IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

"Ai-Driven Language Learning For Indian Engineering Students: A Study On Effectiveness And Perceptions"

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Abstract:
The integration of Artificial Intelligence (AI) into language education is reshaping traditional approaches to English language acquisition, especially within multilingual contexts such as India. This study investigates the impact of AI-powered tools—ChatGPT, Duolingo, and Grammarly—on improving linguistic competence, motivation, and learner autonomy among Indian engineering undergraduates. Employing a mixed-methods design, the study involved 120 intermediate-level English learners from engineering colleges across India. Quantitative data from pre- and post-tests assessing grammar, vocabulary, and writing skills were complemented by qualitative insights from semi-structured interviews and learner diaries. Results revealed statistically significant gains in all measured competencies in the experimental group, with enhanced learner engagement and self-directed learning. Nevertheless, challenges such as digital access disparities and over-dependence on AI tools persist. This article contributes to current discourse on AI-assisted language acquisition and offers context-sensitive pedagogical recommendations tailored to Indian bilingual and technical education settings.

Keywords:
Artificial Intelligence, Engineering Students, English Language Skills, Language Learning Tools, India, Educational Technology, Bilingual Education

1.Introduction

The globalisation of the workforce has made English proficiency a prerequisite for professional success, especially in STEM fields. In India, English occupies a unique status as a functional language for higher education, technological research, and corporate communication. Despite widespread English instruction from early schooling, Indian engineering students frequently exhibit suboptimal communicative competence. This disparity stems from multiple factors: teacher-centred pedagogy, inadequate exposure to spoken English, large class sizes, and limited contextual relevance in learning materials. Moreover, India's bilingual educational landscape—where English often coexists with regional languages as mediums of instruction—further complicates the acquisition process.

With the emergence of Artificial Intelligence (AI) technologies, new opportunities have arisen for personalized and adaptive English learning. AI-powered tools offer interactive, flexible, and data-driven support that complements formal instruction. This study investigates the impact of these tools on Indian engineering students' linguistic development and explores the pedagogical implications within a bilingual higher education framework.

2.Theoretical Framework

The study draws upon key Second Language Acquisition (SLA) theories:

- **Krashen's Input Hypothesis (1982):** Emphasizes comprehensible input as essential for language acquisition. AI tools adapt inputs to learners' proficiency levels.
- **Swain's Output Hypothesis (1985):** Highlights the necessity of meaningful language output and feedback. Tools like Grammarly provide iterative writing practice and correction.
- **Deci and Ryan's Self-Determination Theory (1985):** Focuses on learner autonomy, motivation, and perceived competence—areas where adaptive platforms such as Duolingo and ChatGPT excel.
- **Sociocultural Theory (Vygotsky, 1978):** Language learning is mediated through social interaction and cultural context. AI tools can simulate interaction but lack deep cultural and pragmatic nuance, underlining the importance of blended human-AI learning environments.

3. Literature Review

3.1 Language Learning in the Indian Bilingual Context

Indian learners often navigate dual mediums of instruction—regional languages and English. According to NCERT and UGC reports, this duality can hinder immersion and affect cognitive processing in English. Learners from vernacular-medium schools frequently exhibit anxiety, lack of confidence, and code-switching tendencies, particularly in technical academic writing. Despite substantial curricular focus on grammar and reading, communicative skills are underdeveloped.

3.2 Technology and Language Learning in India

Technology integration in Indian higher education has accelerated, especially post-COVID-19. However, rural-urban divides persist. Studies (Kumar, 2019; Singh, 2020) highlight that while mobile learning is widespread, the use of AI-based language tools remains limited due to lack of awareness, training, and digital infrastructure. Yet, AI's potential to deliver individualized learning pathways remains untapped in engineering colleges.

3.3 Overview of AI-Powered Tools

- **ChatGPT:** Facilitates low-pressure, interactive conversation and grammar refinement.
- **Duolingo:** Uses gamification and adaptive algorithms to personalize vocabulary and grammar drills.
- **Grammarly:** Offers real-time writing assistance and feedback, fostering iterative improvement. These tools, though originally designed for global audiences, have increasing relevance for bilingual Indian learners given their mobile accessibility and adaptive capabilities.

3.4 Advantages and Drawbacks

AI-powered tools support differentiated instruction, instant feedback, learner agency, and data-based progress tracking. However, limitations include the absence of real conversational pragmatics, potential over-reliance, screen fatigue, and privacy concerns. Digital equity remains a central challenge.

4. Research Questions

1. How do AI-powered tools affect grammar, vocabulary, and writing skills of Indian engineering students?
2. What impact do these tools have on learners' motivation, confidence, and autonomy?
3. What challenges and opportunities do AI tools present in a bilingual Indian engineering education context?

5. Methodology

5.1 Research Design

This study employed a mixed-methods approach. Quantitative instruments measured linguistic gains; qualitative methods captured learner perceptions.

5.2 Participants

120 B. Tech students (CEFR B1 level), aged 18–24, from four engineering institutions across India were randomly assigned to:

- **Experimental Group (n = 60):** Used AI tools daily (30 minutes) for 12 weeks
- **Control Group (n = 60):** Attended standard classroom-based instruction

5.3 Instruments

- Grammar, vocabulary, and writing tests (validated via pilot study)
- Motivation and autonomy survey (adapted from Deci & Ryan's Intrinsic Motivation Inventory)
- Semi-structured interviews (n = 20)
- Weekly learner diaries (experimental group)

5.4 Procedure

- Week 1: Orientation and pre-tests
- Weeks 2–11: AI tool usage (ChatGPT, Duolingo, Grammarly) vs. traditional instruction
- Week 12: Post-tests, survey, and interviews

6. Data Analysis

SPSS was used for statistical analysis (paired t-tests, independent t-tests). Thematic analysis followed Braun and Clarke's six-step framework.

7. Results

7.1 Quantitative Findings

Test	Group	Pre-Test Mean	Post-Test Mean	Mean Gain	p-value
Grammar	Experimental	65.2	78.5	+13.3	<0.001
Vocabulary	Experimental	58.7	75.4	+16.7	<0.001
Writing	Experimental	62.4	80.2	+17.8	<0.001

Construct	Experimental	Control	p-value
Intrinsic Motivation	4.3	3.5	<0.001
Autonomy	4.1	3.4	<0.001

Competence	4.2	3.6	<0.001

7.2 Qualitative Findings
Themes:

- **Enhanced Engagement:** Gamification and chat-based tools increased motivation.
- **Personalized Feedback:** Grammarly enabled targeted revision.
- **Increased Confidence:** Learners used more academic vocabulary and complex syntax.
- **Concerns:** Some reported difficulty without AI support and lack of speaking practice.

8. Discussion

AI tools were effective in enhancing linguistic competence and learner autonomy. Results affirm the theories of SLA underpinning this study. However, the bilingual context complicates usage: learners often struggle with transfer errors and cognitive switching between English and L1. While AI tools aid in explicit learning (e.g., grammar), they must be supplemented with interactive speaking activities and cultural content to develop full communicative competence.

9. Recommendations

For Educators:

- Integrate AI tools in a blended learning model, especially for writing and vocabulary instruction
- Provide scaffolding and monitor learner reliance to prevent passivity
- Incorporate culturally responsive materials that bridge L1 and L2 understanding

For Institutions and Policymakers:

- Ensure digital infrastructure and training in Tier 2/3 cities and rural colleges
- Develop institutional policies to ethically use AI tools in classrooms

For Developers:

- Design AI platforms that recognize Indian English varieties and cultural semantics
- Include speech recognition for conversational fluency
- Provide offline capabilities to increase reach and inclusivity

10. Conclusion

AI-powered tools can serve as valuable adjuncts in Indian engineering education, enhancing English language proficiency and learner independence. However, optimal results are achieved when these tools are contextually integrated into bilingual pedagogies. Future research should explore longitudinal effects and include speaking and listening metrics.

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