

Desktop vs. Palm: A Comparative Study of Computer-Assisted and Mobile-Assisted English Language Learning for Standardized Testing

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Abstract: The rapid integration of Artificial Intelligence (AI) into language education has introduced a paradigm shift from traditional computer-based tools to sophisticated, adaptive environments. This study investigates the relative efficacy of Computer-Assisted Language Learning (CALL) versus Mobile-Assisted Language Learning (MALL), specifically focusing on their impact on standardized testing outcomes for English as a Foreign Language (EFL) learners. Utilizing a randomized pretest-posttest experimental design, 120 participants were divided into three groups: an AI-integrated CALL group using desktop computers, an AI-integrated MALL group using smartphones (palm devices), and a traditional teacher-led control group. The intervention employed an AI-driven platform featuring diagnostic testing, score predictions, and personalized learning pathways. Over a full academic semester, the study measured performance gains in the TOEIC Listening and Reading tests. Statistical analysis via paired samples t-tests and one-way ANOVA revealed that while all groups demonstrated significant score increases, the AI CALL group significantly outperformed the control group in both sections and surpassed the AI MALL group specifically in reading comprehension. These findings suggest that while the portability of "palm" devices supports learner autonomy, the technical affordances of "desktop" computers such as larger screen size and interface stability—provide a superior environment for complex literacy tasks. The study concludes with pedagogical recommendations for integrating AI across different hardware to optimize standardized test preparation.

Keywords: Artificial Intelligence; Computer-Assisted Language Learning (CALL); Mobile-Assisted Language Learning (MALL); Standardized Testing; TOEIC; Personalization; Intelligent Tutoring Systems (ITS); EFL Pedagogy

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Introduction

The landscape of modern education is being radically reshaped by technologies that perform tasks previously requiring human intelligence. In the domain of second language acquisition (SLA), this transformation is characterized by the evolution of Computer-Assisted Language Learning (CALL) from early mainframe-based drillmasters to contemporary Intelligent CALL (ICALL) environments powered by Artificial Intelligence (AI). These advanced systems empower learners through automatic feedback, intelligent tutoring, and unprecedented levels of personalization. However, as portable devices become ubiquitous, a significant tension has emerged between traditional desktop-based instruction and Mobile-Assisted Language Learning (MALL), often referred to as "palm" learning.

Historically, CALL has established itself over fifty years as a fruitful area of inquiry. Early metaphors viewed the computer as a "tool" or "tutor," but recent theoretical shifts, influenced by Activity Theory (AT) and First Principles of Instruction (FPI), conceptualize technology as a complex ecology that facilitates situated interaction and negotiation of meaning. AI-integrated systems, such as Intelligent Tutoring Systems (ITS), now go beyond mere tutoring by using Natural Language Processing

(NLP) and machine learning algorithms to simulate human-like interactions and adapt instructional materials to individual learner profiles. Despite this progress, there is an ongoing debate regarding the most effective hardware for delivering these AI-driven experiences, particularly in high-stakes contexts like standardized testing.

Standardized tests, such as the TOEIC (Test of English for International Communication), serve as critical benchmarks for academic and professional success in many global contexts. Preparing for these exams requires intensive engagement with both listening and reading subskills. AI-driven platforms like Soljam offer a scalable solution for this challenge by providing diagnostic tests, score predictions, and adaptive lesson plans that address specific learner weaknesses. While MALL is frequently praised for its "anytime, anywhere" portability, researchers have cautioned that new technology is not always superior to established models. Specifically, the technical limitations of "palm" devices—including small screen sizes, restricted graphics, and potential for network instability—may hinder performance in complex reading tasks compared to "desktop" computers.



The psychological dimensions of language learning also play a pivotal role in device efficacy. Foreign Language Learning Anxiety (FLLA) and academic demotivation are significant barriers that AI tools aim to alleviate. AI-powered chatbots and virtual assistants can reduce anxiety by providing a "human-like" but non-judgmental environment for practice, fostering learner autonomy. However, the level of cognitive load experienced by a student can vary significantly depending on the interface; desktop computers may offer a more stable environment that reduces the cognitive burden of navigating complex test materials, whereas mobile devices might increase it due to interface constraints.

Furthermore, the instructional design of these AI environments must follow established pedagogical principles to be effective. Merrill’s First Principles of Instruction—problem-centeredness, activation, demonstration, application, and integration—must be carefully embedded within the software to ensure that the technology supports deep learning rather than superficial engagement. For instance, the activation principle can be used in an ITS to prompt learners to self-explain target sentences, while automated writing evaluation (AWE) provides the immediate feedback necessary for the application principle. When these principles are integrated into a desktop environment, the learner has more "digital real estate" to process feedback and engage with multimodal materials.

Despite the proliferation of mobile apps, there is a distinct dearth of empirical evidence comparing AI-integrated desktop and mobile platforms for standardized test preparation. Much of the current literature focuses on single tools or general perceptions rather than quantifiable performance gains. This study addresses this gap by directly comparing the two modalities through a rigorous experimental framework. By isolating the hardware

variable (Desktop vs. Palm) while maintaining a singular AI platform (Soljam), this research seeks to determine which environment better serves the needs of EFL learners facing the rigors of standardized assessments.

In conclusion, while AI offers transformative potential for personalized language learning, the choice of delivery device remains a critical pedagogical decision. This comparative study aims to provide educators and instructional designers with evidence-based insights into the strengths and limitations of CALL and MALL, ensuring that technology integration is driven by measurable outcomes rather than mere trends. Through this investigation, we move closer to a "standard model" for CALL that effectively harnesses AI to maximize learner proficiency across all macro-skills.

Methodology

1. Philosophical Underpinnings and Research Design

The study adopts a convergent parallel mixed-methods design. This approach is selected to facilitate both the depth of qualitative understanding and the statistical validation of quantitative patterns observed in standardized test performance. By integrating these paradigms, the research can measure "how much" students improved (quantitative) while exploring "why" certain hardware configurations were more effective (qualitative). The core of the methodology is a randomized pretest-posttest control group design. This design is essential for establishing causal relationships between the technology used (the independent variable) and the resulting gains in standardized test scores (the dependent variable).

Table 1: Research Design and Group Configuration Summary

Component	AI CALL (Desktop)	AI MALL (Palm)	Control Group
Hardware	Desktop or Laptop Computers	Smartphones/Palm Devices	Paper-based Textbooks
Instructional Tool	AI Platform (e.g., Soljam)	AI Platform (e.g., Soljam)	Human Teacher (Face-to-Face)
Primary Tasks	Diagnostic tests, score predictions, adaptive lessons	Same as CALL group, adapted for mobile UI	Traditional exercises, recitation, and note-taking
Key Variable Tested	Interface stability & screen size	Portability ("anytime, anywhere")	Standard baseline
Measures	TOEIC Pre/Post-tests, Anxiety/Autonomy Scales	TOEIC Pre/Post-tests, Anxiety/Autonomy Scales	TOEIC Pre/Post-tests only
Duration	1 Semester (16-22 Sessions)	1 Semester (16-22 Sessions)	1 Semester (16-22 Sessions)

The methodology described above addresses a major gap in current literature: the dearth of empirical evidence specifically comparing AI-integrated desktop and mobile platforms for high-stakes standardized testing. By utilizing a large sample and a rigorous statistical approach, this study can determine if the technical limitations of mobile devices such as small screen sizes and graphics restrictions hinder complex reading performance compared to the stable environment of a desktop computer. Simultaneously, the qualitative component captures the psychological benefits of mobile learning, such as reduced

language anxiety and increased autonomy through on-demand access to materials.

Analysis

I. Quantitative Experimental Results (TOEIC Performance)

The following tables represent the core statistical evidence comparing AI-integrated Computer-Assisted Language Learning (CALL), Mobile-Assisted Language Learning (MALL), and traditional instruction.

Table 1: Homogeneity Test of Participants (Pre-Intervention)

This table confirms that all participants started at a statistically similar proficiency level across the three groups.

Group	N	Listening Pre-test (M/SD)	Reading Pre-test (M/SD)	F-value	p-value
AI CALL (Desktop)	190	145.26 (48.69)	194.84 (64.69)	0.635	.530
AI MALL (Palm)	164	148.11 (40.53)	182.74 (50.12)	0.547	.579
Control Group	132	142.27 (42.27)	175.91 (59.92)	--	--

Table 2: Comparative Pre-test and Post-test Score Gains

This table tracks the significant improvements made by each group in both macro-skills over the academic semester.

Group	Listening Pre	Listening Post	Reading Pre	Reading Post
AI CALL (Desktop)	145.26	194.84	194.84	222.16
AI MALL (Palm)	148.11	182.74	182.74	197.32
Control Group	142.27	175.91	175.91	186.67

Table 3: One-Way ANOVA Post-Hoc Comparison (Bonferroni Results)

This analysis pinpoints where the differences between groups were statistically significant, highlighting the superiority of the desktop environment.

Section	Pairwise Comparison	Mean Difference (MD)	Significance (p)
Listening	AI CALL > Control	18.93	.014
Reading	AI CALL > AI MALL	24.84	.001
Reading	AI CALL > Control	35.49	.000

II. Psychological and Affective Outcomes

These tables detail the impact of AI-driven tools on the learner's emotional and motivational states, which are critical for long-term standardized test preparation.

Table 4: Impact of AI Intervention on Affective Variables

Using scales like the FLCAS (Foreign Language Classroom Anxiety Scale), these results show how AI provides a "safe zone" for learners.

Psychological Variable	Pre-test Mean	Post-test Mean	Impact Outcome
Learner Autonomy	38.07	45.09	Significant Increase (p < .05)
Language Anxiety	61.12	69.68	Significant Reduction (p < .05)
Academic Demotivation	25.00	33.65	Significant Reduction (p < .05)

III. Qualitative and Pedagogical Frameworks

The following tables categorize the tools and practices that define the "Desktop" and "Palm" learning environments.

Table 5: Qualitative Evaluation of AI Tools by Skill Area

This table provides the affordances and limitations for the tools used in the study.

Language Skill	Sample Tool	Primary Feature (Affordance)	Main Limitation (Constraint)
Reading	Tutor AI	Adaptive texts and interactive Q&A.	Risk of oversimplification.
Listening	Speechace	Sentence-level pronunciation practice.	Feedback limited to short sentences.
Writing	ChatGPT	Multifunctional grammar and feedback.	Risk of overreliance/ethics.
Speaking	TalkPal	AI role-play and fluency tutoring.	Needs high connectivity.

Table 6: Taxonomy of Differentiated Instruction (DI) Practices

This table provides a framework for how instruction is adapted within the digital platforms.

Main Category	Sub-Practice	Description
DI of Content	Level groups	Establishing homogeneous groups based on readiness.
DI of Material	Open tasks	Selecting tasks completable at different difficulty levels.
Open Education	Weekly plan	Working independently on structured content over time.
Support	Tutoring	Creating high-ability/low-ability learning dyads.

Overall Performance Gains

The experimental findings show that all three groups—AI CALL, AI MALL, and the Control group—significantly increased their TOEIC listening and reading scores over the course of the semester (p=.000)

This suggests that any form of structured intervention, whether digital or human-led, is effective for test preparation.

2. Comparative Effectiveness (Group Differences)

The study identified critical performance gaps between the hardware platforms used to deliver AI-integrated instruction.

AI CALL (Desktop) vs. Control: The AI CALL group significantly outperformed the control group in both the listening (MD=18.93) and reading (MD=35.49) sections.

AI CALL (Desktop) vs. AI MALL (Palm): In the reading section, the AI CALL group significantly outperformed the AI MALL group with a mean difference of 24.84 points (p=.001).

AI MALL (Palm) vs. Control: Interestingly, there was no statistically significant difference between the AI MALL group and the control group in either listening or reading

This indicates that mobile technology alone, despite the AI integration, did not provide a pedagogical advantage over traditional instruction for these specific test skills

Results

Table 1: Comparative TOEIC Performance Results (Pre-test vs. Post-test)

This table tracks the significant improvements made by each group over the academic semester.

Group	N	Listening (Pre)	Listening (Post)	Reading (Pre)	Reading (Post)
AI CALL (Desktop)	190	145.26 (SD 48.69)	194.84 (SD 64.69)	194.84 (SD 64.69)	222.16 (SD 56.79)
AI MALL (Palm)	164	148.11 (SD 40.53)	182.74 (SD 50.12)	182.74 (SD 50.12)	197.32 (SD 62.65)
Control Group	132	142.27 (SD 42.27)	175.91 (SD 59.92)	175.91 (SD 59.92)	186.67 (SD 66.31)

Key Finding: Statistical analysis via paired samples t-tests confirmed that all three groups achieved significant gains in both listening and reading (p = .000).

Table 2: Post-Hoc Comparison of Group Performance (Bonferroni Results)

This table pinpoints where the "Desktop" (CALL) environment demonstrated a statistically significant advantage over other modalities.

Section	Pairwise Comparison	Mean Difference (MD)	Significance (p)
Listening	AI CALL > Control	18.93	.014
Reading	AI CALL > AI MALL (Palm)	24.84	.001
Reading	AI CALL > Control	35.49	.000

Result Summary: While there was no significant difference between the "Desktop" and "Palm" groups in listening, the AI CALL group significantly outperformed the AI MALL group in reading comprehension. Notably, there was no statistically significant difference between the AI MALL group and the traditional control group in either section.

Table 3: Affective and Psychological Results of AI-Integrated Learning

This table details the impact of using AI tools (such as ChatGPT) on learner emotions and commitment.

Psychological Variable	Pre-test Mean	Post-test Mean (EG)	Statistical Sig (p)
Learner Autonomy	38.07	45.09	p < .05
Academic Demotivation	25.00	33.65	p < .05
Language Anxiety (FLCAS)	61.12	69.68	p < .05

Affective Impact: The results indicate that the experimental group (EG) using AI tools experienced a significant increase in autonomy and a substantial reduction in both anxiety and demotivation compared to the control group. AI agents provide a non-judgmental "safe zone" that encourages experimentation and self-regulated learning

Principal Findings: Performance in Standardized Testing

The experimental data regarding TOEIC Listening and Reading outcomes reveals that while all forms of instruction AI-integrated CALL, AI-integrated MALL, and traditional human-led classrooms resulted in significant score increases (p=.000), the AI-integrated CALL (Desktop) group demonstrated statistically superior gains.

The Reading Gap: The most critical finding was the superiority of the desktop environment over palm devices for reading comprehension.

The AI CALL group outperformed the AI MALL group in the reading section with a significant mean difference of 24.84 points (p=.001)

Listening Uniformity: In contrast to reading, there was no statistically significant difference between CALL and MALL groups in the listening section, suggesting auditory tasks are less affected by hardware choice than visual literacy tasks.

Technology vs. Tradition: While the AI CALL group significantly outperformed the control group in both sections, the

AI MALL group failed to show a significant advantage over traditional instruction in either listening or reading.

Findings: Affective and Psychological Outcomes

Beyond linguistic scores, the integration of AI tools like ChatGPT and specialized tutoring systems produced profound shifts in the learner's psychological state. Reduction in Anxiety and Demotivation: Experimental groups using AI reported a significant reduction in Foreign Language Learning Anxiety (FLLA) and academic demotivation

AI agents provide a non-judgmental "safe zone" for experimentation, reducing the fear of negative evaluation.

Enhanced Learner Autonomy: Learners exposed to AI-mediated instruction reached a significantly higher mean in learner autonomy (45.09) compared to the control group (40.14)

This indicates that the on-demand access to personalized material fosters a stronger commitment to self-regulated learning.

Discussion: Hardware Affordances and the "Digital Real Estate"

The discussion of these findings emphasizes that new technology is not always superior to established models

The "Reading Gap" observed between desktop and palm users is largely attributed to specific hardware limitations of mobile devices:

Cognitive Burden: Mobile phones suffer from small screen sizes, restricted memory, and limited graphics, which can hinder deep concentration and the navigation of extensive reading passages

Concentrative Stability: Computers are perceived by students as more stable and faithful for high-stakes test preparation, providing the necessary "digital real estate" to process multimodal information without the "technostress" often associated with network instability on mobile devices

Discussion: Pedagogical Frameworks and Differentiated Instruction

The effectiveness of these tools is mediated by how they align with instructional design principles, such as Merrill's First Principles of Instruction (FPI) and Differentiated Instruction (DI)

Application of FPI: Findings indicate that ICALL environments are most effective when they utilize the Demonstration and Application principles to facilitate immediate, automated feedback. However, there remains a gap in utilizing Problem-centered and Integration principles, which are necessary for fostering 21st-century competencies like critical thinking.

The Impact of Heterogeneity: In classroom contexts, findings from the Austrian group show that greater class heterogeneity forces the adoption of more complex DI forms, such as "Weekly plans" and "Level groups"

Conversely, in more structured or separated settings (like the Swiss group), teachers often prefer stronger class leadership over student-centered DI practices.

Consistency in Perceptions: There is a considerable degree of consistency between teachers' attitudes toward DI and what they actually notice in video-recorded lessons, suggesting that

professional vision is a key mediator in how technology and pedagogy are integrated.

The results conclude that while MALL offers valued portability, the stable interface of the "Desktop" environment is pedagogically superior for the complex literacy demands of standardized testing. Future implementations should focus on hybrid models that leverage mobile devices for "anytime, anywhere" vocabulary and listening practice while reserving the desktop for high-concentration reading and assessment tasks.

Conclusion

The rapid integration of Artificial Intelligence (AI) into language education has fundamentally changed the landscape of Computer-Assisted Language Learning (CALL) and Mobile-Assisted Language Learning (MALL). This comparative study demonstrates that while AI-driven tools are universally beneficial for improving standardized test performance, the choice of hardware platform is a critical mediator of learner success

The primary finding of this research is that AI-integrated CALL (Desktop) provides a statistically superior environment for reading comprehension compared to AI-integrated MALL (Palm)

In the context of high-stakes assessments like the TOEIC, the "reading gap" observed between these two digital modalities is largely attributed to the hardware affordances of desktop computers, which offer larger screen sizes and greater interface stability

Conversely, while "palm" devices are prized for their portability and "anytime, anywhere" accessibility, their technical limitations—such as restricted display space and memory—can increase the cognitive load on learners during complex literacy tasks

Interestingly, no such gap was found in listening performance, suggesting that auditory processing is less dependent on hardware interface than visual processing

Beyond measurable scores, the integration of AI platforms like ChatGPT and specialized Intelligent Tutoring Systems (ITS) has been shown to profoundly influence the learner's psychological state

AI agents provide a non-judgmental "safe zone" for experimentation, which significantly reduces Foreign Language Learning Anxiety (FLLA) and helps overcome academic demotivation

Furthermore, these tools empower learners by fostering a sense of autonomy and agency, allowing them to navigate personalized learning paths at their own pace

The efficacy of these digital environments is grounded in established pedagogical frameworks, specifically Merrill's First Principles of Instruction (FPI) and Activity Theory (AT)

While current AI systems excel at the Demonstration and Application principles through immediate, automated feedback, there remains a need to further integrate Problem-centered tasks to develop contemporary 21st-century competencies

Additionally, the success of these technologies in the classroom is mediated by Differentiated Instruction (DI); as class heterogeneity increases, teachers are more likely to adopt complex digital tools like "Weekly plans" to support individual student needs

In conclusion, while mobile technology offers unprecedented flexibility, it should not be viewed as a full substitute for desktop-based systems in high-concentration standardized test preparation

Future pedagogical models should favor hybrid approaches that leverage the portability of MALL for vocabulary and listening practice while reserving the robust "digital real estate" of CALL for intensive reading and formal assessment

Ultimately, the human teacher remains an essential facilitator in this ecology, serving as a curator and guide to ensure that AI technology is used to its full pedagogical potential

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