the pandemic by

combining face-to-face and online learning, while maintaining language habituation (Hilmi & Ifawati, 2020). Susanti et al. (2020) demonstrate that even simple digital media, such as PowerPoint, can significantly increase students' motivation to learn Arabic, showing that technological innovation need not be advanced to be effective (Susanti et al., 2020).

Finally, Ahmadi et al. (2024) show that digital learning trends also extend to the management level. Their study identifies three stages of digitalization in Arabic language learning management: curriculum revision, the use of interactive technology-based models, and continuous monitoring and communication between lecturers and students (Ahmadi et al., 2024). This managerial perspective reveals that digitalization is not only a pedagogical tool but also a strategic framework for institutions to optimize Arabic education.

Therefore, the extensive literature confirms that research on digital Arabic learning spans a broad spectrum, from social media and simple digital media to AI-driven personalization and institutional digital management. Together, these trends underscore that the future of Arabic education in the digital era necessitates both pedagogical innovation and systemic preparedness, ensuring that digital strategies address technical, motivational, and institutional challenges while paving the way for solutions to language fossilization.

3.2. Types of linguistic errors that tend to become fossilized in Arabic Language learning, and how teaching approaches have responded to them

Linguistic fossilization in Arabic language learning poses a significant challenge in many educational institutions, including both formal ones, such as universities, and non-formal ones, such as modern boarding school. Fossilization occurs when specific language errors persist, even after learners have received long-term exposure and practice. This shows that there is a form of stagnation in deep, systematic language learning (Selinker, 1972). In Arabic learning, this problem often occurs in morphology, syntax, and vocabulary. The situation worsens due to the influence of the mother tongue and teaching methods that are not grounded in real-world contexts.

Several studies show that the difficulty in understanding Arabic structure often comes from learning practices that focus too much on memorizing vocabulary without context and give little authentic input. Zulaeha (2022) found that Arabic language education students often make grammatical mistakes in writing Arabic composition, especially in the use of prepositions, genitive construction, adjectival phrases, verbal sentences, and nominal sentences (Zulaeha, 2022). These errors are not only technical but also indicate a weak application of grammar structure and morphology rules in productive skills. In the same way, Mukroji et al. (2022) identified elemental weaknesses in the thesis titles of students, such as morphological and syntactic mistakes in prepositions, adjectival phrases, and nominal sentence structures (Mukroji et al., 2022). These findings confirm that repeated and persistent errors in Arabic learning do not only stem from

students but also reflect a learning stagnation that is overly focused on memorization and provides insufficient space for understanding and real application.

Beyond morphology and syntax, fossilization also appears in writing skills. Al Khateeb (2022) finds that Arabic as a foreign language learners repeatedly make grammatical errors in writing during virtual exchange programs (Al Khateeb, 2022). Unlike mechanical errors common in English as a Foreign Language writing, these AFL errors are deeply structural, showing how fossilization in Arabic affects productive skills. Similarly, research on Arabic writing by Syaifuji et al. (2021) identifies repeated errors in syntax, vocabulary, spelling, and punctuation (Syaifuji et al., 2021). Both studies emphasize that teacher feedback and collaborative learning are key in addressing fossilized writing errors.

Phonological fossilization has also been documented. Huddin & Sapar, (2022) show that Malay learners struggle with consonants such as ض, ط, ق, ع, ص, ح, and خ. These sounds often remain mispronounced due to differences in the native phonological system and the learner's age, especially those above 15 years old. To address this, they propose the air pressure control technique, a phonetic training method that helps learners manage articulation more accurately. This finding adds a new dimension to fossilization studies, moving beyond morphology and syntax to phonological skills.

From a broader perspective, Wildi Adila (2019) confirms that fossilization in Arabic is also strongly connected to cross-linguistic influence (Adila, 2019). Her study of Arabic language students found repeated structural errors, including nominal sentences, genitive construction, verb usage, and prepositions. These mistakes occur because of first-language interference and the application of rules without a complete understanding. The findings show that fossilization is not only a learner's problem but also the result of teaching approaches that fail to provide enough contextual practice.

The leading cause of this fossilization does not come only from learners themselves, but also from unresponsive teaching methods. Many schools still employ one-way lectures, memorization of texts, and passive grammar instruction, which do not provide students with opportunities to apply the language in real-life situations. Rajan et al. (2024) noted that both interlingual and intralingual errors can become fixed habits if not appropriately handled (Rajan et al., 2024). For example, the subject-verb-object (SVO) pattern in Indonesian and the verb-subject-object (VSO) pattern in Arabic often lead to repeated word-order mistakes, which are difficult to correct without explicit, form-focused instruction. This condition shows that traditional methods frequently fail to build practical language skills.

In response to these challenges, innovative approaches are being adopted. Syamsu et al. (2023) suggested an integrative learning model that brings together the four main language skills,

which are listening, speaking, reading, and writing, into one meaningful and contextual learning process (Syamsu et al., 2023). This model focuses on combining language skills with other themes such as religious studies, Islamic history, or Islamic economics. At the same time, the neurolinguistic approach developed by Jailani et al. (2021) underscores the importance of engaging both hemispheres of the brain during language learning (Jailani et al., 2021). This method helps students not only to memorize but also to understand and feel the meaning of the language through emotional and physical experiences. Another innovation comes from modern boarding school. Ilyas et al. (2024) explained that Language Improvement Centres (LICs) have successfully created an immersive environment for learning Arabic (Ilyas et al., 2024). These centres offer intensive programs based on practice and honest communication, which help reduce fossilization because students use the language regularly in everyday situations, both inside and outside the classroom.

In addition, Brosh (2019) stressed the vital role of teachers in preventing repeated language errors. According to students, good Arabic teachers are not only those who understand the material but also those who give clear feedback, are patient when correcting mistakes, and understand the language challenges from the learner's perspective (Brosh, 2019). Teachers who can notice common error patterns and explain corrections clearly in context are seen as very helpful in preventing the development of incorrect language habits. So, successful teaching does not only depend on the method but also on the quality of the interaction between teachers and students.

Further studies extend these findings by identifying additional types of fossilized errors and pedagogical responses. Interlanguage fossilization often arises from negative transfer from the mother tongue, a lack of authentic input, and an overreliance on rote memorization. These factors cause morphological simplification and persistent word order errors that are difficult to correct. Similarly, research by Jamil and Maulidah (2023) in Indonesia shows that frequent errors include grammar mistakes in nominal and verbal sentences, and incorrect use of prepositions (Jamil & Maulidah, 2023). These empirical results confirm that fossilization is deeply tied to structural aspects of Arabic grammar.

Taken together, these studies show that fossilization in Arabic learning occurs across multiple dimensions: morphology, syntax, vocabulary, writing, and phonology. The causes range from cognitive and linguistic transfer to methodological weaknesses and limited exposure. Teaching responses also need to be equally diverse: integrative learning models, neurolinguistic approaches, immersive environments, explicit phonetic training, collaborative digital platforms, and clear corrective feedback from teachers.

Because of this, fossilization in Arabic learning is not just a result of student mistakes. It also

shows that some teaching approaches may no longer match today's learning needs. To break the cycle of repeated language errors, we need a new kind of teaching that connects cognitive, emotional, and real-life elements. Approaches such as integrative learning, neurolinguistics, and language-rich environments offer honest and practical ways to help students build stronger, more useful, and lasting Arabic skills.

3.3. The Potential Relationship Between Digital Learning Strategies and the Prevention of Fossilization in Arabic Language Learning Based on the Literature

Although no study directly examines the relationship between digital learning strategies and the prevention of fossilization in Arabic language learning, recent research suggests that digital innovations have strong potential to help reduce repeated language errors. As discussed in RQ2, fossilization results from repeated mistakes that are not corrected. This often occurs due to a lack of clear feedback, limited awareness of language form, and poor use of reflection during learning (Burhanuddin, 2024a; Jailani et al., 2021). In this situation, digital technology can serve not only as a tool for delivering materials but also as a means to correct mistakes and support students' thinking processes in more active, adaptive ways.

Digital strategies using Learning Management Systems (LMS) and interactive websites have shown promising potential in preventing fossilization. Studies by Budiarti et al. (2022) and Asdari et al. (2022) found that platforms such as Padlet and the Arabic Teacher E-learning Website enable students to practice various language skills through multimedia content (Asdari et al., 2022; Budiarti et al., 2022). One crucial feature is peer review and teacher feedback, which help students detect and fix errors before they become permanent. The flexible format of digital platforms also allows students to review materials and check their corrections at any time, which helps deepen their understanding and reduce the chance of fossilization.

More recent approach involves the use of artificial intelligence (AI), especially chatbots with translanguaging features. Research by Zaimah et al. (2024) showed that using bilingual chatbots gives students automatic corrections for word choice, sentence structure, and vocabulary use in context (Zaimah et al., 2024). This real-time correction is very different from traditional methods, which often delay feedback and allow errors to build up. In addition, the use of translanguaging in AI helps connect the first and target languages. This method can reduce negative language transfer and strengthen students' control over their language use, which is essential for preventing fossilization.

Digital learning can also be used to combine different language skills into a single instructional design, such as the integrative learning model proposed by Syamsu et al. (2023). In this approach, listening, speaking, reading, and writing are taught together in a thematic context that encourages students to be more active in the learning process. Digital platforms like LMS

support this integration through features such as written assignments, audio recordings, and both live and delayed discussions. This combination helps students become more aware of language forms clearly and reflectively, which are two crucial factors in breaking the cycle of repeated mistakes. In addition, a digital immersive environment can work like the Language Improvement Centres described by Ilyas et al., (2024), which promote continuous and functional interaction. This has proven to help reduce fossilization.

The success of digital strategies in preventing language fossilization also depends on teachers' roles as instructional designers who understand pedagogy. Brosh (2019) emphasized the importance of teachers planning digital learning activities that are not only technology-based but also grounded in understanding the common mistakes students make. Good teachers are those who use technology to provide precise feedback, guide students to correct their mistakes in context, and help them process and fix their errors more deeply. Therefore, the success of digital strategies in stopping fossilization depends on a strong connection between technology, teaching methods, and the teacher's understanding of language problems.

In addition, visual elements and real-life experiences, as discussed in RQ1, have strong potential for preventing fossilization, particularly when they help students notice and understand language forms. Al-Obaydi & Pikhart, (2022) found that using visuals and experience-based learning can increase students' emotional and mental involvement. This supports their understanding of the target language in a more meaningful way. By building stronger links between visual input, context, and sentence structure, this approach helps avoid mistakes that students often memorize without truly understanding them.

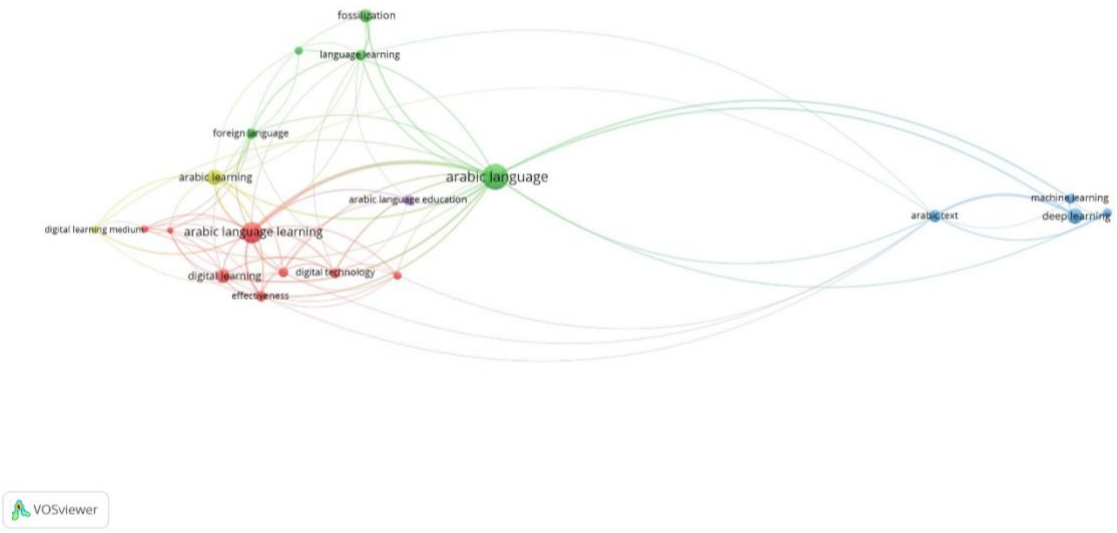

Figure 2. Bibliometric map

Besides these thematic findings, the bibliometric map gives visual evidence that strengthens

the connection between digital strategies, Arabic language learning, and the issue of fossilization. The VOSviewer visualization shows three main clusters, as shown in Figure 2. The green cluster includes fossilization and language learning. The red cluster includes digital learning, digital technology, and Arabic language learning. The blue cluster provides machine learning, deep learning, and Arabic text. The lines connecting the clusters indicate that these three themes often appear together in the literature. This suggests that digital technology and AI innovation are moving closer to the study of linguistic errors in Arabic language learning. It also supports the interpretation that digital strategies have real potential to prevent fossilization.

In conclusion, the connection between digital learning strategies and fossilization prevention lies in the ability of digital learning to create a rich, reflective learning environment that uses multiple media and includes real interaction. Digital learning not only provides access to a wide range of materials but also allows students to detect and fix their errors more frequently and in a personal way. However, to fully reach this potential, teaching design must consider how fossilization works, and teachers need to improve their skills in using technology not just as a tool for delivering content, but as a way to help correct mistakes. In the future, Arabic language curricula need to recognize the critical role of digital technology as a systemic solution to stop repeated language errors and to help students build complete, flexible, and communicative language skills.

4. Conclusion

This study shows that digital learning strategies hold strong potential to prevent fossilization in Arabic language learning, especially when integrated with appropriate pedagogical approaches. Through a systematic review of 30 academic publications, the study found that digital tools such as LMS, AI-based chatbots, and online learning platforms not only enhance access and motivation but also provide instant feedback and repeated practice, two essential mechanisms for interrupting the formation of persistent linguistic errors. However, the effectiveness of these tools depends greatly on instructional design, teacher competence, and institutional support; without these elements, technology risks becoming a passive medium that fails to address fossilization. Therefore, the study emphasizes the need for a strong alignment between technological innovation, integrative teaching methods, and flexible instructional strategies to help learners develop more accurate and confident Arabic language use. The synthesis presented in this research contributes both theoretical and practical insights by identifying a clear direction for future studies: the development of adaptive digital platforms that offer personalized feedback loops, demonstrating how technology can advance from merely supporting instruction to becoming an active agent in preventing fossilization in Arabic language learning.

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