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ARTIFICIAL INTELLIGENCE AND LANGUAGE LEARNING: TOWARDS AN ADAPTIVE COGNITIVE-LINGUISTIC MODEL FOR PERSONALIZED EDUCATION

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Abstract
The integration of artificial intelligence (AI) into language education has transformed traditional pedagogical approaches by enabling adaptive, personalized learning environments. However, existing frameworks often lack a comprehensive theoretical foundation that integrates cognitive linguistics, second language acquisition (SLA), and AI-driven systems. This paper proposes an interdisciplinary model—the Adaptive Cognitive-Linguistic AI Model (ACL-AI)—that explains how AI systems can align with human cognitive processes in language learning. Drawing on recent journal literature in applied linguistics, educational technology, and artificial intelligence, the study critically evaluates current AI-based language learning tools and identifies conceptual gaps. The proposed model emphasizes learner cognition, feedback loops, and dynamic adaptation. The paper contributes to interdisciplinary research by offering a theoretically grounded framework for future AI-driven language education systems.

Keywords: Artificial intelligence, language learning, cognitive linguistics, adaptive learning, interdisciplinary research, educational technology

1. Introduction

Language learning has traditionally relied on standardized instructional models that assume uniform learner needs. However, advances in artificial intelligence

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(AI) have introduced new possibilities for personalized education, particularly through adaptive learning systems.

AI-powered platforms can analyze learner behavior, provide real-time feedback, and adjust content dynamically. Despite these advancements, current implementations often lack a strong theoretical integration with cognitive and linguistic principles.

This paper addresses this gap by proposing an interdisciplinary model that connects AI technologies with cognitive processes in language acquisition.

2. Literature Review

2.1 AI in Language Education

AI applications in language learning include intelligent tutoring systems, automated feedback tools, and speech recognition technologies.

Holmes et al. (2019) highlight the transformative potential of AI in education, particularly in personalization. Similarly, Zawacki-Richter et al. (2019) identify AI as a key driver of innovation in educational systems.

2.2 Cognitive Linguistics and SLA

Cognitive linguistics emphasizes how language learning is shaped by mental processes such as memory, attention, and pattern recognition.

Ellis (2019) argues that frequency and usage patterns play a critical role in language acquisition.

DeKeyser (2020) highlights the importance of practice and feedback in developing linguistic competence.

2.3 Adaptive Learning Systems

Adaptive learning systems adjust content based on learner performance.

Kulik and Fletcher (2016) demonstrate that adaptive systems improve learning outcomes compared to traditional methods.

However, most systems rely on behavioral data without fully integrating cognitive theories.

2.4 Gaps in Existing Research

- Lack of integration between AI systems and cognitive linguistics
- Over-reliance on data-driven approaches without theoretical grounding
- Limited focus on learner cognition and interaction

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3. Theoretical Framework

3.1 The Adaptive Cognitive-Linguistic AI Model (ACL-AI)

The proposed model integrates three core components:

1. **Cognitive Processing Layer**
   - Memory
   - Attention
   - Pattern recognition
2. **AI Adaptation Layer**
   - Data analytics
   - Machine learning algorithms
   - Feedback systems
3. **Language Learning Outcomes**
   - Fluency
   - Accuracy
   - Retention

3.2 Model Structure

Figure 1: ACL-AI Model

Learner Cognition
(memory, attention, processing)
↓
AI Adaptive System
(data analysis, feedback loops)
↓
Personalized Learning Pathways
↓
Language Acquisition Outcomes
(fluency, accuracy, retention)
↺ (continuous feedback loop)

4. Model Implications

4.1 Personalized Learning

The model enables tailored instruction based on cognitive characteristics, improving learner engagement.

4.2 Feedback Optimization

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Table 1: Traditional vs AI-Based Feedback

Feature	Traditional Learning	AI-Based Learning
Feedback timing	Delayed	Immediate
Personalization	Low	High
Adaptability	Limited	Dynamic

4.3 Interdisciplinary Integration

The model bridges:

- Linguistics
- Cognitive science
- Artificial intelligence

5. Discussion

The ACL-AI model demonstrates that effective AI-driven language learning must go beyond algorithmic efficiency. It requires alignment with cognitive processes and linguistic principles.

This interdisciplinary integration enhances both theoretical understanding and practical application.

6. Conclusion

AI has the potential to revolutionize language education, but its effectiveness depends on theoretical grounding. The proposed model offers a pathway for integrating cognitive linguistics with AI systems to create more effective and personalized learning environments.

Future research should focus on empirical validation of the model and its application in real-world educational settings.

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