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Mapping Technology, Impact, and Challenges in Nahwu Learning: A Systematic Review (2020–2025)

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Abstract

This systematic literature review examines technological innovations in Nahwu learning in Indonesia from 2020 to 2025, focusing on three dimensions: types of technology used, educational impact, and implementation challenges. Using the PRISMA framework, 20 peer-reviewed articles were selected based on clear inclusion and exclusion criteria. The findings reveal that Android-based mobile applications, educational games, web platforms, and AI-powered tools are most commonly used, with recent trends favoring adaptive and interactive solutions. These technologies have enhanced student motivation, understanding, and learning flexibility. However, significant challenges persist, including limited infrastructure, low digital literacy among teachers and students, and the need for media tailored to Nahwu's unique characteristics. Unlike previous reviews, this study holistically synthesizes innovations, impacts, and contextual obstacles, highlighting a research gap in technology integration specific to Nahwu instruction. Limitations include the relatively small number of eligible studies and the potential for publication bias. The review recommends developing context-appropriate learning media, strengthening teacher training, and improving infrastructure to maximize the transformative potential of technology in Nahwu learning. Comprehensive and adaptive strategies are essential to ensure effective and equitable technology integration, supporting the evolving needs of students and educators in the digital era.

Keywords

Digital Learning, *Nahwu* Learning, Systematic Literature Review, Technological Innovation.

INTRODUCTION

Arabic language learning has become integral to educational systems across various countries, particularly in those with significant Muslim populations. Nahwu, as a fundamental branch of Arabic grammar, plays a crucial role in comprehensive language acquisition for communicative, academic, and religious purposes (Afandi et al., 2024; Asy'ari, 2016). The ability to understand Arabic grammatical structures facilitates language learning and provides access to the intellectual treasury contained in classical and modern Arabic literature. In the digital transformation era, technological innovations in learning offered various potentials to revitalize Nahwu instruction, which has traditionally been perceived as complex and conventional. Adinda et al. (2024) in their analysis of psycholinguistic roles in Arabic language learning, that technology-based methods facilitate more effective cognitive engagement with grammatical structures. Meanwhile, Azizah et al. (2024) underline how the development of Arabic language learning in Indonesia from the 19th to 21st centuries has been increasingly characterized by technological integration as a response to contemporary demands.

Nahwu learning faces several challenges, notably the limitations of conventional methods and unequal access to educational technology. Traditional approaches, often deductive and focused on memorizing grammar rules without context, result in students who understand the theory but struggle with practical application (Anshari, 2024; Asy'ari, 2016). Abdilah & Al Farisi (2023) found that students perceive Nahwu as difficult and monotonous. Additionally, there is a limited understanding of how technology influences motivation, engagement, and achievement in Nahwu learning (Rahma & Ismail, 2025). Jamil & Agung (2022) highlight that disparities in digital implementation have led to unequal learning experiences, as some institutions adopt innovations while others stick to traditional methods.

Incorporating technology into Nahwu instruction is a complex process that requires careful pedagogical considerations and a range of interrelated challenges. Limited technological infrastructure, especially in rural or underserved regions—significantly hinders equitable access to digital learning resources (Baroroh, 2025). Resistance from educators used to traditional methods and fears of losing cultural elements further complicate the process. Arif et al. (2023) noted tensions in Islamic boarding schools between preserving traditional grammar depth and embracing modernization. Socio-cultural factors, including integrating local wisdom to increase the contextual relevance of Nahwu learning, also play a vital role (Nurjannah & Wisudawati, 2025). Additionally,

Wahyuni et al. (2023) also emphasized that grammar is essential to developing Arabic listening and speaking skills, which should inform technological innovation. Integrating technology should aim for meaningful pedagogical change, not just replacing conventional methods.

Despite many studies that have explored Arabic language learning, there remains a notable gap in research that holistically examines technological innovations, their impacts, and implementation challenges in Nahwu instruction. For instance, while Rishanda et al. (2025) investigated AI use in independent Nahwu learning, they did not address long-term effects or implementation barriers. Similarly, Khurrosyidah et al. (2024) focused on collaborative learning through the Jigsaw model but lacked a clear link to technology and its outcomes. Sagala (2023) and Nuryadin et al. (2024) contributed valuable reviews on Arabic grammar and Sharaf learning strategies but did not center on technology. Simon et al. (2025) discussed collaboration in Arabic learning without tying it to tech-related challenges in Nahwu. Royani et al. (2024) also found limited research in graduate theses addressing these critical intersections. These studies highlight the urgent need for more integrated and focused studies on how technology shapes Nahwu learning, which is crucial for the future of Arabic language education.

While previous studies have explored various aspects of Arabic grammar learning including the use of AI (Rishanda et al., 2025), collaborative models (Khurrosyidah et al., 2024), and strategic grammar instruction (Sagala, 2023; Nuryadin et al., 2024), none have provided a comprehensive synthesis that explicitly maps the intersection of technology, pedagogical outcomes, and implementation challenges specific to Nahwu instruction. This study fills that gap by offering an integrated and systematic review of recent innovations, not merely describing technologies but critically analyzing their educational implications and barriers to adoption. Thus, this article offers a novel contribution by positioning itself at the confluence of Arabic grammar pedagogy and digital transformation, a perspective that has been underrepresented in existing literature.

This study addresses the urgent need to explore technological innovations in Nahwu learning by identifying existing tools, analyzing their educational impact, and examining implementation challenges. Understanding these three dimensions is essential for shaping effective and relevant instructional strategies in the context of rapid digital transformation. Through a systematic literature review of publications from 2020 to 2025, this study focuses on: (1) identifying technologies used in Nahwu instruction, (2) evaluating their effects on student motivation, engagement, and achievement, and (3) examining key implementation challenges. This research

aims to bridge traditional grammar teaching with digital innovation and contribute to the development of evidence-based educational practices in Nahwu learning.

METHOD

This study employs a qualitative research method utilizing a Systematic Literature Review (SLR) approach to explore various technological innovations in Nahwu learning. The SLR approach was chosen due to its structured methodology in identifying, evaluating, and interpreting all relevant studies to a particular research topic, enabling the researcher to obtain a comprehensive overview of technological trends (Fernández-Sáez et al., 2010). The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework guided the review process, ensuring transparency and reproducibility in reporting the study's findings.

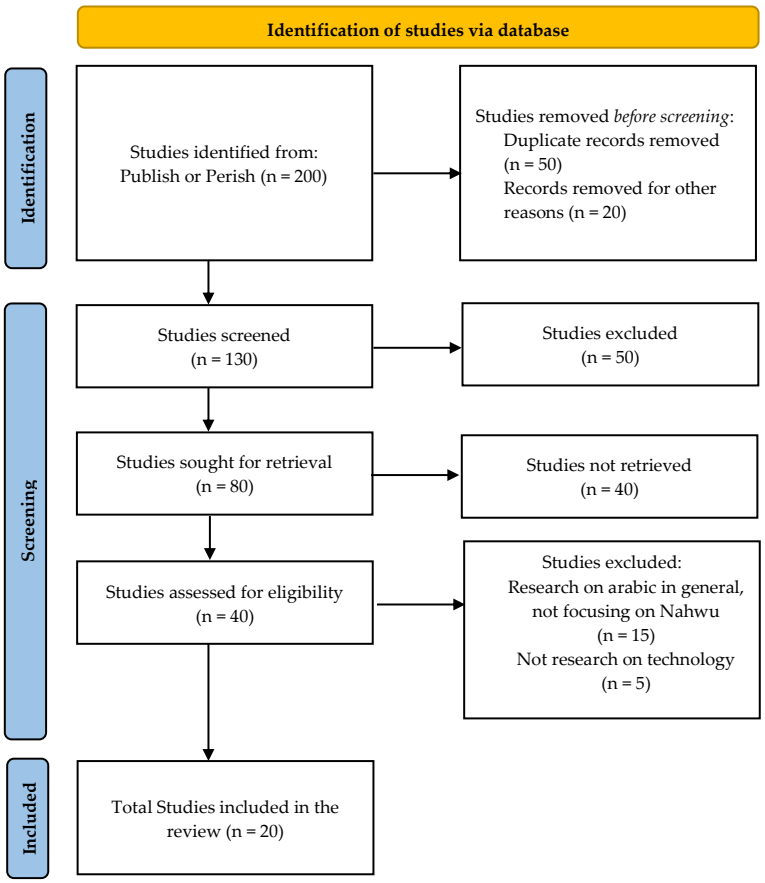
The initial stage involved formulating research questions focusing on what types of technology are used in Nahwu instruction and what impacts and challenges are associated with their implementation. Specific inclusion and exclusion criteria were established to ensure a focused and rigorous review. These criteria were formulated based on the research questions, which aimed to explore the types of technology used in Nahwu instruction and the associated impacts and implementation challenges. The April literature search used the Publish or Perish application and academic databases. The inclusion and exclusion criteria applied in this study are summarized in table 1:

Table 1. Criteria Inclusion and Exclusion

Criteria	Inclusion	Exclusion
Publication Year	Publish between (2020-2025)	Publish before 2020
Type of Publication	Peer-reviewed journal articles or conference papers	Non-peer-reviewed sources, such as editorials or opinion pieces
Topic Relevance	Technology-based *Nahwu* learning, Arabic grammar and educational technology, innovation in *Nahwu* instruction, interactive media for Arabic grammar.	Does not comprehensively cover the combined topics or focused only on partial aspects.

This selection process is summarised in the PRISMA flowchart in Figure 1.

Figure 1. PRISMA Flowchart



The PRISMA flowchart outlines the systematic process to identify and select relevant studies for this literature review. Initially, 200 records were identified through the Publish or Perish database. Before screening, 50 duplicate entries were removed, and an additional 20 records were excluded for various reasons, including inaccessibility and lack of relevance to the research topic. Following this initial stage, 130 studies were subjected to title and abstract screening. Of these, 50 studies were excluded due to misalignment with the inclusion criteria, resulting in 80 articles selected for full-text retrieval. However, 40 of these studies could not be accessed in full due to restricted availability or retrieval issues. The remaining 40 full-text articles were assessed for eligibility. At this stage, 15 studies were excluded for discussing Arabic language education in general without specific reference to Nahwu, and 5 studies were excluded because they did not involve technological aspects of instruction.

Ultimately, 20 articles met the inclusion criteria and were incorporated into the qualitative synthesis. This rigorous selection process ensured that only studies directly relevant to technological innovations in Nahwu instruction were included, thereby strengthening the validity and focus of

the review findings. The 20 eligible studies were selected for in-depth analysis. Each article was reviewed using qualitative content analysis. The themes were synthesized to identify the technologies employed, the grammatical content covered, the target learner groups, and the impact and challenges encountered. To ensure the reliability of the findings, a pilot testing procedure was conducted using a small sample of articles to validate the inclusion and exclusion criteria. This step helped ensure the criteria's clarity, consistency, and appropriateness before applying them to the whole dataset and minimized potential bias during the review process.

FINDINGS AND DISCUSSION

Findings

The research data presented in this study consists of the results of analysis and synthesis of documented articles, particularly those related to technology in Nahwu instruction. These findings are systematically presented in Table 2, which outlines the identified articles and innovations in Nahwu learning technology; Table 3, which highlights the target users of Nahwu learning technologies; and Table 4, which details the Nahwu materials delivered through these technological platforms. Furthermore, the impacts and challenges associated with the use of such technologies are discussed in the discussion section.

1. Types of Technology Used in Nahwu Learning

To understand the trends in technology integration within Nahwu instruction, the identified innovations were grouped based on their platform or technical characteristics. This classification reveals the diversity of tools utilized and the technological preferences among educators and developers. Table 1 provides a comprehensive list of the technologies applied in the reviewed studies.

Table 2. Types of Technology Used in Nahwu Learning

No.	Technological Innovation	Study	Sum
1.	Interactive Whiteboard (IWB)	Masnun et al. (2025)	1
2.	Pawtoon – Web-based Learning Animation Media	Kafahulloh & Al Farisi (2024)	1
3.	*Qurtub.my.id* – Interactive and responsive web-based learning media	Richard & Thoyyibah (2024)	1
4	Quizizz	Al Azmi et al. (2023)	1
5.	*NAHMA* – Android-based educational game using Unity 3D	Azkia (2022) Hasyim et al. (2022)	2
6.	*Petualangan Fikri dan Fatimah* – Android-based Educational	Kusumodestoni et	1

	Games; Backpropagation	al. (2019)	
7.	Android-based iSpringSuite	Fadilah & Sulaikho (2022), Hasan & Sulaikho (2020)	2
8.	AI – Chat GPT, Disco, Viva Learning, Kahoot! AI, Chatsonic	Afrianti (2025), Rishanda et al. (2025)	2
9.	*TANYA ZAID* – Chatbot Telegram	Astari et al. (2023)	1
10.	H5P App (HTML5 Package)	Sultoni et al. (2021)	1
11.	Offline access interactive digital application	Abdulhakim et al. (2025)	1
12.	*NahShorNa* – Adobe Flash CS5-based application	Ma'arif et al. (2020)	1
13.	WhatsApp	Auliya & Anwar (2024), Musonif et al. (2023)	2
14.	*Arruz* App – Android-based mobile learning app	Sulhadi (2020), Taufik et al. (2020)	2
15.	Articulate Storyline 3 App – Interactive platform with video animations, practice questions	Al-Ansori et al. (2023)	1
	Total Articles		**20**

As shown in Table 2, of the 20 articles reviewed, Nahwu learning technologies are predominantly based on Android and mobile learning platforms (7 out of 15 types) due to their flexibility across various educational levels. AI- and chatbot-based technologies have started to appear in more recent studies (2023–2025), indicating a new trend toward learning automation and adaptive learning. Meanwhile, interactive media such as Articulate Storyline and H5P reflect efforts to enhance visual engagement and hands-on practice. However, few studies utilize social media platforms like WhatsApp, despite their strong potential to reach a wider audience with limited access to advanced technology.

2. User Target

Understanding the user demographic is essential to evaluate the inclusivity and appropriateness of technological implementations. Table 2 categorizes the intended users based on educational level, providing insight into the reach and focus of the studied technologies.

Table 3. User Target

No.	User Target	Technology	Study	Sum
1.	High School/MA Students	Interactive Whiteboard (IWB), Qurtub.my.id, Interactive digital app, WhatsApp	Abdulhakim et al. (2025), Masnun et al. (2025), Musonif et al. (2023), Richard & Thoyyibah (2024)	4
2.	Junior High School/MTs	Pawtoon, iSpringSuite,	Fadilah & Sulaikho (2022), Hasan	5

	Students	NahShorNa	& Sulaikho (2020), Kafahulloh & Al Farisi (2024), Ma'arif et al. (2020), Sultoni et al. (2021)	
3.	Elementary School/MI Students	Android-based Educational Games	Kusumodestoni et al. (2019)	1
4.	College Students	Quizizz, Articulate Storyline, Kahoot! AI, Disco, Viva Learning, *NAHMA,* Arruz *App*	Al-Ansori et al. (2023), Al Azmi et al. (2023), Afrianti (2025), Hasyim et al. (2022), Sulhadi (2020)	5
5.	All Levels/General Public	WhatsApp Application, Mobile Learning, ChatGPT, Tanya Zaid, Android-based Educational Games	Astari et al. (2023), Auliya & Anwar (2024), Azkia (2022), Rishanda et al. (2025), Taufik et al. (2020)	5
		Total Articles		**20**

Table 3 shows that most Nahwu learning technologies target junior high school students and college students, who generally have independent learning abilities and access to digital technology. Meanwhile, only one study focuses on elementary-level (MI/SD) students, indicating a lack of attention toward technological approaches for early-age learners. On the other hand, five studies developed media for all education levels or the public, reflecting efforts to expand Nahwu learning access inclusively. The technologies used for this group are familiar and straightforward, such as WhatsApp and chatbots, tailored to the technological capabilities of general users.

3. Nahwu Learning Materials

The final aspect analyzed is the range of Nahwu topics covered by the digital tools. This evaluation allows us to assess whether technology has been leveraged merely for foundational knowledge or extended to deeper syntactic exploration. Table 3 details the materials delivered across the reviewed articles.

Table 4. Nahwu Learning Materials

No.	Material	Study	Sum
1.	Basic Knowledge of *Nahwu*-Sentence Structure (*isim*, *fi'il*, *harf)*	Auliya & Anwar (2024), Azkia (2022), Hasan & Sulaikho (2020), Kafahulloh & Al Farisi (2024), Ma'arif et al. (2020), Richard & Thoyyibah (2024), Sulhadi (2020)	9
2.	*Jumlah Ismiyyah* and *Fi'liyyah*	Al Azmi et al. (2023), Sultoni et al. (2021)	2
3.	Various *Isim* and *Fi'il*	Astari et al. (2023), Fadilah & Sulaikho (2022)	2
4.	*Mubtada'-Khabar*, *Iʿrāb*	Al-Ansori et al. (2023), Al Azmi et al. (2023), Afrianti (2025), Hasyim et al. (2022), Masnun et al. (2025), Musonif et	7

al. (2023), Rishanda et al. (2025)	
Total Articles	**20**

Table 4 above shows that the most dominant Nahwu material is the introduction to basic sentence elements (isim, fi'il, harf), indicating that learning technologies are primarily used to strengthen foundational concepts in Nahwu. Meanwhile, topics such as Jumlah Ismiyyah, Jumlah fi'liyyah, and Iʿrāb have begun to be introduced through digital media, but not as extensively as the basic materials. The table reveals a gap in developing technologies for advanced topics or complex syntactic analysis. AI and interactive media are expected to help bridge this gap through approaches based on adaptive practice and automated analysis.

Discussion

The review of 20 articles shows that technological innovations in Nahwu learning have developed rapidly through various forms of media and digital platforms. A dominant trend is observed in using Android-based mobile applications, educational games, and interactive web-based platforms such as H5P, Articulate Storyline, and Powtoon. Additionally, WhatsApp and Telegram have gained popularity, especially in pesantren and informal learning communities, owing to their accessibility and ease of use (Astari et al., 2023; Musonif et al., 2023). One prominent example is Qurtub.my.id, an interactive website designed for high school students offering comprehensive Nahwu content. This platform has been empirically validated as highly effective in enhancing student comprehension and motivation (Richard & Thoyyibah, 2024). Similarly, the Interactive Whiteboard (IWB) has significantly improved cognitive retention, student participation, and overall learning effectiveness in Nahwu instruction (Masnun et al., 2025). This finding aligns with prior research underscoring the role of interactive media in fostering student engagement (Giannikas, 2021).

Artificial Intelligence (AI) is increasingly shaping Nahwu education. Tools such as ChatGPT and the Telegram chatbot "TANYA ZAID" provide adaptive, self-paced learning opportunities with real-time feedback, facilitating student understanding of complex grammatical rules (Rishanda et al., 2025). However, their integration into formal curricula remains limited and requires careful pedagogical planning. Moreover, multimedia applications like Articulate Storyline and H5P offer rich, interactive content that makes abstract grammatical concepts more accessible and engaging. These tools effectively bridge the gap between passive content consumption and active syntactic analysis (Al-Ansori et al., 2023; Sultoni et al., 2021). Despite such advances, most technological tools

currently focus primarily on foundational sentence components, with fewer applications targeting advanced syntactic structures.

Technological innovations have positively influenced learner motivation, comprehension, flexibility, and active participation. Game-based platforms like Quizizz and Unity-powered educational games have transformed Nahwu learning from a traditionally tedious subject into a stimulating and engaging experience (Hasyim et al., 2022; Kusumodestoni et al., 2019). Supporting this, Richard and Thoyyibah (2024) reported that interactive web platforms such as Qurtub.my.id significantly improve motivation and understanding among high school and vocational students.

Empirical evidence also indicates improved learning outcomes associated with Android-based media, including iSpring Suite and other digital Nahwu applications. For instance, the Nahwu al-Basith application has been shown to enhance student achievement significantly and has been deemed feasible for broad implementation (Mustofa et al., 2024). The flexibility of access offered by mobile and web technologies enables learners to study anytime and anywhere. Telegram chatbots and WhatsApp channels facilitate autonomous learning through digital content delivery, quizzes, and interactive communication (Astari et al., 2023; Mustofa, 2020). Nonetheless, social media-based learning platforms tend to emphasize one-way content delivery and may lack depth in developing learners' analytical skills (Huwaida & Inas, 2024; Rishanda et al., 2025).

Interactive tools such as Interactive Whiteboards, Powtoon, and Articulate Storyline provide dynamic visual learning experiences aligned with diverse learning styles. These media enhance comprehension of complex and abstract grammatical structures, fostering active and autonomous learning processes (Kafahulloh & Al Farisi, 2024; Masnun et al., 2025).

Despite the promising potential of technology in Nahwu education, several challenges persist. Infrastructure disparities, especially in pesantren and rural schools, hinder equitable access to digital learning resources due to unstable internet connectivity and inadequate hardware (Mali et al., 2023; Richard & Thoyyibah, 2024). This digital divide exacerbates educational inequalities. Moreover, limited digital competencies among educators and learners hinder effective technology integration. Many Nahwu teachers lack sufficient skills to operate digital applications optimally, and students often require additional support to engage productively with technology-based learning (Haleem et al., 2022). Continuous teacher training and mentoring are critical for overcoming these obstacles (Cholidah & Muid, 2024). At the same time, adapting Nahwu materials into digital formats presents additional pedagogical challenges. Complex grammatical topics require not only

repetition but also structured guidance and meaningful context—features often missing from existing applications, which tend to emphasize mechanical exercises over deeper linguistic comprehension.

Finally, concerns over excessive screen time, distraction, and overdependence on technology have been raised, potentially reducing academic focus and critical thinking development(Pérez-Juárez et al., 2023). Furthermore, long-term sustainability of media use following initial implementation has rarely been examined (Masnun et al., 2025). These findings highlight operational and pedagogical barriers and reveal a deeper theoretical gap between the conceptual ideals of technology-enhanced learning and its practical implementation in the context of Nahwu education. While mobile and web-based platforms such as Android apps and Qurtub.my.id have demonstrated significant improvements in motivation and foundational understanding, their pedagogical frameworks often remain anchored in behaviorist paradigms that prioritize repetition over analytical engagement (Mustofa et al., 2024; Richard & Thoyyibah, 2024). Interactive tools like Articulate Storyline and Interactive Whiteboards offer greater support for advanced syntactic analysis, yet their integration remains limited due to infrastructural and skill-based constraints (Al-Ansori et al., 2023).

Furthermore, few platforms incorporate localized and culturally contextualized content, such as sentence examples from Nusantara Islamic literature, which has significantly enhanced learning retention (Richard & Thoyyibah, 2024). Most studies in the review also suffer from methodological limitations, including small sample sizes, short intervention periods (often less than one month), and lack of control for external variables such as teacher expertise or learner background (Masnun et al., 2025; Rishanda et al., 2025) There is also a paucity of long-term, comparative studies evaluating the sustained impact of different technologies after the conclusion of formal interventions.

In response to these challenges, this study proposes an "Adaptive Nahwu Learning Framework", which synthesizes principles from cognitive multimedia theory with classical Arabic grammar instruction. The framework emphasizes a balanced integration of digital interactivity with in-depth syntactic analysis, encouraging personalization and academic rigor. Practically, this calls for developing hybrid applications that leverage AI for learner-specific feedback while incorporating interactive, analytical modules for advanced grammar topics. It also necessitates formulating inclusive, adaptive, and context-sensitive national standards for Nahwu digital media

development. Lastly, sustainable progress in this field requires stronger collaboration between pesantren, universities, and educational startups to ensure that content development remains pedagogically sound, culturally relevant, and technologically feasible (Huwaida & Inas, 2024; Richard & Thoyyibah, 2024).

CONCLUSION

This systematic review demonstrates that integrating digital technologies in Nahwu instruction—such as mobile applications, interactive multimedia, and web-based platforms—substantially enhances students' motivation, comprehension, and flexibility. These findings deepen the understanding of how technology supports the acquisition of complex grammatical concepts while highlighting the necessity for developing contextually relevant learning materials and strengthening educators' digital competencies. Addressing challenges related to infrastructure limitations and insufficient specialized teaching tools requires coordinated strategies and stakeholder collaboration. The insights gained emphasize a balanced approach to technology adoption that aligns instructional methods with learners' needs and contemporary educational demands, thereby fostering meaningful advancements in Arabic grammar education.

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