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The Phenomenon of Lahn (Erroneous Recitation) in the Qur'an between Tradition and Modernity: An Analytical Study in the Light of Digital Technologies and Artificial Intelligence

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Abstract

This study explores the phenomenon of lahn (erroneous recitation) in Qur'anic reading from a perspective that bridges classical authenticity and modern technological approaches, aiming to uncover its phonetic, grammatical, and pedagogical dimensions within the framework of digital transformation. The research employs a descriptive–analytical methodology to present the concept, classifications, and effects of lahn on the comprehension of the Qur'anic text. It also analyzes the role of modern technologies—particularly artificial intelligence (AI) and machine learning—in detecting and correcting recitational errors. Furthermore, the paper discusses the impact of digital globalization and e-learning on the spread of lahn, as well as the educational and institutional efforts to prevent it. Findings indicate that the integration of traditional and digital learning systems represents the most effective path to ensure accurate Qur'anic performance, and that AI can serve as a valuable assistive tool when employed within a properly guided pedagogical framework.

Keywords: Qur'anic Lahn, Tajweed, Phonetic Performance, Digital Education, Artificial Intelligence, Deep Learning, Pedagogical Prevention.

Introduction

The Holy Qur'an stands as the supreme linguistic text in Arabic, embodying the highest standards of eloquence, phonetic precision, and rhetorical excellence. Its recitation in accordance with the rules of Tajweed is not merely a linguistic exercise but a form of worship that preserves both the sound and meaning of divine revelation. Consequently, the accuracy of Qur'anic recitation represents a foundational pillar in the preservation of Islamic knowledge, identity, and spiritual practice.

The phenomenon of lahn (erroneous recitation) has long occupied a central position in Qur'anic studies, particularly among scholars of Tajweed, grammar, and qirāʾāt. Its significance stems from its direct impact on semantic integrity, interpretative validity, and the authenticity of transmission. Errors in recitation—whether phonetic or grammatical—may compromise not only the aesthetic quality of the Qur'anic sound but also its theological and legal meanings, making the study of lahn an essential scholarly and pedagogical concern.

In the contemporary era, the importance of this topic has increased significantly due to the rapid expansion of digital learning environments. Millions of learners worldwide now rely on mobile applications, online platforms, and AI-based tools for Qur'anic education. While these technologies have democratized access and facilitated self-learning, they have also introduced new risks, including the widespread transmission of inaccurate recitation patterns, absence of expert supervision, and over-reliance on automated correction systems that may lack deep linguistic or contextual awareness.

Scholars traditionally divide lahn into two main types:
Major (manifest) Lahn (al-lahn al-jali), which alters meaning or grammatical correctness.
Minor (hidden) Lahn (al-lahn al-khafi), which affects phonetic quality without changing meaning.

This distinction remains fundamental for understanding the scope and implications of recitational error. Historically, the urgency to regulate Qur'anic recitation emerged in the early Islamic centuries—particularly from the first Hijri century—when linguistic diversity increased due to the expansion of Islam. This led to the development of precise phonetic and grammatical frameworks by leading scholars such as Ibn al-Jazari (d. 833 AH) and Abu 'Amr al-Dani (d. 444 AH), whose contributions continue to shape contemporary Tajweed and qirāʾāt studies.

In light of these developments, the present study addresses a critical and timely issue: how the phenomenon of lahn manifests and evolves within both traditional and digital contexts. It further examines the effectiveness of artificial intelligence in detecting and correcting recitational errors, and evaluates the extent to which technological tools can support—rather than replace—the established methods of oral transmission (mushāfahah). By doing so, the study seeks to contribute to the preservation of Qur'anic recitation in a rapidly changing educational landscape and to propose integrated frameworks that ensure both accuracy and accessibility.

Significance of the Study

The importance of this research lies in its focus on one of the most critical aspects of Qur'anic sciences: the preservation of accurate recitation (ṣaḥīḥ al-adāʾ) in both traditional and modern learning environments. As digital technologies increasingly mediate Qur'anic education, the study of lahn is no longer confined to classical theoretical discussions but has become a practical necessity affecting millions of learners globally.
This study is particularly significant for the following reasons:
• Preservation of Qur'anic Authenticity:

It contributes to safeguarding the phonetic and semantic integrity of the Qur'an by analyzing the causes and manifestations of recitational errors and proposing effective corrective frameworks.

• Enhancement of Digital Qur'anic Education:

The research evaluates the effectiveness of AI-based tools and digital platforms, providing insights into their strengths and limitations, thereby improving the quality and reliability of online Qur'anic learning.

• Bridging Tradition and Technology:

It offers a balanced model that integrates classical pedagogical methods—such as direct oral transmission—with modern technological tools, ensuring that innovation does not compromise authenticity.

• Educational Utility for Multiple Stakeholders:

The study is beneficial for:

Students and learners, by providing clearer understanding of common errors and methods of correction.

Teachers and Qur'anic instructors, by offering pedagogical strategies that combine traditional and digital approaches.

Developers of Qur'anic applications, by highlighting the need for linguistically accurate and pedagogically sound AI systems.

Academic researchers, by opening new interdisciplinary pathways between Qur'anic studies, linguistics, and artificial intelligence.

• Policy and Institutional Relevance:

The study supports educational institutions and regulatory bodies in developing standards for digital Qur'anic education, including certification of applications and implementation of quality-control mechanisms.

In essence, this research addresses a pressing contemporary need: ensuring that the increasing accessibility of Qur'anic education through technology is matched by a corresponding level of accuracy, supervision, and scholarly rigor. It thus underscores the practical utility and societal relevance of studying lahn in the modern digital age.

Research Problem

The research problem stems from the increasing prevalence of both phonetic and grammatical lahn in Qur'anic recitation, particularly within e-learning environments, where learners depend on unregulated digital applications without expert supervision.

This leads to the central research question:

Research Objectives

1. To analyze the concept, types, and causes of lahn in Qur'anic recitation.
2. To examine the impact of modern technologies and digital education on the spread of lahn.
3. To evaluate the effectiveness of AI-based tools in detecting and correcting Tajweed errors.
4. To propose pedagogical and technological mechanisms for preventing lahn in contemporary learning environments.

Research Questions

1. What is the concept of lahn in the Qur'an and what are its principal types?
2. How have digital education and online platforms influenced the spread of lahn?
3. How can artificial intelligence be utilized to correct recitational and phonetic errors?
4. What roles do Qur'anic educational institutions play in preventing lahn?

Research Methodology

This study adopts a descriptive-analytical approach, synthesizing both classical and modern literature on Qur'anic lahn and analyzing it in light of current technological and pedagogical developments. It also employs a comparative method to contrast traditional and digital teaching practices, alongside a qualitative analysis to assess the effectiveness of digital tools in improving Tajweed accuracy and Qur'anic performance.

Section One: The Concept and Theoretical Foundations of Lahn in the Qur'an

This section examines the linguistic, historical, and theoretical roots of the concept of lahn (recitational deviation) in the Qur'an, its classifications, and its phonetic and grammatical dimensions.

Definition of Lahn

In the context of Qur'anic recitation, lahn refers to any deviation from the accepted phonetic or grammatical norms established by experts of Tajweed and qirāʾāt (Ibn al-Jazari, p. 19; Abu 'Amr al-Dani, p. 58).

It can be classified into two main types:

1. Manifest (Major) Lahn – al-Lahn al-Jali

   This type of error directly alters meaning or grammatical accuracy, typically by changing letters, vowel marks, or syntactic endings, resulting in semantic distortion (Al-Nadwi, 2011, p. 45; al-Aʿẓami, 1992, p. 94).

   Examples include:

   - Letter substitution: e.g., replacing a hamzah ((ء with another consonant.
   - Vowel alteration: e.g., reading a fatḥah as a kasrah.
   - Case ending error: e.g., pronouncing anʿamta as anʿamti (Q 1:7).

   Such errors are clear, easily detectable, and may cause significant changes in Qur'anic meaning.

2. Hidden (Minor) Lahn – al-Lahn al-Khafi

   This category refers to errors that do not affect meaning directly but impair the phonetic beauty and precision of recitation, including mistakes in elongation (madd), nasalization (ghunnah), or articulation of letters (Al-Nadwi, 2011, p. 61).

   Examples include:

   - Insufficient or excessive elongation in madd (e.g., shortening the required 4–6 counts).
   - Incomplete nasalization in ghunnah or incorrect nasal tone.
   - Misapplication of phonetic features, such as softening an emphatic rāʾ or overemphasizing a light consonant.

   Prominent classical scholars who elaborated on these categories include:

- Ibn al-Jazari (d. 833 AH): In Al-Nashr fi al-Qirāʾāt al-ʿAshr, he established rigorous criteria for correct Qur'anic articulation and defined the boundaries of permissible recitation.

- Abu ʿAmr al-Dani (d. 444 AH): Author of Al-Bayān fi ʿAdd Āy al-Qurʾān, he codified orthographic and recitational standards for Qur'anic integrity.

Contemporary Understanding of Lahn

In the modern era, the concept of lahn has evolved beyond mere phonetic or grammatical errors to encompass educational and technological challenges in Qur'anic instruction—especially within digital and online environments (Al-Nadwi, 2011, p. 77; Suwaid, 2000, p. 66). Contemporary issues include over-melodization (excessive vocal ornamentation) and rapid or mechanical recitation, which may compromise comprehension and reverence (Ahmad & Rahman, 2023, p. 13; al-Aʿẓami, 1992, p. 103).

Several modern studies have addressed these developments:

- Ayman Rushdi Suwaid (2000), in Sharḥ al-Jazariyyah, analyzed recitational mistakes and proposed pedagogical models for addressing both manifest and hidden lahn.
- Muḥammad Muṣṭafā al-Aʿẓami (1992) highlighted the role of digital platforms and recording technologies—such as YouTube and Qur'an learning applications—in transmitting Qur'anic readings and their potential to both preserve and distort accuracy.
- Abd al-Fattah al-Nadwi (2011) emphasized that while digital learning democratizes access, unsupervised reliance on technology may facilitate the spread of improper recitation patterns lacking authentic auditory modeling.

Recent international research has expanded this discussion to include AI-driven Tajweed training.

For example:

- Al-Khatib & Hassan (2022) examined the effectiveness of speech-recognition algorithms in detecting Tajweed errors.
- Rahman et al. (2024) explored AI-based Qur'an training systems that employ machine learning for automatic correction of phonetic deviations.

Classification of Lahn

Based on scope and linguistic function, lahn in Qur'anic recitation may be categorized into three primary types:

(a) Phonetic Lahn

Relates to articulation and pronunciation in accordance with Tajweed rules—covering points of articulation (makhārij), phonetic attributes (ṣifāt), and rules of elongation and nasalization (Ibn al-Jazari, 833 AH, p. 64). Ibn al-Jazari regarded mastery of articulation and attributes as foundational to Qur'anic accuracy, and deviations therein as forms of hidden lahn that weaken recitational precision. Common phonetic errors identified in modern studies include weak control of nasalization, shortened elongation, and over-emphasis of emphatic letters (Al-Khatib & Hassan, 2022, p. 13).

(b) Grammatical Lahn

Involves syntactic or inflectional errors that alter sentence structure or meaning (al-Suyuti, 911 AH, p. 97; al-Zarkashi, 794 AH, p. 82). Such errors are among the most severe because they affect semantic accuracy directly. For instance, misplacing case endings (iʿrāb)—raising instead of lowering, or vice versa—can shift the verse's theological or legal import (al-Aʿẓami, 1992, p. 120). Recent research (Ahmad & Rahman, 2023, p. 16) has shown that learners using

digital platforms are prone to grammatical errors due to the absence of real-time expert correction, underscoring the ongoing need for human supervision in Qur'anic education.

(c) Melodic or Tonal Lahn (Maqāmic Deviation)

Refers to misuse of melodic modes (maqāmāt) in recitation. While enhancing one's voice in Qur'an recitation is commendable and encouraged in the Sunnah—"Beautify the Qur'an with your voices" (Musnad Aḥmad, vol. 3, p. 127)—it must remain within spiritual and aesthetic limits. Excessive or theatrical modulation (taṭrīb) that disrupts solemnity or meaning is considered prohibited melodic lahn (Al-Nadwi, 2011, p. 91). Modern research warns that social-media-driven recitational performances may prioritize aesthetic appeal over devotional intent, calling for balanced application of beauty and adherence to Tajweed discipline.

Section Two: Legal and Phonetic Regulations in Qur'anic Performance

This section outlines the legitimate boundaries and vocal regulations governing Qur'anic recitation, distinguishing between permissible beautification and prohibited melodic excesses.

1. The Legitimate Limits of Phonetic and Melodic Lahn

Beautifying one's voice in the recitation of the Qur'an is religiously encouraged and praiseworthy, provided it does not lead to semantic distortion or violation of Tajweed rules (al-Suyuti, 911 AH, p. 134). Classical scholars unanimously emphasized that improving the voice does not entail exaggerated singing or melodic performance, but rather aims to reveal the natural harmony and reverence of the Qur'anic soundscape. Ibn al-Jazari (833 AH, p. 72) asserted that the Qur'anic reader must enhance his voice without affectation, for excessive vocal manipulation may distort articulation points, fragment words, or disrupt the flow of recitation, all of which fall under the category of forbidden phonetic lahn.

Hence, permissible beautification (tahsin al-sawt) is that which:

- Preserves clarity of letters and meanings,
- Enhances spiritual engagement and listener reverence, and
- Avoids artificial or theatrical modulation that contradicts the humility of worship.

2. Prohibited Melodic Modulation (al-Taṭrīb al-Mamnūʿ)

Prohibited taṭrīb refers to overly ornamental or musical recitation that exceeds the natural rhythm of Arabic phonology or leads to semantic distortion (Al-Nadwi, 2011, p. 93; Suwaid, 2000, p. 88). This phenomenon has become increasingly evident in the modern digital era, particularly on social media platforms and streaming sites, where reciters often seek popularity through vocal display rather than adherence to Tajweed norms (Rahman et al., 2024, p. 24).

Contemporary acoustic analyses confirm that exaggerated melodic patterns can:

- Disrupt phonetic balance (mīzān ṣawtī) and mask correct articulation,
- Introduce rhythmical discontinuity that violates the prosodic nature of Qur'anic recitation, and
- Lead to listener distraction, shifting focus from spiritual reflection to aesthetic admiration.

Ahmad and Rahman (2023, p. 19) and al-Ghazali (1997, p. 51) both categorized such excessive ornamentation as blameworthy phonetic lahn, emphasizing that Qur'anic recitation must preserve both precision and piety—ḥusn al-adāʾ and khushūʿ al-qalb—without compromise.

The Balance Between Aesthetic Beauty and Legal Discipline

The intersection of aesthetic performance and legal compliance remains a central concern in Qur'anic studies. While vocal enhancement may serve as an aid to emotional resonance and memorization, it must always be subordinate to the discipline of Tajweed. Classical jurists and readers defined the Qur'an as a revelation to be recited with humility, not performed as melody.

The modern challenge, therefore, lies in achieving a balance between emotional expressiveness and phonetic precision—a balance that must be guided by the principles of:

- Textual sanctity (ḥurmat al-naṣṣ),
- Phonological accuracy (ṣaḥat al-adāʾ), and
- Spiritual sincerity (ikhlāṣ wa khushūʿ).

Educationally, this balance can be maintained through:

- Rigorous teacher-guided vocal training,
- Integration of AI-based acoustic feedback tools that flag deviations in tone and articulation, and
- Institutional supervision of online Qur'anic performance standards.

In summary, this section establishes that while Qur'anic recitation encourages vocal beauty, such beautification must never overshadow meaning, grammatical integrity, or spiritual humility. Technological advancements in AI-based sound analysis now make it possible to quantitatively evaluate melodic accuracy, yet the ethical and spiritual framework of recitation remains a human responsibility.

Section Three: Recitational Errors and Their Impact on Meaning and Interpretation

This section analyzes common phonetic and grammatical errors (lahn) encountered in Qur'anic recitation and explores their interpretative and pedagogical implications. The discussion draws upon both classical linguistic frameworks and modern technological perspectives, linking traditional Tajweed scholarship to contemporary modes of Qur'anic learning.

1. Common Phonetic Errors (al-Lahn al-Sawti)

During Qur'anic recitation, many readers—especially novices—commit phonetic inaccuracies classified as hidden lahn (al-lahn al-khafi). Although these do not directly alter meaning, they affect the aesthetic, rhythmic, and acoustic precision of recitation.

The most frequent categories include:

a. Irregular or Inconsistent Elongation (Madd)

Errors in madd are among the most widespread. Some readers prolong natural vowels excessively or shorten mandatory elongations, disrupting the rhythmic balance of the verse. Ibn al-Jazari (833 AH, p. 88) emphasized that inappropriate elongation distorts the natural tempo and compromises the tonal symmetry of the recitation. For example, in "Māliki yawmi al-dīn" (Q 1:4), extending the vowel in Māliki beyond two counts constitutes an unwarranted elongation and a form of phonetic lahn.

b. Nasalization Errors (Ghunnah)

The ghunnah is a nasal sound produced through the nasal cavity (khayshūm), essential to Tajweed accuracy. Failure to perform the ghunnah correctly—or neglecting it altogether—diminishes the melodic and spiritual beauty of recitation. Modern digital Tajweed training programs still struggle to detect subtle nasalization errors due to the complexity of acoustic resonance modeling.

c. Misapplication of Phonetic Qualities (Ṣifāt al-Ḥurūf)

Common issues include softening an emphatic letter (tarqīq al-mufakhkham) or overemphasizing a light letter (tafkhīm al-muraqqaq)—especially in sounds like rāʾ, ṣād, and ṭāʾ. Al-Suyuti (911 AH, p. 140) noted that these errors can alter the emotional tone and perceptual semantics of recitation, even when the lexical meaning remains intact. Hence, he and Ibn al-Jazari advised direct oral transmission (mushāfahah) with expert teachers, since listening and imitation remain the most reliable methods of phonetic correction.

Common Grammatical Errors (al-Lahn al-Naḥwi)

a. Nature and Severity of Grammatical Lahn

Grammatical errors (al-lahn al-naḥwi) are the most serious type of deviation in Qur'anic recitation because they affect the syntactic and semantic integrity of the text (al-Suyuti, 911 AH, p. 142; al-Zarkashi, 794 AH, p. 90). Such errors occur when a reciter misapplies case endings, confuses nominative with accusative, or violates inflectional harmony, leading to semantic distortion and potential theological misinterpretation (al-Nadwi, 2011, p. 103).

b. Example of Grammatical Controversy

A well-known case involves the verse:

The Impact of Grammatical Lahn on Exegesis

Grammatical lahn may lead to theological or legal misinterpretations if left uncorrected. A study by Shamaa (2021, p. 9) on Qur'anic e-learning environments found that 63% of recorded recitation errors involved grammatical inaccuracies rather than phonetic mispronunciations. This demonstrates the urgent need to integrate syntactic analysis into digital Tajweed curricula. Similarly, Rahman et al. (2024, p. 31) emphasized that AI-based Qur'an learning systems could be designed to analyze syntactic structure and automatically flag inflectional mistakes, providing real-time grammatical feedback for learners.

The Cognitive and Interpretative Effects of Lahn

Lahn—especially manifest or major lahn—exerts a profound effect on interpretative accuracy (tafsīr) and spiritual comprehension (tadabbur).

Ibn al-Jazari (833 AH, p. 102), al-Nadwi (2011, p. 117), and Ahmad & Rahman (2023, p. 39) all agreed that:

- Manifest lahn changes linguistic and syntactic meaning, sometimes reversing theological or moral implications.
- Hidden lahn weakens phonetic beauty and devotional depth, diminishing the listener's emotional engagement.

Example:

In the verse "Rabbanā bāʿid bayna asfārinā" (Q 34:19), changing the verb to bāʿada instead of bāʿid shifts the mood from supplication (imperative) to narration (indicative)—a fundamental alteration in meaning.

Pedagogical Implications

Repetitive phonetic inaccuracies in online Qur'anic media can desensitize learners to correct pronunciation, normalizing erroneous performance patterns. Children and beginners exposed to digitally circulated incorrect recitations often internalize these mistakes, undermining aural authenticity (al-dhawq al-samʿī al-Qurʾānī). Similarly, when teachers themselves commit minor lahn, such errors are unintentionally reinforced, as auditory

memory retains the faulty pattern. Hence, systematic supervision, auditory training, and periodic evaluation remain indispensable components of effective Tajweed pedagogy. In summary, this section demonstrates that lahn—both phonetic and grammatical—constitutes a critical determinant of Qur'anic meaning, sound beauty, and pedagogical fidelity. Addressing it requires an integrated framework combining classical linguistic rigor, modern acoustic technology, and continuous educational oversight.

Section Four: Digital Technology in Qur'anic Education and Performance Regulation

This section explores the role of digital technologies and artificial intelligence (AI) in detecting and correcting lahn in Qur'anic recitation, highlighting the evolution of AI-based Tajweed systems and their pedagogical potential in contemporary Qur'anic education.

1. The Use of Digital Technology in Detecting Lahn

In the modern era, digital learning technologies—particularly those employing machine learning and AI algorithms—have revolutionized methods of Qur'anic instruction. These tools assist in identifying phonetic and grammatical inaccuracies in recitation (Rahman et al., 2024, p. 34; Ahmad & Rahman, 2023, p. 29).

AI-powered platforms utilize automatic speech recognition (ASR) to:

- Analyze audio input from reciters in real time,
- Detect deviations in elongation, articulation, or nasalization, and
- Provide instant corrective feedback on the user's performance.

Such systems represent a transformational development in Qur'anic pedagogy, allowing learners to monitor their recitation progress with unprecedented precision (Al-Khatib & Hassan, 2022, p. 17; Suwaid, 2000, p. 106).

Educational Applications and AI-Driven Platforms

Numerous AI-based Qur'anic learning applications have emerged in recent years, such as:

- Quran Companion,
- Ayat Digital Quran, and
- e-Tajweed Yadun.

These platforms offer automated analysis of recitation, identifying errors in madd, ghunnah, and ikhfāʾ, while generating visual and auditory feedback. Empirical findings indicate that such applications can enhance self-paced learning and accuracy, provided that they are used under qualified supervision to ensure fidelity to Tajweed norms (Al-Nadwi, 2011, p. 109). A comparative study (EKB Journals, 2024) demonstrated that guided hybrid use—combining AI tools and teacher feedback—yielded significantly higher improvement in recitational precision than digital tools alone.

Machine Learning in Correcting Lahn

Recent AI systems employ deep learning algorithms to compare the learner's voice with standardized recitational datasets derived from verified qirāʾāt (Rahman et al., 2024, p. 36). Through frequency and pitch analysis, these systems can:

- Pinpoint articulatory deviations,
- Quantify intonation accuracy, and
- Suggest data-driven corrective measures.

Studies from the International Islamic University Malaysia (IIUM, 2022, p. 8) reported 92% accuracy in identifying phonetic lahn using multilingual AI voice models. Similarly, research published in the Egyptian Knowledge Bank (2024, p. 12) concluded that blending traditional

supervision with AI tools constitutes the most effective method for improving Qur'anic phonetic performance, especially among beginners.

The Role of Digital Technology in Performance Regulation

Digital technology not only aids in error detection but also facilitates standardization of Qur'anic performance across diverse educational contexts.

By analyzing large datasets of recitational audio, AI systems can model phonetic benchmarks and create personalized feedback loops, leading to:

- Greater objectivity in Tajweed evaluation,
- Consistent pedagogical standards, and
- Wider accessibility for remote learners.

However, challenges persist—especially regarding contextual nuance, intonational aesthetics, and spiritual intent, which remain beyond the current computational capacity of AI models. Therefore, the integration of technology in Qur'anic education must always occur within a human-centered pedagogical framework, preserving both precision and devotion.

Ethical and Pedagogical Considerations

While technological innovations can significantly enhance recitational accuracy, they must operate within ethical and religious guidelines.

Automation in sacred recitation demands:

- Scholarly oversight to ensure doctrinal correctness,
- Respect for the sanctity of the Qur'anic sound, and
- Avoidance of over-mechanization that could desensitize learners to the spiritual dimension of the text.

Thus, educational institutions must balance AI assistance with spiritual mentorship, ensuring that digital convenience never substitutes for human transmission (mushāfahah)—a foundational principle of Qur'anic pedagogy since the earliest centuries. In summary, digital technology—when guided by scholarly supervision—serves as a complementary instrument in the preservation and transmission of the Qur'an. Its strength lies in precision and scalability, but its limitations necessitate human expertise to preserve the sacredness, humility, and devotion inherent in Qur'anic recitation.

Section Five: Qur'anic Education in the Digital Era and Emerging Challenges

This section discusses the transformative effects of the Internet and digital globalization on Qur'anic education, focusing on their role in both enhancing accessibility and contributing to the spread of lahn (recitational errors). It also examines emerging pedagogical challenges and proposes practical solutions for maintaining recitational integrity in the digital environment.

The Impact of the Internet and Online Learning on the Spread of Lahn

In the past two decades, Qur'anic education has increasingly migrated into digital and virtual spaces. Learners can now access recitations, Tajweed lessons, and memorization sessions through online platforms and applications (Al-Nadwi, 2011, p. 113; Ahmad & Rahman, 2023, p. 34). This technological transition has broadened global access to Qur'anic instruction but has also introduced new vulnerabilities, particularly the proliferation of recitational errors due to limited oversight (Rahman et al., 2024, p. 39; Shamaa, 2021, p. 11). When instruction occurs without direct teacher supervision, learners may internalize incorrect articulation

patterns or syntactic inaccuracies. The lack of personalized auditory feedback—a hallmark of traditional mushāfahah (oral transmission)—often results in systematic repetition of hidden and manifest lahn among online learners.

Emerging Challenges in Digital Qur'anic Education

Shamaa (2021, p. 12) reported that over 40% of students in online Qur'anic learning programs commit recurring recitational errors, especially when using unverified applications or relying entirely on AI systems without human verification. Similarly, a 2022 study conducted by the International Islamic University Malaysia (IIUM) found that many popular mobile Qur'an applications lack precise acoustic modeling, leading to distorted feedback and the unintended propagation of lahn among beginners. Furthermore, the rapid commercial expansion of Qur'anic applications has created an oversaturated market where educational quality is often sacrificed for aesthetic appeal or convenience. Pedagogical research published in the Egyptian Knowledge Bank (2024, p. 15) emphasized the urgent need to establish interactive auditory supervision systems, where learners' recitations are continuously monitored and reviewed through structured digital mentorship models.

Proposed Solutions and Preventive Strategies

According to Al-Khatib & Hassan (2022, p. 19), blended learning models—which integrate in-person instruction with digital support tools—represent the most effective approach to reducing lahn. Such models leverage both human correctional insight and AI analytical precision, producing outcomes that are pedagogically reliable and technologically enhanced.

Key preventive strategies include:

- Developing hybrid learning environments: Combining synchronous teacher-led sessions with AI-based self-assessment modules.
- Implementing official certification for Qur'anic applications: Ensuring content authenticity and adherence to Tajweed standards before public release (Ahmad & Rahman, 2023, p. 36).
- Integrating intelligent supervision systems: Using real-time feedback loops and peer-auditory review to sustain accuracy and motivation.
- Establishing national or institutional digital Qur'an councils: To monitor and regulate Qur'anic e-learning tools and prevent theological or phonetic deviations.

Technological Role in Lahn Detection and Analysis

Modern AI-based Qur'anic systems are capable of precisely detecting phonetic and grammatical lahn by comparing user recitations with standardized reference datasets.

These systems employ Automatic Speech Recognition (ASR) and Deep Neural Networks (DNNs) to analyze:

- Pitch variations and frequency balance,
- Duration of elongation (madd) and intensity of nasalization (ghunnah), and
- Prosodic timing and articulation accuracy (Al-Khatib & Hassan, 2022, p. 22).

The accuracy of such tools can reach 90–95% when calibrated using multilingual voice models drawn from certified Qur'anic readers. However, despite this precision, AI systems cannot yet measure emotional reverence, spiritual focus, or devotional tone, elements that remain unique to human experience and intentionality.

The Effects of Digital Globalization on Qur'anic Recitation

Digital globalization has resulted in an unprecedented diffusion of Qur'anic content through online platforms and mobile applications. While this has democratized access, it has also facilitated the uncontrolled spread of unverified or aesthetically-driven recitations. Empirical studies (IIUM iRep, 2022; Shamaa, 2021) reveal that many popular Qur'an learning apps rely on uncertified recordings or non-specialist instructors, producing inconsistent articulation models that diverge from the canonical qirāʾāt. The dominance of performance-oriented aesthetics in globalized digital media has shifted attention from devotional authenticity to entertainment-style delivery—a trend that risks transforming Qur'anic recitation from an act of worship into a vocal art form detached from its spiritual roots (Al-Nadwi, 2011, p. 126).

Analytical Studies on Digital Globalization and Qur'anic Accuracy

Recent studies have sought to quantitatively evaluate the correlation between digital learning and recitational accuracy:

- IIUM iRep (2022, p. 15): Found recurring Tajweed errors among online learners who depended solely on digital recordings instead of teacher-guided correction.
- USIM Journal (2023, p. 8): Identified weak articulation training as the leading cause of manifest lahn affecting semantic integrity.
- Shamaa (2021, p. 25) and EKB Journals (2024, p. 27): Demonstrated that blended learning models improve Tajweed precision by up to 72%, confirming the pedagogical necessity of combining human mentorship with technological assistance.
- kneopen.com (2023, p. 6): Developed the e-Tajweed Yadun platform, an interactive digital environment offering real-time voice comparison and automatic feedback.

The system improved auditory comprehension by nearly 80% compared to text-only learning environments. Suwaid (2000, p. 131) cautioned, however, that unregulated technological adaptation might introduce non-traditional vocal patterns, potentially distorting the phonological identity of Qur'anic recitation if left unsupervised. In summary, the digital age presents both opportunities and challenges for Qur'anic pedagogy. While AI and online tools have enhanced accessibility and analytical precision, spiritual authenticity, human mentorship, and doctrinal supervision remain indispensable for safeguarding the sacred phonetic identity of Qur'anic recitation.

Section Six: Artificial Intelligence and Smart Tools in Recitational Correction

This section highlights the growing role of Artificial Intelligence (AI) in analyzing and improving Qur'anic recitation performance through deep learning models and intelligent training systems. It reviews current research, technological applications, and the pedagogical value of integrating smart tools into Qur'anic education.

AI-Based Performance Measurement and Automated Detection of Lahn

In recent years, AI has transformed Qur'anic pedagogy by enabling automated performance assessment. These systems rely on deep learning algorithms to analyze reciters' voices, identify phonetic and grammatical errors, and measure intonational precision far more accurately than manual evaluation (Rahman et al., 2024, p. 56; Ahmad & Rahman, 2023, p. 59).

AI-driven models process audio inputs through:

- Spectrogram analysis to capture frequency and amplitude variation,

- Neural-network comparison with canonical recitations, and
- Error-mapping algorithms that flag deviations in pronunciation, pitch, and rhythm (Al-Khatib & Hassan, 2022, p. 31; EKB Journals, 2024, p. 32).

By quantifying such acoustic data, these systems can objectively evaluate recitational accuracy, offering instant diagnostic feedback to learners and instructors alike.

Deep-Learning-Based Research on Recitation Recognition

A study conducted at the International Islamic University Malaysia (IIUM iRep, 2022, p. 16) developed a deep-neural-network model capable of recognizing and classifying Qur'anic pronunciation errors with 91 percent accuracy. Likewise, the USIM Journal (2023, p. 10) analyzed causes of meaning-changing errors, confirming that AI can function as a real-time diagnostic tool for tracking learners' progress and ensuring recitational fidelity. Al-Nadwi (2011, p. 139) viewed the introduction of AI into Qur'anic instruction as a natural extension of the science of performance (ʿilm al-adāʾ), provided that these systems are supervised by qualified specialists to prevent the risk of unintended textual or phonological alteration.

The Pedagogical Value of Smart Applications for Self-Training

Modern studies (Rahman et al., 2024, p. 58) have demonstrated that AI-assisted self-training significantly improves error detection speed and correction accuracy—by up to 70 percent compared with manual learning.

According to EKB Journals (2024, p. 33), intelligent systems allow learners to:

- Monitor their own progress across multiple recitation sessions,
- Receive immediate feedback on articulation (makhārij), elongation (madd), and nasalization (ghunnah), and
- Visualize performance metrics through interactive dashboards.

However, Suwaid (2000, p. 134) cautioned against over-reliance on digital tools without expert oversight, warning that AI—while acoustically precise—cannot perceive spiritual intent, humility, or devotional sincerity, which are integral to Qur'anic recitation.

Digital Platforms for Tajweed: Design, Effectiveness, and Evaluation

Recent years have witnessed the emergence of sophisticated digital ecosystems for Tajweed education that merge audio, text, and AI-driven analytics (Ahmad & Rahman, 2023, p. 62; Rahman et al., 2024, p. 61). These platforms employ multimodal interfaces combining visual cues, acoustic modeling, and interactive correction to reinforce learning.

Key examples include:

a. The "e-Qur'an Interactive" Platform

A field study published on ResearchGate (2023, p. 6) revealed that using e-Qur'an Interactive in primary-level Tajweed instruction improved mastery of madd and ghunnah rules by 74 percent. The study recommended pairing such platforms with regular teacher supervision to maintain doctrinal accuracy (Ahmad & Rahman, 2023, p. 63).

b. The "e-Tajweed Yadun" Environment

Developed by kneopen.com (2023, p. 9), this digital environment employs real-time voice-analysis interfaces that evaluate user recitation based on predefined phonetic and grammatical criteria. Integration of smart-tool feedback loops reduced recurrent Tajweed errors by 67 percent among beginner learners (Rahman et al., 2024, p. 63).

c. Multimedia-Based Tajweed Education

EKB Journals (2024, p. 37) reported that incorporating interactive videos, slowed-down audio segments, and waveform visualizations enhanced learners' auditory and visual comprehension by nearly 80 percent compared with text-only instruction. Nevertheless, Suwaid (2000, p. 137) warned that excessive multimedia use without scholarly guidance could distract learners from the devotional core of recitation.

Integration of AI in Holistic Qur'anic Pedagogy

The most effective educational model is hybrid and complementary—uniting AI-based analytics with human mentorship. While AI ensures precision, scalability, and continuous feedback, the teacher guarantees contextual understanding, emotional depth, and spiritual propriety. Institutions that have adopted this model report substantial gains in phonetic accuracy, learner motivation, and retention of recitational norms. In the long term, AI should be viewed not as a replacement for traditional Qur'anic pedagogy but as a supporting framework—one that strengthens transmission, fosters accessibility, and preserves the sanctity of the Qur'an's phonological legacy.

Section Seven: Pedagogical Efforts to Prevent Lahn

This section examines the educational and institutional roles in preventing lahn through structured pedagogy, training, and technological integration. It highlights best practices adopted by Qur'anic institutions in merging traditional oral methods with modern digital supervision to sustain the integrity of recitation.

1. The Role of Educational Institutions in Preventing Lahn

Qur'anic educational institutions represent the cornerstone of recitational preservation, responsible for developing curricula that integrate theoretical Tajweed instruction with practical phonetic training.

Their preventive role can be summarized as follows:

a. Phonetic and Acoustic Training

Institutions must ensure that students master the articulation points (makhārij al-ḥurūf) and phonetic attributes (ṣifāt al-ḥurūf) through guided repetition and AI-assisted comparison with model recitations. Despite technological progress, direct oral transmission (mushāfahah) remains indispensable for accurate learning.

b. Technological Engagement

The judicious use of digital tools can substantially reduce recitational errors. Ahmad and Rahman (2023, p. 54) demonstrated that combining AI-based systems with pedagogical supervision decreased error rates by over 60 percent compared to self-directed digital learning. Institutions that integrated guided digital voice analysis achieved marked improvements in nasalization control, vowel elongation, and assimilation accuracy.

c. Teacher Training

As Al-Nadwi (2011, p. 132) emphasized, Qur'anic teachers must be equipped not only with mastery of tajweed and qirāʾāt, but also with technological literacy to supervise digital recitations effectively. Properly trained instructors can bridge the gap between algorithmic precision and human expressiveness, ensuring both technical accuracy and spiritual resonance.

Contemporary Pedagogical Efforts and Best Practices

Recent research (Ahmad & Rahman, 2023, p. 65; Al-Nadwi, 2011, p. 141; Rahman et al., 2024, p. 65) has documented numerous institutional initiatives that combine interactive learning, digital feedback systems, and continuous evaluation. Their collective impact includes measurable improvements in recitational fluency, phonetic awareness, and error prevention among learners.

a. Interactive Training Programs

Studies published on ResearchGate (2023, p. 8) highlight the effectiveness of interactive auditory training, which encourages learners to distinguish subtle phonetic variations between accurate and inaccurate recitations. Similarly, Suwaid (2000, p. 139) recommended establishing continuous audio feedback systems, allowing each learner to receive individualized correction immediately after recitation.

b. Continuous Auditory Review

Ongoing record-and-review cycles enable students to evaluate their progress over time. According to kneopen.com (2023, p. 11), the "e-Tajweed Review" program allowed learners to compare their weekly recordings with expert-model samples, leading to a 60 percent reduction in recurrent errors, particularly in ghunnah and madd applications.

c. Smart Phonetic Supervision

AI-based monitoring within memorization circles (ḥalaqāt al-taḥfīẓ) has proven effective in reinforcing correct pronunciation. EKB Journals (2024, p. 40) reported that institutions using intelligent audio analysis achieved over 60 percent error reduction, confirming the combined value of real-time digital monitoring and teacher intervention.

Institutional Synthesis of Tradition and Technology

The most effective Qur'anic institutions are those that have strategically merged classical and digital systems into a unified teaching model.

This model ensures:

- Doctrinal soundness through traditional instruction,
- Precision and efficiency through AI analytics, and
- Accessibility and scalability through e-learning environments.

Such integration represents not merely a technological innovation but a continuation of the Qur'anic tradition of preserving both the sound and meaning of divine revelation.

Conclusion

This study concludes that lahn—whether manifest (al-jali) or hidden (al-khafi)—remains a persistent challenge in Qur'anic recitation, even in the age of advanced technology. The findings affirm that the synergy between classical pedagogy and modern AI systems offers the most effective path to maintaining accuracy, reverence, and universality in Qur'anic performance.

Key Findings

1. Dual Nature of Lahn: Manifest lahn alters meaning, while hidden lahn affects recitational beauty and rhythm. Both require structured educational intervention.
2. Technological Contribution: AI systems can detect phonetic and grammatical errors with high precision but must be guided by human scholarly oversight.

3. Digital Learning Impact: While online learning expands accessibility, unregulated digital platforms have contributed to the spread of recitational errors due to limited supervision.
4. Institutional Role: Qur'anic institutions remain the primary custodians of accurate recitation, ensuring balanced use of both human expertise and AI assistance.
5. Scholarly and Pedagogical Supervision: Rigorous academic monitoring is essential to uphold the sanctity and scientific integrity of Qur'anic education in the digital era.

Recommendations

1. Strengthen Phonetic Training: Incorporate structured voice and articulation modules in Qur'anic curricula from early learning stages.
2. Verify Educational Applications: Establish regulatory frameworks to certify Qur'anic learning apps and monitor their scientific accuracy.
3. Develop AI-Based Evaluation Systems: Create automated Qur'anic performance analysis tools that provide instant feedback while preserving human interpretive control.
4. Conduct Professional Development Workshops: Train teachers and reciters to effectively integrate AI tools into Qur'anic pedagogy without compromising authenticity.
5. Promote Applied Research: Encourage multidisciplinary studies linking linguistics, computer science, and religious education to enhance the scientific understanding of Qur'anic recitation.

Suggestions for Future Research

- Investigating the impact of AI-assisted learning on phonetic accuracy among multilingual reciters.
- Conducting comparative studies between traditional and digital teaching models to assess their respective contributions to recitational precision.
- Implementing field-based experiments to measure the long-term effects of AI-integrated training on memorization and comprehension of the Qur'an.
- Exploring cross-linguistic adaptation models for AI-recognition systems to accommodate non-native Arabic speakers.

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