

An Integrative Arabic Language Learning Model Based on Neurolinguistics and Digital Learning for the Development of Maharah Istima' in 21st Century Islamic Schools

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Abstract: This study is motivated by the low level of optimization in Maharah Istima' instruction, which remains passive, fragmented, and has not yet systematically integrated neurolinguistic principles with digital learning. In fact, listening skills play a fundamental role in mastering Arabic as a foreign language. The results of the study indicate that the integration of neurolinguistics and digital learning can create an adaptive learning system based on cognitive processing through a cyclical mechanism of input-process-interaction-feedback. The resulting model has been analytically proven to improve students' comprehension accuracy and cognitive efficiency in listening. The contribution of this research lies in the development of an integrative learning model that is not only conceptual but also operational, measurable, and applicable, thereby providing a theoretical foundation and practical guidance for the development of adaptive, interactive, and relevant Arabic language learning to meet the demands of 21st-century education.

Keywords : Digital Learning, Learning Models, Maharah Istima', Neurolinguistics

Abstrak: Penelitian ini dilatarbelakangi oleh rendahnya optimalisasi pembelajaran Maharah Istima' yang masih bersifat pasif, parsial, dan belum secara sistematis mengintegrasikan prinsip-prinsip neurolinguistik dengan pembelajaran digital. Padahal, keterampilan mendengarkan memainkan peran mendasar dalam penguasaan bahasa Arab sebagai bahasa asing. Hasil penelitian menunjukkan bahwa integrasi neurolinguistik dan pembelajaran digital mampu membentuk sistem pembelajaran adaptif berdasarkan pemrosesan kognitif melalui mekanisme siklikal input-proses-interaksi-umpan balik. Model yang dihasilkan telah terbukti secara analitis dapat meningkatkan akurasi pemahaman siswa dan efisiensi kognitif dalam mendengarkan. Kontribusi penelitian ini terletak pada pengembangan model pembelajaran integratif yang tidak hanya konseptual, tetapi juga operasional, terukur, dan dapat diterapkan, sehingga memberikan landasan teoretis serta panduan praktis untuk pengembangan pembelajaran bahasa Arab yang adaptif, interaktif, dan relevan guna memenuhi tuntutan pendidikan abad ke-21.

Kata Kunci : Keterampilan Mendengar, Model Pembelajaran, Neurolinguistik, Pembelajaran Digital

INTRODUCTION

Maharah Istima' is the main foundation in Arabic language learning, especially for Arabic as a foreign language learners, because it plays a role in building understanding, context, and readiness for oral communication. Listening skills that are not optimally



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developed tend to limit the development of other language skills, making it a crucial indicator of the success of comprehensive Arabic language learning [1].

Many Arabic language teachers in Islamic schools still face challenges in integrating digital technology with brain-based approaches to optimally improve students' listening skills [2]. Ignorance or limited understanding of neurolinguistic principles often makes the use of digital media merely a formality, without actually stimulating students' attention, working memory, or motivation [3]. As a result, the interactive and personalized learning potential that digital learning should enable is not being fully utilized, resulting in limited development of students' *Maharah Istima'* abilities.

On the other hand, conventional learning methods which are still dominant tend to be passive, emphasizing lectures or monotonous listening exercises, so they are less able to facilitate students' cognitive and emotional processing [4]. The mismatch between neurolinguistic theory and digital learning practices in the classroom makes learning strategies out of sync with how the brain works, so students are not fully engaged in the learning process [5]. This situation underscores the need for an integrative learning model capable of synergizing brain-based approaches and digital media to make Arabic language learning more effective, enjoyable, and relevant to the needs of modern Islamic schools.

In line with the demands of 21st-century education, Islamic schools face the need to combine digital technology with neurolinguistic approaches to make learning more effective and enjoyable, while also aligning with how the human brain processes language. Digital Learning offers a variety of interactive media that can stimulate students' attention, working memory, and motivation, from adaptive audio-visuals to interactive simulations and quizzes [6]. However, its utilization is often still partial, only emphasizing the technological aspect without being accompanied by pedagogical strategies that pay attention to neurolinguistic principles [7]. This creates a gap between the potential of digital media and the effectiveness of real-world learning, making integration of the two crucial for creating a more comprehensive Arabic learning experience that is responsive to the needs of modern students.

Therefore, given the limitations of *Maharah Istima'* learning, which still tends to be partial, the integration of neurolinguistic and digital learning approaches provides a promising framework for optimizing the learning process. Neurolinguistics provides an understanding that language processing involves the interaction of working memory, attention, and emotion, which directly influences the ability to understand auditory input [8]. In this context, learning focuses not only on delivering material but also on how the given stimulus can activate cognitive and emotional processes simultaneously, making information easier to understand, remember, and use functionally. This potential can be strengthened through digital learning, which provides an interactive, adaptive, and multimodal learning environment through audio-visual media, simulations, and feedback-based platforms [9].

The integration of these two approaches demonstrates that digital technology serves more than just a tool, but has the potential to become a mechanism that stimulates brain function more optimally through repeated reinforcement, adjusting learning rhythms, and increasing student emotional engagement. Thus, *Maharah Istima'* learning tends not only to facilitate information acquisition but also to encourage active engagement, motivation to learn, and a deeper and more sustainable internalization of Arabic.

Previous research has shown that language is based on neurolinguistics, namely the connection between the language areas of the brain (Broca-Wernicke's), working memory, and attention. Structured input activates neural pathways, strengthening neural connectivity, and supporting language production through brain plasticity. Therefore, language learning needs to be aligned with neural architecture as the basis for a neuroscience-based curriculum [10]. Furthermore, the neurolinguistic approach effectively enhances Arabic language learning by

optimizing brain function in cognitive, affective, and speaking aspects. This approach is relevant for further development in a more comprehensive learning model [11]. There is also the development of Arabic qowaid teaching language based on print media with a neurolinguistic programming (NLP) approach which is considered to be able to overcome students' learning difficulties [12].

Other research on digital Arabic language learning through the i-Tahaddath application effectively enriches early childhood learning experiences by increasing interest and basic language mastery. However, the quality of the content and teacher training are important for optimal learning. In general, integrating technology into the preschool curriculum has great potential to enhance learning while preparing children for the digital era [13]. Learning through digital media such as YouTube, smart TVs, and LCDs can also improve students' listening skills and vocabulary, making learning more effective. However, its success depends on teacher preparedness, adequate resources, and creative learning design [14].

Based on previous studies, it can be identified that research on neurolinguistic-based Arabic language learning has highlighted cognitive aspects such as working memory, attention, and neural activation, while digital learning studies have shown the potential of interactive media and applications in increasing student engagement; however, the two approaches are still being developed separately. Neurolinguistic studies tend to stop at the conceptual level and have not been operationalized in the form of a systematic learning model, while digital learning research focuses more on the use of technology without conceptual integration with neurolinguistic principles. As a result, there is no learning framework that simultaneously integrates both approaches in a single, structured and applicable model, especially for the development of *Maharah Istima'* for learners of Arabic as a foreign language in the context of 21st-century Islamic schools; this gap is the focus of this research.

In line with the identified gaps, this research is conceptual in nature to formulate an integrative learning model that combines neurolinguistic principles and digital learning strategies. Specifically, this research is directed to answer the problem formulations (1) how neurolinguistic principles and digital learning can be integrated in *Maharah Istima'* learning, (2) how the form of an integrative learning model is systematic and applicable for Arabic language learners as a foreign language in 21st-century Islamic schools, and (3) what are the pedagogical implications of the model for optimizing students' listening skills.

The novelty of this research lies in the formulation of an integrative framework that explicitly links neurolinguistic mechanisms with digital learning design in a single, structured conceptual model oriented toward the development of *Maharah Istima'*. Thus, this research contributes to theoretical, conceptual, and practical aspects. Theoretically, this research enriches the study of Arabic language learning through the integration of neurolinguistics and digital learning within a single, integrated framework. Conceptually, this research produces an integrative model that links brain mechanisms with digital learning design. Practically, this research provides guidance for teachers in designing *Maharah Istima'* learning that is more adaptive, interactive, and appropriate to the characteristics of Arabic as a foreign language learners in 21st-century Islamic schools.

METHODS

This research is a library research with a conceptual-analytical approach which is carried out systematically and transparently to ensure the replicability and validity of the synthesis [15]. This approach is aimed at examining, reviewing, comparing, and evaluating key concepts related to neurolinguistics, digital learning, and the development of *Maharah Istima'* in the context of Arabic language learning in 21st-century Islamic schools. The choice of this method

is based on the research character, which is not oriented towards collecting field data, but rather on compiling academic arguments and synthesizing theories to produce an integrative conceptual framework for learning. Thus, this research aims to build a systematic conceptual model as a basis for innovation in *Maharah Istima'* learning based on the integration of neurolinguistics and digital learning, while strengthening theoretical foundations relevant to the development of 21st-century education.

The data sources for this research are national and international journal articles obtained from academic databases such as Google Scholar, Scopus, Sinta, and DOAJ with a publication period of 2021–2025. Inclusion criteria include: (1) articles indexed by Scopus (Q1–Q3) or Sinta (S1–S3), (2) having direct relevance to neurolinguistics, digital learning, or *Maharah Istima'* learning, (3) focusing on the pedagogical aspects of language learning, and (4) available in *full text*. The exclusion criteria included: (1) non-academic or opinion articles, (2) studies unrelated to the context of Arabic language learning, and (3) duplicate publications. Based on the selection process, approximately 20 articles were obtained for in-depth analysis. Data collection was carried out through documentation techniques with directed searches using the keywords "neurolinguistic", "digital learning", "Maharah Istima' ", and "Arabic language learning" in academic databases and educational institution repositories.

Data analysis is carried out in stages and operationally through three main stages, namely conceptual analysis, comparative analysis, and theoretical synthesis [16]. In the conceptual analysis stage, researchers extracted key concepts from each article using content analysis techniques, such as identifying definitions, main principles, models, and findings related to neurolinguistics, digital learning, and *Maharah Istima'* learning. The data were then coded and grouped into several main categories, namely: (a) neurolinguistic mechanisms (working memory, attention, emotion), (b) characteristics of digital learning (interactivity, adaptivity, multimodality), and (c) implications for listening learning. The next stage is comparative analysis, namely comparing the literature to identify similarities, differences, as well as the advantages and limitations of each approach, especially in the context of implementing Arabic language learning.

In the theoretical synthesis stage, all analyzed findings are then integrated into a coherent and systematic conceptual framework. This process is carried out iteratively through comparing, revising, and confirming relationships between concepts until theoretical consistency and saturation are achieved. To ensure validity and credibility, this study applies source triangulation through cross-study comparisons and checking conceptual consistency across the literature. Thus, the resulting model is not only integrative but also has a strong analytical basis and can be scientifically justified as a foundation for developing more adaptive and contextual *Maharah Istima'* learning in the digital era.

RESULTS AND DISCUSSION

A. Conceptual Analysis of *Maharah Istima'* Learning from a Neurolinguistic and Digital Learning Perspective

Table 1. Conceptual Analysis of *Maharah Istima'* Learning

Analysis Category	Number of Articles	Key Findings	Implications
Neurolinguistic Mechanisms	7 Articles	Working memory, attention, and emotion influence auditory processing	Learning needs to be based on cognitive and emotional stimulation

Digital Learning	7 Articles	Interactivity, adaptivity, and multimodality increase learning engagement.	More adaptive and contextual learning
Maharah Istima'	4 Articles	Listening is an active process of meaning, not passive hearing.	Need for interpretive learning design
Conceptual Integration	2 Articles	Integration of neurolinguistics and digital learning increases learning effectiveness	Supporting adaptive and data-based Maharah Istima' learning

The findings of this study indicate that the integration between *Maharah Istima'*, neurolinguistic perspective, and digital learning is not only conceptual, but also has an operational relationship pattern that can be identified through content analysis to various relevant literature sources. Research data were obtained from articles, journals, and scientific studies discussing neurolinguistics, digital learning, and *Maharah Istima'* learning, then analyzed systematically by extracting key concepts from each source. Next, the data were coded, compared, and classified into three main categories, namely: (1) neurolinguistic mechanisms that include working memory, attention, and emotion; (2) characteristics of digital learning that include interactivity, adaptivity, and multimodality; and (3) the implications of the integration of these two aspects on *Maharah Istima'* learning.

The coding results indicate that the three categories have a strong functional relationship and are complementary. In this context, *Maharah Istima'* is consistently positioned as a receptive skill that requires contextual, real-time, and layered processing of meaning. A neurolinguistic perspective provides a theoretical basis for the cognitive mechanisms underlying this process, specifically how working memory plays a role in temporarily retaining auditory information for further processing, attention functions in filtering relevant linguistic stimuli, and emotions influence the level of engagement and information retention. On the other hand, digital learning acts as a medium that enables interactive, adaptive, and multimodal learning processes, thus being able to accommodate learners' cognitive needs more flexibly.

Furthermore, based on the conceptual synthesis resulting from the cross-literature analysis, a tendency can be identified that learning that integrates *Maharah Istima'*, neurolinguistic mechanisms, and digital learning characteristics has the potential to improve the quality of understanding and efficiency in processing auditory information. This potential arises from the alignment between the way the learner's cognitive system works and the design of a technology-based learning environment, which allows for the optimization of working memory function, attention management, and strengthening of emotional aspects in the learning process.

However, it is important to emphasize that these findings are conceptual-analytical in nature, obtained through content analysis of various literature sources, and not the result of direct experimental measurements. Therefore, the increased learning effectiveness indicated in this study should be understood as a theoretical potential supported by consistent findings in the literature, thus requiring further validation through empirical research based on experiments or field studies.

B. Comparative Analysis: Gaps and Fragmentation of Maharah Istima' Learning

In the context of the studies conducted, there are indications that although theoretically the three domains neurolinguistics, language learning pedagogy, and digital learning have been

widely discussed in the literature, their implementation in learning practice still shows a pattern that is not fully integrated. However, the main findings indicate that in practice, these three domains still operate partially and are not yet systematically integrated. This fragmentation results in suboptimal listening learning, which tends to be linear, less responsive to students' cognitive states, and lacks authentic context.

To strengthen the analytical foundation, the results of this comparative synthesis are compiled based on a systematic comparison of the various research findings coded in the previous stage. This process emphasizes identifying patterns of similarities, differences, and limitations in each domain through a source triangulation approach.

Table 2. Comparative Analysis

Domain	Key Findings	Limitations	Pedagogical Implications
<i>Maharah Istima'</i>	Meaning-based understanding	Reduced to a passive listening activity	Need for active interpretation-based design
Neurolinguistik	Memory & emotion activation	Not integrated in learning	Need for cognitive-emotional stimulation
<i>Digital Learning</i>	Interactive	Just as a medium, not an adaptive system	Need for data-driven integration

Based on the table, it can be seen that each domain has significant conceptual strength but also faces limitations in implementation.

1. On the domain *Maharah Istima'* language understanding is actually constructed through the process of interpreting meaning, context, and linguistic nuance (Baharudin & Rahman, 2025). However, in learning practice, it is often reduced to passive listening without adequate cognitive engagement [17]. This indicates a gap between theoretical constructs and pedagogical practice.
2. In the neurolinguistic domain, language comprehension involves a complex interaction between working memory, attention, and emotional aspects that play a role in the retention and meaning-making processes [18], [19]. However, these dimensions have not been systematically integrated into Arabic language learning design, thus the potential for optimizing students' cognitive functions has not been fully utilized.
3. In the digital learning domain, instructional technology has great potential to create interactive and multimodal learning experiences [20], [21]. However, in practice, technology still tends to be used as a tool to deliver content, rather than as a data-driven, adaptive system capable of tailoring learning to individual students' needs.

Based on a comparative analysis of the three domains, it can be concluded that *Maharah Istima'* learning still experiences conceptual gaps and pedagogical fragmentation. In the linguistic domain, learning tends to reduce *istima'* activities to passive listening, thus not fully building in-depth interpretations of meaning and context. In the neurolinguistic domain, aspects of working memory, attention, and emotion, which play a crucial role in language comprehension, have not been systematically integrated into learning design. Meanwhile, in the digital learning domain, technology, which should be able to create adaptive and multimodal learning, is still predominantly used as a medium for delivering material. This fragmentation between domains indicates that *Maharah Istima'* learning has not been developed through an integrative approach that fully connects linguistic, cognitive, and technological aspects, necessitating a more holistic, adaptive, and experience-centered pedagogical reconstruction.

C. Theoretical Synthesis: Integrative Reconstruction of *Maharah Istima'* Based on Neurolinguistics and Digital Learning

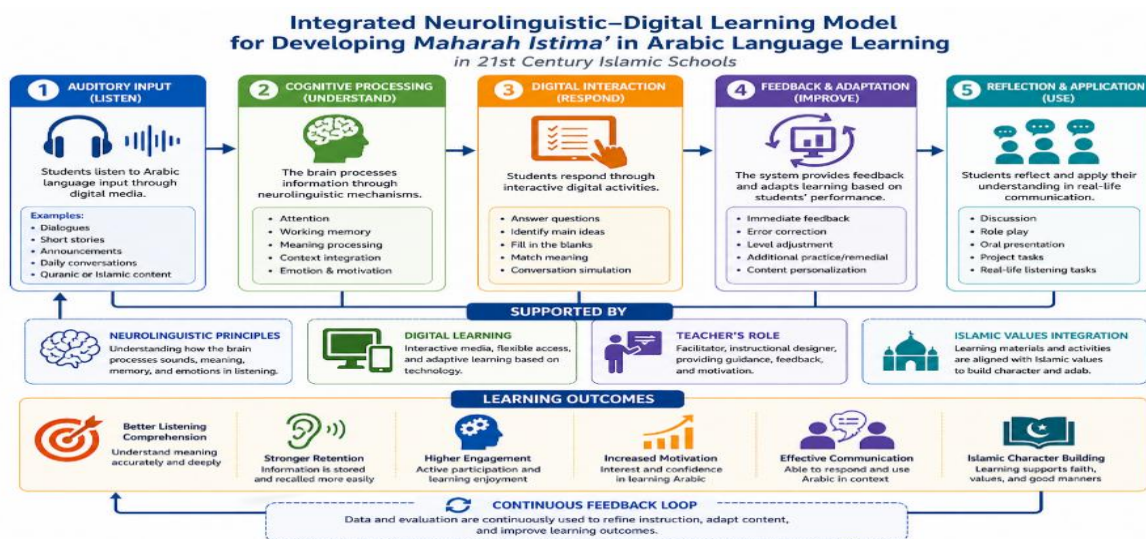
The theoretical synthesis in this study was conducted iteratively and continuously through a process of comparing, revising, and confirming relationships between concepts obtained from various literature sources. This process was not linear, but rather cyclical, with each finding being re-examined against other findings to ensure its coherence and consistency. Each identified concept was not immediately integrated but first underwent a conceptual validation stage by testing its suitability to patterns emerging from various studies, both supporting and dissenting. This process continued until conceptual harmony (theoretical saturation) was achieved, a condition where no further variations in meaning or significant new relationships between concepts were found.

Through this process, an integrative framework was produced that shows that effective *Maharah Istima'* learning must simultaneously combine three main components: cognitive processing (neurolinguistics), learning experiences (pedagogy), and technology-based adaptive systems (digital learning). These three components are interrelated and reinforcing, where cognitive mechanisms such as working memory, attention, and emotions are optimized through appropriate pedagogical strategies, and supported by an interactive, adaptive, and multimodal digital environment. Thus, learning effectiveness is not determined by only one aspect, but is the result of a synergistic integration between cognitive, pedagogical, and technological dimensions in an adaptive and meaning-oriented learning ecosystem.

D. Development of an Integrative Arabic Language Learning Model Based on Neurolinguistics and Digital Learning

Based on these needs, this research then leads to the formulation of a conceptual description of a learning model, namely the Integrative Arabic Learning Model Based on Neurolinguistics and Digital Learning for the Development of *Maharah Istima'* in 21st Century Islamic Schools. This model is designed as an operational synthesis that not only integrates the three domains conceptually, but also constructs an adaptive, interactive, and data-driven learning mechanism. The model proposed in this study is the result of theoretical construction based on literature synthesis, not the result of direct experimental testing. Therefore, this model is positioned as a conceptual-operational framework that can be used as a basis for further empirical research.

Figure 1. Integrated Neorlinguistic-Digital Learning Model



This image represents the Integrative Arabic Learning Model based on Neurolinguistics and Digital Learning for the development of *Maharah Istima'* as a cyclical and adaptive learning system. The main concept proposed is the integration of auditory input (the language heard), neurolinguistic processing (how the brain processes information), and digital learning (media and technology-based adaptive systems) within a single operational framework. This model is based on neurolinguistic theory, which explains that language comprehension involves complex cognitive activities such as attention, working memory, and the construction of meaning in the brain [22]. Furthermore, information processing theory views listening skills as an active process that includes the stages of stimulus reception, information processing, memory storage, and contextual retrieval of meaning [23]. Therefore, this model positions listening skills not as a passive activity, but as an active cognitive process involving sound decoding, processing in working memory, meaning construction, and reinforcement through emotions and motivation. On the other hand, constructivism and digital learning theories emphasize that learning will be more effective when students receive interactive, multimodal, and adaptive learning experiences [24]. In this context, digital learning functions as an adaptive support system that provides multimodal input (audio, visual, interactive) while adapting material based on student responses and learning development.

In terms of process, this model operates through several main, interconnected stages. First, students receive auditory input through digital media designed contextually and appropriately to their ability level, in line with the comprehensible input theory, which emphasizes the importance of exposure to language that students can understand. Second, this input is processed through neurolinguistic processing, which involves attention, working memory, integration of meaning, and strengthening linguistic associations in the brain. Third, the digital system provides adaptive practice and feedback, such as interactive exercises and real-time feedback, to strengthen students' understanding and improve memory retention. This stage is supported by the adaptive learning theory, which emphasizes the importance of personalized learning based on individual performance and needs. Fourth, learning outcomes are implemented in contextual listening activities, such as simulations or real-world interactions, so students can connect language understanding with authentic experiences. This entire process forms an iterative feedback loop, a continuous evaluation cycle in which student performance is continuously analyzed to adjust subsequent learning, allowing *Maharah Istima'* to develop gradually, measurably, adaptively, and sustainably.

Thus, this integrative Arabic language learning model based on neurolinguistics and digital learning shows that the development of *Maharah Istima'* can no longer be viewed as a linear and passive process, but rather as a dynamic system that integrates cognitive processing, experiential learning, and adaptive technology into a single entity. Through the input-processing-adaptation-evaluation cycle, learning becomes more responsive to individual needs while remaining contextual and communicative. Thus, this model not only offers a conceptual framework but also provides a clear implementation direction for creating more effective, adaptive, and relevant Arabic language learning to meet the demands of 21st-century education.

E. The Operational Mechanism of *Maharah Istima'* Based on Neurolinguistics

To address the various limitations that have been identified previously, *Maharah Istima'* is reconstructed no longer as a passive receptive activity, but rather as a neurolinguistic-based operational process that occurs systematically, dynamically, and repeatedly. This reconstruction positions listening as a closed-loop cognitive system, a system that involves a continuous cycle of language input, cognitive processing, interpretation of meaning, and reinforcement through learning experiences [25]. With this approach, listening is understood

not only as a process of receiving information, but as a complex mental activity involving interactions between language structures, brain mechanisms, and the learner's psychological state.

1. Auditory Input Processing

In the initial stage, students receive auditory input in the form of words, phrases, or sentences through various learning media. This process does not stop at physical hearing, but involves phonological decoding, namely the brain's ability to identify and differentiate language sounds, including phonemes, stress, intonation, and the rhythms typical of Arabic. From a neurolinguistic perspective, this stage is crucial because it serves as the main entry point for the entire subsequent comprehension process. As explained, listening is an active process in recognizing phonological structures, so the quality of auditory input is crucial for the success of the next stage [26]. In other words, if input is not processed accurately at the phonological level, errors will continue to the meaning stage.

2. Working Memory Integration Stage

Once the input is recognized, the information enters working memory as a temporary processing center. At this stage, the sounds heard are integrated with their meaning, context, and prior knowledge. This process is highly dynamic because it involves the simultaneous activation of various cognitive networks, including attention control and semantic processing. Working memory capacity is a determining factor for success, as limitations in this capacity can hinder the information integration process. Furthermore, the more effective working memory management, the higher the level of understanding achieved [19], [27]. Therefore, learning design needs to consider cognitive load to prevent it from exceeding students' processing capacity.

3. Meaning Construction and Interpretation

This stage is the core of *Maharah Istima'*, where students begin to construct meaning through the integration of linguistic information and situational context. This process is not mechanical, but interpretive, as students actively interpret messages based on their experiences, knowledge, and available contextual clues. Within this framework, language comprehension occurs when the input received is at a comprehensible level, as explained in the Input Hypothesis theory [28]. Thus, the success of this stage depends heavily on the relevance and accessibility of the material for students. If the input is too complex, the meaning-construction process will be disrupted; conversely, if it is appropriate, understanding can develop optimally.

4. Emotional and Cognitive Reinforcement

Unlike traditional approaches that tend to ignore affective aspects, the neurolinguistic perspective positions emotions and motivation as integral components of the learning process. At this stage, students' emotional states, such as interest, self-confidence, and comfort, play a role in strengthening or weakening information processing. Positive emotional engagement can increase the activation of brain networks related to memory and comprehension [18]. Therefore, a supportive, interactive, and non-pressuring learning environment is an essential prerequisite for a successful learning process *Maharah Istima'* running optimally. In other words, successful understanding is not only determined by cognitive factors, but also by the accompanying emotional conditions.

5. Long-term Memory Encoding

The final stage of this mechanism is storing information in long-term memory. Processed and understood information is encoded through systematic practice, repetition, and reinforcement. Information will only remain in long-term memory through repetition and elaboration [29]. In the context of Arabic language learning, this means that established understanding needs to be reinforced through ongoing practice, such as repeated listening

exercises, discussions, or use in real-life contexts. Without this reinforcement, information tends to quickly disappear from memory.

The five stages in this mechanism are not constructed speculatively, but rather are the result of a structured synthesis of various findings in the neurolinguistics and language learning literature, which consistently show similar patterns in explaining the auditory comprehension process. This integration is carried out through a comparative analysis of various relevant studies, so that each formulated stage has a strong theoretical basis and supports each other. Thus, the resulting mechanism is not only descriptive but also represents general trends in scientific studies related to how auditory input is processed, understood, and interpreted in the context of language learning.

F. Digital Learning Integration as an Adaptive Learning System

The integration of digital learning in *Maharah Istima'* learning can no longer be understood merely as a medium to assist in delivering material, but rather as an adaptive system that plays an active role in strengthening students' neurolinguistic mechanisms during the language acquisition process. From this perspective, technology functions not only to provide access to Arabic input but also to dynamically manage learning experiences based on each individual's responses, needs, and cognitive development [30]. Thus, digital learning connects biological processes, such as how the brain processes language, with pedagogically and systematically designed learning experiences. This concept aligns with the connectivism theory proposed by Siemens, which asserts that learning in the digital era occurs through information networks and technological interactions that enable students to construct knowledge in a flexible, personalized, and sustainable manner [31]. In the context of *Maharah Istima'*, technology not only conveys information but also creates a learning environment that is responsive to students' thinking processes and language development.

The theoretical basis of digital learning integration can also be explained through the Cognitive Theory of Multimedia Learning proposed by Mayer (2024), which states that humans process information through two main channels, namely visual and auditory [32]. When both channels are activated simultaneously and coordinated, the understanding process becomes more effective because the cognitive load can be distributed equally. In *Maharah Istima'* learning, language understanding is not only obtained from the sounds heard, but is also strengthened by visual representations such as images, text, animations, and videos that provide additional context to the meaning of speech [33]. This multimodal integration supports the auditory processing and meaning construction processes in neurolinguistic mechanisms, so that students can connect language sounds with the context of use in a more concrete and meaningful way.

Operationally, digital learning works through interconnected adaptive learning mechanisms that form a technology- and cognitive science-based learning ecosystem [34]. Learning materials are presented through multimedia input delivery in the form of audio, video, animation, and supporting text, enabling students not only to hear Arabic but also to understand the context of its use visually and situationally. This process enriches phonological decoding while facilitating the construction of meaning because language input becomes more concrete and contextual. Furthermore, digital learning also provides interactive engagement through quizzes, conversation simulations, drag-and-drop exercises, and rapid responses to auditory stimuli, encouraging active student involvement in the learning process. This interactivity strengthens working memory and cognitive processing pathways, making learning more participatory and experiential [35].

On the other hand, digital learning is supported by an adaptive feedback system that allows for direct or real-time feedback based on student responses [36]. The system can identify errors, provide corrections, and adjust the difficulty level of the material to suit individual abilities. This mechanism is relevant to neurolinguistic principles because rapid feedback can strengthen neural connections (neural reinforcement) while preventing the formation of recurring errors. Furthermore, data-based progress monitoring allows teachers to monitor student development in real time, including level of understanding, response speed, and error patterns throughout the learning process. Thus, digital learning functions not only as a learning medium but also as a diagnostic and evaluative system that supports personalized learning tailored to student characteristics and needs.

Thus, digital learning has transformed from a mere learning medium into an adaptive learning environment that manages the learning process holistically, encompassing cognitive, affective, and performative aspects. This approach makes *Maharah Istima*' learning more personalized, interactive, and contextualized to meet students' needs. In addition to enhancing learning effectiveness, this integration of technology and neurolinguistics also serves as a crucial foundation for developing an Arabic language learning ecosystem based on technology, cognitive science, and adaptive pedagogical approaches in the digital era.

G. Operational Mechanism of Data-Driven Model and Adaptive Learning Pathway

To ensure that the integrative neurolinguistic-digital learning model does not stop at the conceptual level, this research formulates an operational mechanism based on empirical data and students' cognitive processes. This mechanism is designed as a system capable of capturing, analyzing, adapting, and continuously improving the learning process. Thus, learning *Maharah Istima*' not only ongoing, but also continues to develop adaptively according to the dynamics of student abilities.

1. Capture of Listening Performance

The initial stage in this mechanism is the automatic collection of student performance data through a digital learning system. Every listening activity is comprehensively recorded, including answer accuracy, response speed or time, and any error patterns that arise. This process promotes evidence-based learning, as all pedagogical decisions are based on real data, not assumptions [37]. From a neurolinguistic perspective, this data represents how students process language input at the cognitive level, thus serving as an early indicator for understanding their actual condition.

2. Cognitive Processing Analysis

The collected data is then analyzed to identify students' levels of understanding, the types of difficulties they encounter, and their underlying cognitive characteristics. This analysis looks beyond correctness and incorrectness of answers, but also considers response patterns, performance consistency, and information processing speed. With this approach, teachers and the system can gain a deeper understanding of how students understand language, including whether their difficulties lie in phonological, semantic, or contextual aspects. Compared to conventional evaluations, this analysis is far more diagnostic and comprehensive.

3. Adaptive Learning Pathway

Based on the results of the cognitive analysis, the system then designs an adaptive learning pathway. The material, difficulty level, and type of activity are tailored to the individual student's needs. High-ability students are presented with more complex challenges, while those experiencing difficulties receive reinforcement in basic aspects. This mechanism ensures that each student learns within their zone of proximal development, making the

learning process more effective and non-uniform. In this context, digital learning functions as an automatic manager of learning differentiation.

4. Iterative Feedback Loop

The final stage is providing continuous feedback in the form of an iterative feedback loop. Each student response is immediately followed by informative feedback, whether in the form of correction, explanation, or reinforcement. This process is cyclical, where the results of one activity form the basis for the next. Thus, learning occurs in a continuous cycle: trying, getting feedback, improving, and trying again. From a neurolinguistic perspective, this repetition accompanied by feedback plays a crucial role in strengthening memory connections and enhancing long-term retention.

The data-driven mechanism proposed in this model is a conceptual elaboration of various findings related to adaptive learning in the literature, demonstrating how learning systems can adapt to the needs and characteristics of individual learners. This model integrates the principles of adaptability into the context of *Maharah Istima*' learning, particularly in accommodating variations in cognitive abilities, auditory comprehension levels, and student learning responses.

H. Novelty of the Proposed Learning Model

The novelty of this model is achieved through the integration of cross-study findings that previously developed separately in the realms of neurolinguistics, language learning pedagogy, and digital learning, resulting in a more integrated and comprehensive framework. This integration does not stop at merely combining concepts descriptively, but also emphasizes the functional relationships between components that are systematically constructed based on the suitability of patterns found in various literatures. Thus, the novelty in this model does not lie solely in the compilative aspect, but rather in the consistency of functional relationships between elements that have been tested through source triangulation and strengthened by an iterative, comparative, and iterative theoretical synthesis process until achieving stable conceptual alignment.

Conceptually-operationally, this novelty lies in:

1. Repositioning *Maharah Istima*' as a cognitive processing system. In this model, listening skills are no longer viewed as a passive receptive activity, but rather as an active mental process involving stages of sound processing (phonological decoding), integration in working memory, construction of meaning, and storage in long-term memory. Thus, learning no longer focuses on the final outcome of a right or wrong answer, but rather on how the cognitive process unfolds and can be optimized.
2. Operationalizing a neurolinguistic perspective into learning design. Neurolinguistics in this model serves not only as a theoretical foundation but also translates directly into instructional strategies, such as managing cognitive load, activating working memory through gradual tasks, and strengthening emotional aspects to increase retention. In other words, the principles of how the brain processes language go beyond explanation and become the foundation for designing more effective learning experiences.
3. The transformation of digital learning into an adaptive learning system. Technology is no longer positioned as a medium for delivering material, but as a system that actively manages data-driven learning. Every student response is recorded, analyzed, and used to adjust the difficulty level of the material, the type of activity, and the form of feedback in real time. This makes learning more personalized and responsive to individual needs.
4. Integration between individual processing and learning context. Previously, *Maharah Istima*' learning tended to focus on individual aspects without considering the context of

actual language use. In this model, students' internal cognitive processes are connected to contextual and multimodal communication situations, so that understanding is not only linguistic but also functional in real life. This integration encourages a shift from individual listening to contextual listening comprehension.

5. Establishing a closed-loop adaptive learning system. The model is designed as a cyclical system that connects input, processing, response, feedback, and adaptation in a continuous flow. Each learning outcome does not stop as output but becomes data used to improve subsequent learning processes. With this mechanism, learning is iterative, adaptive, and evidence-based, allowing the development of *Maharah Istima*'s abilities to be systematically monitored and improved.

To ensure that this model is not only conceptual but also empirically testable, each main component is broken down into measurable operational indicators. Auditory processing is measured through the level of accuracy of students' comprehension in completing listening tasks, while working memory is observed through the speed of response to auditory stimuli. Digital adaptation is identified through changes in the type and difficulty of tasks based on student performance, while learning engagement is measured by the frequency of student participation in digital activities. Furthermore, adaptive feedback is analyzed through performance improvements following feedback, and adaptive cycles are evaluated based on the consistency of student ability development over time. Thus, the main novelty of this model lies not only in the integration of neurolinguistics, language pedagogy, and digital learning, but also in its ability to build a *Maharah Istima*' learning system that is adaptive, measurable, data-driven, and oriented towards continuous skill development.

I. Interpretation of Findings and Pedagogical Implications

The findings of this study show that the integration between neurolinguistics and digital learning does not merely enrich learning methods *Maharah Istima*', but fundamentally transforms the learning paradigm itself. While previously listening learning tended to be passive and focused on receiving information, through this integration, learning evolves into a cognitive-based, adaptive system that responds to student needs and characteristics. The learning process is no longer linear, but rather dynamic and based on the interaction between input, mental processing, and ongoing feedback.

Within this framework, the role of teachers has undergone a significant shift. Teachers are no longer positioned as the sole source of knowledge or conveyor of information, but rather as learning architects who strategically design learning experiences [38]. Teachers are tasked with managing a learning ecosystem that integrates cognitive, technological, and contextual aspects of learning, and utilizing student performance data to determine appropriate interventions. Thus, learning becomes more focused, personalized, and evidence-based.

The pedagogical implications of these findings are evident in the transformation of learning design, which is no longer uniform but rather adaptive and multimodal. Material is presented through a combination of audio, visual, and digital interactions, enabling students to understand language more contextually and deeply. This approach also directly increases student engagement, as they are not merely recipients of information but actively interact, respond, and construct understanding independently. This engagement is key to activating more complex cognitive processes, such as analysis, interpretation, and reflection.

Furthermore, learning evaluation has shifted from a summative model to a continuous, data-driven evaluation. Every student activity generates data that can be analyzed to understand their development in real time. This allows teachers to make quick and precise adjustments to instruction, making the learning process more effective and efficient. From a neurolinguistic perspective, this approach also strengthens cognitive processing through

targeted stimulation of memory, attention, and emotions, all of which contribute to improved language comprehension.

Furthermore, in the context of Islamic schools, this integration has an additional strategic dimension: strengthening religious values in learning. The use of Qur'an-based content and contextual communication situations allows Arabic language learning to function not only as a means of mastering linguistic skills but also as a means of internalizing spiritual and moral values [2]. Thus, the findings of this study indicate that the integration of neurolinguistics and digital learning not only enriches the *Maharah Istimah*' learning method but also fundamentally transforms the learning paradigm itself.

CONCLUSION AND IMPLICATION

Based on the overall research findings, it can be concluded that the principles of neurolinguistics and digital learning can be integrated in *Maharah Istimah*' learning through the alignment of cognitive mechanisms (working memory, attention, emotions) with interactive, adaptive, and multimodal technology-based learning designs, so that the listening process is not only understood as receiving information, but as an active and gradual process of processing meaning. This integration is then realized in the form of an Integrative Arabic Language Learning Model Based on Neurolinguistics and Digital Learning that is systematic and applicable, which connects auditory input, neurolinguistic processing, adaptive learning systems, and iterative feedback loops in a data-driven learning cycle that enables personalization and sustainable development of student skills. The pedagogical implications of this model indicate the transformation of *Maharah Istimah*' learning from a linear and passive pattern into a dynamic, contextual, and responsive learning system, where teachers act as learning architects, evaluation is continuous and data-based, and students' listening skills can be optimized through strengthening cognitive, affective, and technological aspects simultaneously in the 21st-century learning ecosystem in Islamic schools.

The implications of this study affirm that *Maharah Istimah*' learning needs to be developed in a more adaptive, interactive, and data-driven manner through the integration of neurolinguistic principles and digital learning. Arabic language teachers are no longer positioned merely as transmitters of learning materials, but as designers of learning experiences who are able to manage auditory input, multimodal activities, interactive exercises, and continuous feedback according to students' needs. This model has implications for increasing students' cognitive and affective engagement, strengthening listening comprehension progressively, and utilizing technology as a personalized and contextual learning system. For Islamic schools, this study also encourages the strengthening of teachers' digital literacy, the provision of relevant learning media, and the integration of Islamic values into *istimah*' materials. Thus, this study offers a new direction for 21st-century Arabic language learning that is more effective, meaningful, and aligned with learners' characteristics, although it still requires empirical validation through field research.

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