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Towards a Proposed Instructional Model for Harnessing Generative Artificial Intelligence to Personalize Arabic Language Teaching for Non-Native Speakers in Light of Cognitive Load Theory

Vers un modèle pédagogique proposé pour l'exploitation de l'intelligence artificielle générative dans la personnalisation de l'enseignement de la langue arabe aux non-arabophones selon la théorie de la charge cognitive

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Abstract:

This study aims to develop a proposed instructional model for employing Generative Artificial Intelligence (GenAI) to personalize Arabic language learning for non-native speakers in light of Cognitive Load Theory among international students in higher education. It also seeks to explore the integration of these two approaches to design adaptive learning environments. The study adopts a descriptive-analytical approach to develop an instructional framework that integrates both conceptual and practical dimensions for the development of the proposed model.

The findings reveal that the systematic integration between generative artificial intelligence and cognitive load theory enables the design of adaptive learning pathways that accommodate the learner's proficiency level-through diagnosing educational needs, generating scaffolding content and activities, and providing immediate feedback-thereby contributing to enhanced learning outcomes. Furthermore, the article proposes an instructional model comprising five interconnected phases (diagnosis, cognitive load analysis, content personalization, feedback management, and adaptive assessment), providing a theoretical and practical framework for advancing Arabic language education in digital environments.

Keywords: Generative Artificial Intelligence; Arabic Language Pedagogy for Non-Native Speakers; Personalized Learning; Cognitive Load Theory; Instructional Design.

Résumé:

Cet article vise à élaborer un modèle pédagogique proposé pour l'exploitation de l'intelligence artificielle générative dans la personnalisation de l'apprentissage de la langue arabe aux non-arabophones, à la lumière de la théorie de la charge cognitive chez les étudiants étrangers dans l'enseignement supérieur, ainsi qu'à explorer les complémentarités entre elles pour concevoir des

environnements d'apprentissage adaptatifs. L'étude adopte une approche descriptive-analytique pour établir un cadre pédagogique conceptuel et appliqué afin de construire ce modèle.
Les résultats révèlent que l'intégration systématique entre l'intelligence artificielle générative et la théorie de la charge cognitive permet de concevoir des parcours d'apprentissage adaptatifs qui prennent en compte le niveau de l'apprenant—à travers le diagnostic des besoins, la génération de contenus et d'activités progressifs, et la fourniture d'un feedback immédiat—ce qui contribue à l'amélioration des acquis d'apprentissage. De plus, l'article propose un modèle pédagogique composé de cinq phases interconnectées (diagnostic, analyse de la charge cognitive, personnalisation du contenu, gestion du feedback et évaluation adaptative), offrant ainsi un cadre pour le développement de l'enseignement de la langue arabe dans les environnements numériques.
Mots-clés : Intelligence artificielle générative ; Didactique de l'arabe langue étrangère ; Apprentissage personnalisé ; Théorie de la charge cognitive ; Design pédagogique.

1. Introduction

The higher education sector is undergoing a rapid transformation driven by successive developments in generative artificial intelligence (GAI) technologies. These advancements have created new opportunities to enhance instructional practices and transition from standardized instruction to personalized learning that accommodates individual differences among learners. In the field of Teaching Arabic to Speakers of Other Languages (TASOL) for international students, there is a growing need to integrate these technologies within pedagogical frameworks grounded in contemporary learning theories. This integration serves to keep pace with digital demands and adapt complex morphological, syntactic, and semantic content to develop learners' linguistic competencies and core skills.

The research problem manifests in the marked disparity among international learners' background knowledge and learning styles, which results in varying rates of skill acquisition and increases the cognitive load imposed on working memory due to content density or poor activity design. Despite the promising opportunities provided by generative artificial intelligence in performance analysis and adaptive content generation, an analytical review of the literature reveals a research gap-namely, a scarcity of studies that offer an integrated instructional model combining the capabilities of these technologies with the principles of Cognitive Load Theory (CLT). Consequently, the central research problem is articulated in the following main question:

How can generative artificial intelligence be harnessed to construct an instructional model that achieves personalized Arabic language learning in light of Cognitive Load Theory?

From this perspective, the significance of this study stems from two complementary dimensions: a theoretical significance that lies in enriching the educational literature with a framework integrating AI technologies and Cognitive Load Theory in language pedagogy, and a practical significance centered on providing a functional model that curriculum designers and instructors can utilize to alleviate cognitive burden and personalize learning for international students. Accordingly, the study aims to uncover the theoretical and integrative foundations between artificial intelligence and Cognitive Load Theory, diagnose the parameters of this load among

international learners, and ultimately develop a proposed instructional model that respects the learner's cognitive capacity while tailoring their educational pathway.

To provide accurate answers to this problem and achieve these objectives, the study adopts a descriptive-analytical approach to systematically review and deconstruct the relevant literature, alongside a conceptual instructional design approach to structure the proposed model. This approach delivers a conceptual and applied framework to guide the personalization of Arabic language instruction for non-native speakers and ensure the reduction of cognitive load in digital environments.

2. Artificial Intelligence

Artificial Intelligence (AI) is considered one of the most prominent digital technologies that has brought about a radical transformation across various fields, owing to its ability to simulate human capabilities in learning, analysis, and decision-making. Today, it has become a primary driver of innovation and sustainable development by enhancing efficiency and supporting decision-making processes across diverse sectors.

2.1. Concept of Generative Artificial Intelligence

Generative Artificial Intelligence (GAI) represents one of the most notable recent advancements in the field of AI. It relies on deep learning models capable of producing new content that mimics human creation-whether text, images, audio, or programming code-by leveraging vast amounts of data used to train these models. Unlike traditional AI applications that focus on classification or prediction, Generative AI is distinguished by its capacity for creativity and the generation of novel outputs tailored to user-provided prompts.[1]

Furthermore, the emergence of Large Language Models (LLMs) has catalyzed a qualitative shift in education. These models have become capable of generating instructional texts, answering queries, designing activities, providing immediate feedback, and explaining concepts using varied approaches, making them promising tools for supporting teaching and learning processes.[2]

2.2. Characteristics of Generative Artificial Intelligence in Educational Environments

Generative Artificial Intelligence is characterized by a set of features that enhance its potential for educational application, most notably:

- Personalization of educational content according to the learner's level and needs.
- Real-time interaction with learner queries and the provision of immediate feedback.
- Generation of diverse activities and questions at varying levels of difficulty.
- Support for self-directed and independent learning.
- Analysis of learner performance and the recommendation of suitable learning pathways.
- Flexibility in designing and continuously reproducing educational resources.

These characteristics position Generative Artificial Intelligence as a powerful tool capable of shifting education from a standardized model to personalized learning that respects individual differences among learners.

3. Teaching Arabic Pedagogy

The didactics of the Arabic language is an educational field concerned with the study of methods for teaching and learning Arabic based on modern scientific approaches, with the aim of developing learners' linguistic and communicative competencies. It relies on the implementation of instructional strategies and pedagogical techniques that contribute to improving the quality of learning and enhancing the efficiency of language performance.

3.1. Concept and Objectives

Arabic language pedagogy is defined as the scientific discipline that examines the methods of teaching and learning Arabic through applying linguistic, psychological, and pedagogical principles to design instructional situations that develop the learner's linguistic and communicative competencies. Arabic language pedagogy goes beyond transferring linguistic knowledge; it aims to build a learner capable of utilizing language in various life situations, interacting with texts, and effectively producing oral and written discourse.[3]

Arabic language pedagogy seeks to achieve a set of key objectives, most notably:

- Developing skills in listening, speaking, reading, and writing.
- Equipping the learner with grammatical, morphological, and semantic competencies.
- Enhancing the ability to communicate in Arabic across various contexts.
- Cultivating critical and creative thinking through language activities.
- Utilizing modern technology to improve learning quality.

3.2. Requirements of Arabic Language Pedagogy in the Digital Age

Digital transformation has imposed new challenges on Arabic language pedagogy, most notably the necessity of transitioning from traditional teaching to interactive digital learning environments that respond to learners' needs. The success of the educational process is no longer solely tied to content abundance, but rather to the teacher's ability to design flexible learning that respects individual differences among learners and encourages active participation.[4]

In this framework, there is a growing need to employ Generative Artificial Intelligence tools in designing lessons and activities, generating instructional texts, preparing scaffolded exercises, correcting linguistic errors, and providing real-time feedback, thereby contributing to the enhancement of Arabic language learning and fostering learner autonomy.

3.3. Fields of Applying Generative Artificial Intelligence in Arabic Language Pedagogy

Generative Artificial Intelligence can be applied in Arabic language pedagogy across multiple fields, most notably:

- **Educational Content Generation:** Preparing reading texts and questions tailored to lesson objectives and learners' proficiency levels.
- **Developing Reading Skills:** Producing diverse texts accompanied by comprehension questions that progress in difficulty.
- **Developing Writing Skills:** Offering suggestions for stylistic improvement, correcting language errors, and rephrasing texts while explaining the rationale for edits.

- **Developing Speaking and Listening Skills:** Creating conversational scenarios and communicative activities that simulate real-life situations.
- **Smart Assessment:** Designing adaptive tests, analyzing learner responses, and providing immediate feedback that aids in performance enhancement.
- **Personalized Learning:** Constructing tailored educational pathways based on the learner's proficiency level, learning pace, strengths, and weaknesses.[5]

From the above, it is evident that Generative Artificial Intelligence represents a promising opportunity to advance Arabic language pedagogy due to its capabilities in content generation, learning personalization, and ongoing assessment support. However, maximizing the benefits of these technologies requires employing them within a pedagogical framework based on modern learning theories. This makes Cognitive Load Theory a suitable framework for guiding the design of smart learning environments that respect learners' characteristics and effectively support knowledge construction, which will be addressed in the second section.

4. Cognitive Load Theory and Learning Personalization in Arabic Pedagogy

Cognitive Load Theory is considered one of the most prominent educational theories that seeks to optimize learning by structuring information in alignment with the processing capacity of working memory. Meanwhile, learning personalization focuses on accommodating individual differences among learners and tailoring content and activities to their specific needs and levels. In Arabic language pedagogy, the integration of these two approaches contributes to enhancing linguistic skill acquisition, improving comprehension, and providing a more effective and efficient educational environment.

4.1. Concept of Cognitive Load Theory

Cognitive Load Theory (CLT) is a leading contemporary framework in cognitive psychology and instructional design, developed by researcher John Sweller in the late 1980s to explain how working memory processes information during learning. The theory originates from a fundamental premise: working memory has a limited capacity, and exceeding this capacity leads to decreased learning efficiency and impairs the ability to process and acquire information.[6]

The theory posits that the success of the educational process is not solely dependent on the volume of information presented, but rather on how appropriately its design aligns with the learner's cognitive capacities. Therefore, instructional design should minimize unnecessary mental effort and direct cognitive resources toward building and organizing mental schemas within long-term memory, thereby achieving deeper and more sustainable learning.

4.2. Types of Cognitive Load

Cognitive Load Theory distinguishes between three primary types of cognitive load, each differing in its origin and impact on the learning process:

4.2.1. Intrinsic Cognitive Load

Intrinsic cognitive load is inherent to the nature of the learning material itself, its degree of complexity, and the number of elements the learner must process simultaneously. It is also influenced by the learner's prior knowledge; novice learners typically experience a higher intrinsic

load compared to expert or native speakers of the language. In Arabic language pedagogy, this type of load increases when studying complex grammatical rules, analyzing literary texts, or acquiring morphological and semantic structures that require concurrent processing of multiple concepts.[7]

4.2.2. Extraneous Cognitive Load

Extraneous cognitive load arises from poor instructional design or suboptimal presentation methods, rather than the intrinsic nature of the content itself. Examples include cluttered screens, unclear instructions, or presenting text and visuals in a distracting manner. This type of load is undesirable because it consumes working memory resources without contributing to learning outcomes; thus, it should be minimized through improved activity and media design.[8]

4.2.3. Germane Cognitive Load

Germane cognitive load represents the constructive mental effort directed by the learner toward understanding information, integrating it with prior knowledge, and constructing the cognitive schemas essential for learning. This type of load is beneficial as it facilitates knowledge retention and fosters higher-order thinking skills. Effective instructional design aims to reduce extraneous load, manage intrinsic load, and foster germane load to achieve meaningful learning. [9]

5. Personalizing Learning in Light of Cognitive Load Theory

Personalized learning refers to designing educational experiences tailored to each learner's characteristics-including cognitive level, learning pace, interests, and educational needs-enabling them to achieve optimal learning outcomes. This approach aligns directly with the principles of Cognitive Load Theory; accommodating individual differences ensures the presentation of content suitable for the learner's abilities, thereby reducing the likelihood of overloading working memory with information beyond its processing capacity. When learners receive content aligned with their actual proficiency, their capacity for comprehension increases, enhancing overall instructional effectiveness.[10]

In Arabic language pedagogy, learning personalization can be achieved through diversifying texts and activities, adapting language exercises, scaffolding difficulty levels, and delivering targeted feedback tailored to individual performance.

5.1. Design Principles for Personalized Learning in Arabic Language Pedagogy

To maximize the benefits of Generative Artificial Intelligence in light of Cognitive Load Theory, several core principles should be observed when designing Arabic learning environments:

- Diagnosing learners' linguistic and cognitive levels prior to instruction.
- Segmenting content into interconnected modules scaffolded in difficulty.
- Minimizing distracting elements within the learning environment.
- Diversifying activities to match learner characteristics.
- Utilizing applied examples linked to real-world contexts.
- Providing immediate, targeted feedback.
- Adopting adaptive assessment that tracks learner development.
- Continuously updating learning pathways based on assessment outcomes. [11]

The preceding indicates that Cognitive Load Theory provides a solid scientific framework for designing learning environments that respect working memory limitations and support effective knowledge construction. Concurrently, Generative Artificial Intelligence offers advanced technical capabilities to apply these principles in practice through content personalization, activity adaptation, feedback delivery, and continuous assessment. Consequently, the integration of these two dimensions establishes the theoretical and practical foundation for constructing an instructional model capable of advancing Arabic language pedagogy-a topic addressed in the following section.

5.2. Proposed Instructional Model for Harnessing Generative AI in Arabic Pedagogy in Light of Cognitive Load Theory

The proposed instructional model is based on leveraging Generative Artificial Intelligence in Arabic language pedagogy to achieve more efficient and flexible learning, while adhering to Cognitive Load Theory principles in organizing content and reducing unnecessary cognitive load. It aims to foster personalized learning that adapts to learners' needs, thereby developing their linguistic skills and improving learning outcomes.

5.2.1. Philosophy of the Proposed Model

The proposed model stems from an integrative perspective combining the personalization capabilities offered by Generative AI with the design principles emphasized by Cognitive Load Theory. It operates under the premise that enhancing Arabic language learning is not achieved merely by introducing AI tools into the classroom, but rather by employing them within a pedagogical framework that respects learners' characteristics, working memory limits, and individual differences.

The model aims to transition from standardized instruction to adaptive learning, enabling each learner to receive content and activities aligned with their linguistic and cognitive levels, while minimizing extraneous load, managing intrinsic load, and fostering germane load to support knowledge construction.

5.2.2. Components of the Proposed Model

The model consists of five interconnected components that work integratively to achieve personalized and effective learning:

- **A. Learner Diagnosis:** Serving as the starting point, this phase gathers learner-related data-including linguistic proficiency, prior knowledge, recurring language errors, learning pace, learning style, and cognitive load indicators-to build an educational profile that forms the foundation for content personalization.
- **B. Educational Data Analysis:** The AI system analyzes the gathered data to identify strengths, pinpoint weaknesses, categorize learners into proficiency levels, and estimate the appropriate level of content complexity, thereby mitigating unnecessary cognitive overload.
- **C. Personalized Content Generation:** Based on analysis results, the system produces tailored learning content, including reading texts scaffolded in difficulty, grammar and morphology exercises, written expression tasks, communicative listening/speaking scenarios, and questions

targeting varied cognitive levels. Content is scaffolded from simple to complex and segmented into bite-sized units.[12]

- **D. Smart Feedback:** The system provides immediate feedback following each activity, including error correction, explanations for mistakes, alternative correct forms, additional examples, and remedial or enrichment tasks tailored to performance. [13]
- **E. Adaptive Assessment:** Ending in continuous adaptive evaluation, the system adjusts question difficulty based on performance, tracks skill progression, updates learner profiles periodically, and re-architects content when necessary, making assessment an active part of the learning process. [14]

5.2.3. Application of the Model in Arabic Language Pedagogy

The mechanisms of this model can be applied across various domains of Arabic language instruction for non-native speakers:[15]

- **Reading:** Generating texts tailored to the learner's level alongside varied comprehension questions.
- **Writing:** Analyzing learner-produced text, offering corrections, and suggesting stylistic improvements.
- **Grammar and Morphology:** Presenting scaffolded exercises with supplementary examples based on mastery level.
- **Listening and Speaking:** Designing communicative situations and prompts that stimulate active interaction.
- **Vocabulary:** Recommending contextualized activities to expand lexical repertoire.

5.2.4. Roles of Teacher and Learner in the Model

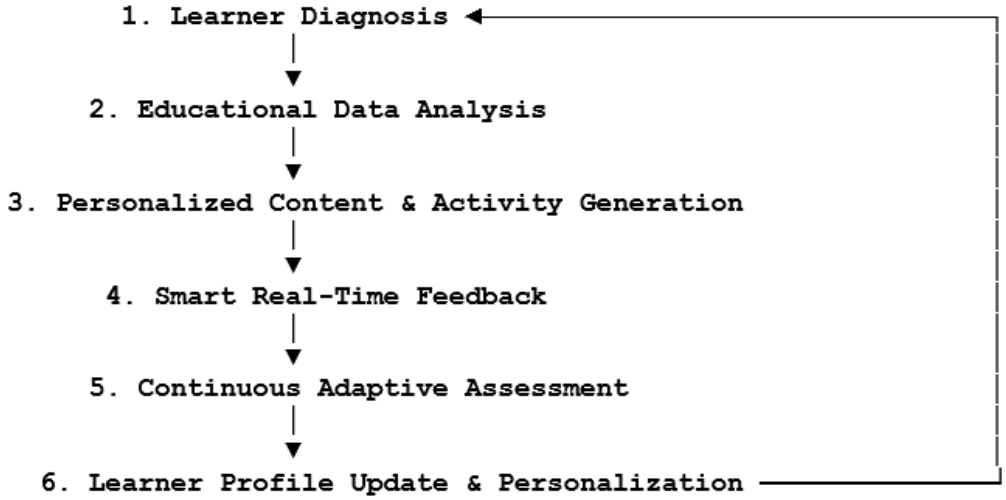
The model does not aim to replace the teacher with artificial intelligence, but rather to redistribute roles to enhance educational quality:

- **Role of the Teacher:** Planning instructional situations, selecting learning objectives, reviewing AI-generated content, guiding learners, tracking progress, and interpreting assessment results to make informed pedagogical decisions.
- **Role of the Learner:** Engaging actively with activities, utilizing feedback, executing remedial/enrichment tasks, managing self-directed learning, and continuously monitoring their own progress.

5.2.5. Success Indicators of the Model

The effectiveness of the model can be evaluated through several indicators: improvement in linguistic competencies, reduction in recurring language errors, decreased extraneous cognitive load during learning, heightened learner engagement, improved formative/summative assessment results, and enhanced learner autonomy.

Accordingly, the proposed instructional model can be represented in the following diagram:



5.3. Discussion of the Proposed Model and Future Prospects

This section discusses the proposed model and illuminates its pedagogical and practical dimensions in Teaching Arabic to Speakers of Other Languages (TASOL), analyzing its efficacy in managing cognitive load and personalizing learning while exploring future integration prospects in digital environments.

5.3.1. Analytical Reading of the Proposed Model

The proposed model is grounded in a pedagogical vision that views Generative AI as a supportive tool rather than a replacement for the teacher. Its primary value lies in harnessing Large Language Models within a framework anchored in Cognitive Load Theory, ensuring technology serves learning goals rather than acting as a mere technical novelty. Furthermore, it shifts instruction from a one-size-fits-all model to adaptive learning by balancing task challenge with cognitive capacity, thereby directing mental resources toward knowledge construction.

5.3.2. Contribution of the Model to Cognitive Load Management

The model demonstrates clear alignment with Cognitive Load Theory through three key mechanisms:

- **Reducing Extraneous Cognitive Load:** By simplifying content, organizing it into coherent modules, providing clear instructions, and removing distracting elements.
- **Managing Intrinsic Cognitive Load:** By tailoring content to learner proficiency and breaking complex tasks into scaffolded steps aligned with working memory limits.
- **Fostering Germane Cognitive Load:** By encouraging learners to analyze errors, connect new knowledge to prior experience, and engage in reflective problem-solving.

The discussion demonstrates that the proposed model possesses theoretical and practical foundations enabling it to advance Arabic language pedagogy. Successful implementation requires

a supportive learning environment, clear organizational policies, and ongoing teacher training to enhance instructional quality, linguistic competencies, and learner autonomy.

5.4. Practical Implementation of the Proposed Model through Prompt Engineering

To illustrate the practical implementation of the proposed instructional model, this section presents an example of prompt engineering designed according to Cognitive Load Theory. The scenario demonstrates how Generative Artificial Intelligence can personalize Arabic grammar instruction for an A2-level learner while effectively regulating cognitive load.

5.4.1. System Input (Structured Prompt)

Prompt: *Act as an adaptive Arabic language tutor grounded in Cognitive Load Theory.*
Target Learner: Elementary Arabic (A2 Level)
Learning Objective: Teach the basic concept of the Arabic Possessive Construction (Idafa).
Cognitive Constraints:

- **Reduce Extraneous Cognitive Load:** Delay introducing technical grammatical terminology (e.g., *Mudaf* and *Mudaf Ilayh*) until the learner understands the basic concept. Use simple language and clear visual formatting.
- **Manage Intrinsic Cognitive Load:** For this introductory lesson, present only one simplified grammatical pattern: **Indefinite noun + Definite noun beginning with "al-"**. Exclude case endings, irregular forms, and grammatical exceptions.
- **Enhance Germane Cognitive Load:** Provide two worked examples followed by one guided completion exercise that encourages schema construction and knowledge transfer.

5.4.2. AI System Output

Concept: The Arabic **Idafa (Possessive Construction)** connects two nouns to express ownership or association.
Simplified Rule (Introductory Level)

- **Word 1:** An indefinite noun.
- **Word 2:** A definite noun beginning with **"al-"**.

Worked Examples:

- **Kitāb** (book) + **al-ṭālib** (the student) → **Kitābu al-ṭālib** "The student's book"
- **Sayyārah** (car) + **al-muʿallim** (the teacher) → **Sayyāratu al-muʿallim** "The teacher's car"

Practice Activity:
Combine the following words to express **"The boy's pen".**
Qalam (pen) + **al-walad** (the boy)
Answer: The boy's pen

5.4.3. Cognitive Load Management Analysis

- **Extraneous Cognitive Load Reduction:** The lesson minimizes unnecessary processing demands by postponing unfamiliar grammatical terminology and presenting the rule through simple language and clear formatting. This allows working memory resources to focus on understanding the core concept.

- **Intrinsic Cognitive Load Management:** Instruction is limited to a single introductory grammatical pattern, reducing element interactivity and matching the cognitive abilities expected of an A2 learner. Advanced grammatical features, such as case endings and exceptions, are intentionally postponed.
- **Germane Cognitive Load Enhancement:** Two worked examples followed by a guided completion activity promote schema construction, reinforce the grammatical relationship between the two nouns, and facilitate knowledge transfer to similar language contexts.

Table (01) : Cognitive Load Regulation through Prompt Engineering

Prompt Design Principle	Cognitive Load Component	Instructional Function
Simple language and delayed terminology	Extraneous Load	Reduces unnecessary cognitive processing
One grammatical pattern at a time	Intrinsic Load	Controls instructional complexity according to learner level
Worked examples	Germane Load	Facilitates schema construction
Guided completion exercise	Germane Load	Promotes knowledge transfer and active learning
Clear instructional sequencing	Overall Cognitive Load	Supports progressive learning and retention

Source: Designed by the researcher.

This sequence demonstrates that the proposed model operates as a continuous and adaptive instructional cycle. By leveraging assessment outcomes to update learner profiles and dynamically adjust content and activities, the framework systematically aligns Generative AI capabilities with Cognitive Load Theory principles.

Consequently, integrating learner diagnosis, cognitive load analysis, content personalization, smart feedback, and adaptive assessment transforms generative tools from passive media into a structured cognitive support system. This integrative approach offers a robust, practical foundation for TASOL digital environments, paving the way for future empirical validation and cross-cultural implementation.

6. Conclusion

In conclusion, the proposed model bridges the gap between the capabilities of Generative Artificial Intelligence and human cognitive architecture in Teaching Arabic to Speakers of Other Languages (TASOL). By reducing extraneous cognitive load through simplified interfaces and well-structured prompts, managing intrinsic load through scaffolded content segmentation, and enhancing germane load through contrastive activities and real-time intelligent feedback, Generative AI evolves from a mere content-generation tool into a cognitive support system that enhances learning efficiency. Accordingly, the study demonstrates that the pedagogically guided integration of Generative AI, grounded in Cognitive Load Theory, provides a promising

framework for improving Arabic language instruction in AI-supported learning environments. **The principal findings and recommendations are summarized below.**

6.1. Findings

1. Effective integration of Generative AI in Arabic instruction requires grounding in contemporary learning theories-chiefly Cognitive Load Theory-to reduce extraneous cognitive load and facilitate working memory processing.
2. Generative tools can effectively diagnose individual learner needs, generate scaffolded content, and provide adaptive feedback that promotes learner autonomy.
3. The research formulates an instructional framework comprising five interconnected phases (Learner Diagnosis, Data Analysis, Content Personalization, Smart Feedback, and Continuous Adaptive Assessment), offering a conceptual blueprint for digital environments.
4. AI serves as a supportive tool that enhances instructional efficiency and optimizes classroom management time, provided ethical and academic standards are maintained.

6.2. Recommendations

1. Incorporate the parameters of the proposed model into the development of smart Arabic educational platforms to offer tailored learning pathways for non-native speakers.
2. The findings demonstrated the ability of generative AI tools to diagnose individual learning needs, generate learning content with progressively increasing levels of difficulty, and provide adaptive feedback that promotes self-directed learning while accommodating individual differences among international students.
3. Review and update Arabic language curricula for international students to align with adaptive learning requirements and scaffolded generative activities.
4. Establish clear governance frameworks and ethical guidelines governing AI usage in educational institutions, ensuring data privacy and academic integrity.

6.3. Future Research Directions

1. Experimental validation of the proposed framework.
2. Integration with Large Language Models.
3. Comparison with conventional instruction.
4. Measuring cognitive load quantitatively.
5. Application to speaking, writing and pronunciation.
6. Cross-cultural validation.

Footnotes:

[1] **-** Sweller, J. Cognitive Load Theory in Instructional Design**.** Riyadh: Al-Hadeeth, 2022, p. 45.

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