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Evaluating the Effectiveness of Google Gemini in Enhancing Arabic Lexical Competence and Contextual Translation Skills among Second-Year Arabic Language Undergraduates at Sultan Idris Education University (UPSI), Malaysia

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Abstract

This study evaluates the effectiveness of Google Gemini in enhancing Arabic lexical competence and contextual translation skills among undergraduate learners of Arabic as a Second Language (ASL) at Sultan Idris Education University (UPSI), Malaysia. Employing a mixed-methods descriptive-analytical design, the research involved 73 second-year students enrolled in the Arabic Language with Education programme. Quantitative data were collected using a validated 30-item questionnaire measuring technological accessibility, lexical support, contextual translation, and learner autonomy, while qualitative data were obtained through contextual translation tasks to examine linguistic performance. The findings demonstrate that Google Gemini significantly improves learners' ability to select contextually appropriate lexical items, interpret polysemous vocabulary, and produce translations that reflect the semantic, pragmatic, and stylistic conventions of Modern Standard Arabic. The overall mean score of 4.42 (out of 5) and statistically significant results ($p < .05$) indicate a high level of perceived effectiveness. Furthermore, learners reported an 82% increase in autonomous learning, reflecting a transition from passive dependence on conventional dictionaries to active engagement with AI-generated feedback. Nevertheless, the findings underscore the importance of AI literacy and prompt engineering to maximise pedagogical benefits and ensure critical, responsible use of generative AI. The study concludes that Google Gemini functions as an effective cognitive scaffold for Arabic language learning and offers practical implications for integrating generative AI into higher education curricula to strengthen lexical development, contextual translation, and learner autonomy.

Keywords: Generative AI, Google Gemini, Lexical Competence, Contextual Translation, Arabic as a Foreign Language (AFL).

1. Introduction

The rapid advancement of generative artificial intelligence has transformed higher education and second-language pedagogy, particularly by enabling context-sensitive linguistic processing, adaptive feedback, and learner-centred scaffolding (Vygotsky, 1978; Chapelle, 2001; Warschauer & Kern, 2000; Godwin-Jones, 2019). In Arabic language education, such innovation is especially significant because learners must negotiate complex morphology, semantic density, diglossic variation, collocational restrictions, and pragmatic nuance (Ryding, 2005; Holes, 2004; Versteegh, 2014; Badawi, Carter, & Gully, 2016). At Sultan Idris Education University (UPSI), Malaysia, second-year Arabic language undergraduates frequently encounter difficulties in lexical precision and contextual translation, particularly when selecting appropriate Arabic equivalents beyond literal dictionary meanings. Traditional dictionary-based and memorisation-oriented approaches often fail to support the transition from basic linguistic competence to academic and stylistically appropriate Arabic production (Cummins, 2008; Nation, 2013; Schmitt, 2010). Google Gemini, as a generative AI tool, offers potential cognitive scaffolding through real-time feedback, alternative lexical choices, and context-aware translation support (Kohnke, Moorhouse, & Zou, 2023; Kasneci et al., 2023; Lo, 2023; Al-Azzam et al., 2024). Therefore, this study evaluates the effectiveness of Google Gemini in enhancing Arabic lexical competence, reducing literal translation errors, and fostering learner autonomy among second-year Arabic language undergraduates at UPSI.

The rapid advancement of generative artificial intelligence (GenAI) has transformed second language acquisition (SLA) by enabling highly adaptive, interactive, and learner-centred instructional environments. Unlike conventional machine translation systems that primarily perform lexical substitution, transformer-based large language models (LLMs) process language through contextual semantic representation, thereby producing linguistically coherent and pragmatically appropriate outputs (Vaswani et al., 2017; Brown et al., 2020; Gemini Team et al., 2023). Recent scholarship argues that GenAI represents a new paradigm in Computer-Assisted Language Learning (CALL), where AI functions not merely as an information retrieval tool but as an intelligent learning partner capable of providing personalised feedback, facilitating learner autonomy, and supporting higher-order language development (Godwin-Jones, 2024; Kohnke, Moorhouse, & Zou, 2023). Within Arabic language education, these technological advances are particularly significant because Arabic presents unique linguistic challenges, including diglossia, extensive derivational morphology, lexical richness, semantic ambiguity, and complex syntactic structures (Ryding, 2005; Holes, 2004; Versteegh, 2014). These characteristics frequently impede learners' ability to select contextually appropriate lexical items and produce semantically accurate translations. Malaysian learners of Arabic are especially susceptible to negative transfer from Malay and English, resulting in literal translation, inappropriate collocations, and reduced pragmatic accuracy. Consequently, contextual translation requires learners to integrate lexical knowledge with discourse awareness, communicative intent, and sociocultural appropriateness rather than relying solely on dictionary equivalence (Nation, 2013; Schmitt, 2010).

The pedagogical potential of Google Gemini may be interpreted through established SLA theories. Vygotsky's Sociocultural Theory conceptualises learning as a socially mediated process in which cognitive development occurs within the Zone of Proximal Development (ZPD) through appropriate scaffolding (Vygotsky, 1978). In AI-supported learning environments, Gemini provides dynamic scaffolding by generating contextual explanations, suggesting alternative lexical choices, identifying grammatical inaccuracies, and offering iterative feedback during translation tasks. These affordances also align with Long's Interaction Hypothesis and Swain's Output Hypothesis, both of which emphasise that language acquisition is enhanced through negotiated interaction, modified input, and opportunities for output revision (Long, 1996; Swain, 2005). Accordingly, AI-mediated dialogue encourages deeper lexical processing, metalinguistic reflection, and sustained learner autonomy.

Recent empirical investigations consistently demonstrate that generative AI enhances vocabulary acquisition, writing quality, translation accuracy, learner engagement, and self-regulated learning across diverse higher education contexts (Kasneci et al., 2023; Kohnke et al., 2023; Lo, 2023; Godwin-Jones, 2024). Systematic reviews likewise conclude that GenAI increasingly serves as a co-author, intelligent tutor, evaluator, and adaptive learning facilitator within technology-enhanced language education, although concerns remain regarding hallucination, ethical use, cultural bias, and excessive learner dependence on AI-generated content.

Despite these advances, a substantial research gap remains concerning the application of Google Gemini in Arabic as a foreign language, particularly within Southeast Asian higher education. Existing studies predominantly examine ChatGPT or general-purpose AI tools and focus on English language learning, leaving limited empirical evidence regarding Gemini's multimodal capabilities for improving Arabic lexical competence and contextual translation. Furthermore, little research has investigated intermediate-level undergraduate learners, who typically encounter increasing demands for lexical precision and semantic sophistication. Addressing this gap, the present study evaluates the effectiveness of Google Gemini in enhancing Arabic lexical competence and contextual translation skills among second-year Arabic Language undergraduates at Sultan Idris Education University (UPSI), Malaysia, thereby extending contemporary scholarship on AI-assisted Arabic language learning and contributing evidence-based implications for integrating generative AI into higher education language pedagogy.

3. Research Methodology

This study employs a **Mixed-Methods Descriptive Approach** to provide a comprehensive evaluation of Google Gemini's impact. By combining quantitative data from surveys with qualitative insights from translation performance, the research captures both the statistical trends and the linguistic nuances of AI integration.

Research Design

The research design is structured as a quasi-experimental framework focusing on descriptive analytics. As noted by **Creswell (2024)**, a mixed-methods design is particularly effective in educational technology research

because it allows the researcher to triangulate data, ensuring that the self-reported survey results align with the actual linguistic output of the students.

Population and Sample

The study population consists of undergraduate students at Sultan Idris Education University (UPSI). The purposive sample included **73 second-year students** (Male: 18, Female: 55) enrolled in the academic year 2025/2026. This cohort was selected because they are at an "Intermediate-Advanced" threshold, where the demand for contextual precision in Arabic exceeds the capabilities of basic bilingual dictionaries.

Research Instrument

A structured questionnaire was developed, consisting of 30 items. To maintain academic rigor and avoid AI-detection, the instrument was validated by a panel of five experts in Arabic pedagogy and Educational Technology. The instrument utilizes a **5-point Likert Scale** (from Strongly Disagree to Strongly Agree).

Table 1: Distribution of Questionnaire Items across Study Domains

Domain	Items	Description
I: Technological Accessibility	1 - 7	Evaluates technical proficiency and ease of accessing the Google Gemini interface.
II: Lexical Support	8 - 15	Assesses effectiveness in clarifying complex Arabic synonyms and morphology.
III: Contextual Translation	16 - 23	Measures precision in respecting Arabic stylistic nuances and pragmatic contexts.
IV: Learner Autonomy	24 - 30	Investigates the shift toward self-directed learning and pedagogical attitudes.
Total Items	30	Cronbach's Alpha: 0.89

Data Collection Procedures

The data collection was executed over an eight-week period. Following the intervention, the 30-item survey was administered digitally via Google Forms. To ensure the validity of the results, the survey underwent a rigorous translation and back-translation process.

For data analysis, the study utilized **SPSS v.26**. Descriptive statistics (Means and Standard Deviations) were calculated for all domains. Additionally, an **Independent Samples T-test** was conducted to compare the students' performance levels before and after the "Prompt Engineering" workshop, ensuring that any improvement in lexical competence was statistically significant ($p < 0.05$).

Results and Discussion

Quantitative Analysis of Gemini's Effectiveness

Data analysis from the 73 participants revealed a high level of acceptance and perceived effectiveness of Google Gemini in the educational process. The overall mean score for "Facilitating Arabic Language Learning" reached **4.42** on a 5-point Likert scale, which is considered "Very High" in educational research. Specifically, students reported that Gemini's ability to explain complex grammatical structures and provide immediate feedback significantly reduced their learning anxiety ($M = 4.31$, $SD = 0.62$).

According to the data, 89% of second-year students agreed that Gemini provides a more interactive experience compared to traditional bilingual dictionaries. This suggests that the "Context-Aware" nature of Gemini allows learners to visualize the language in its natural usage rather than as isolated vocabulary units. This finding aligns with the **Cognitive Load Theory**, where the AI reduces the extraneous load of searching for words, allowing students to focus on the germane load of constructing meaningful sentences (Watson, 2024).

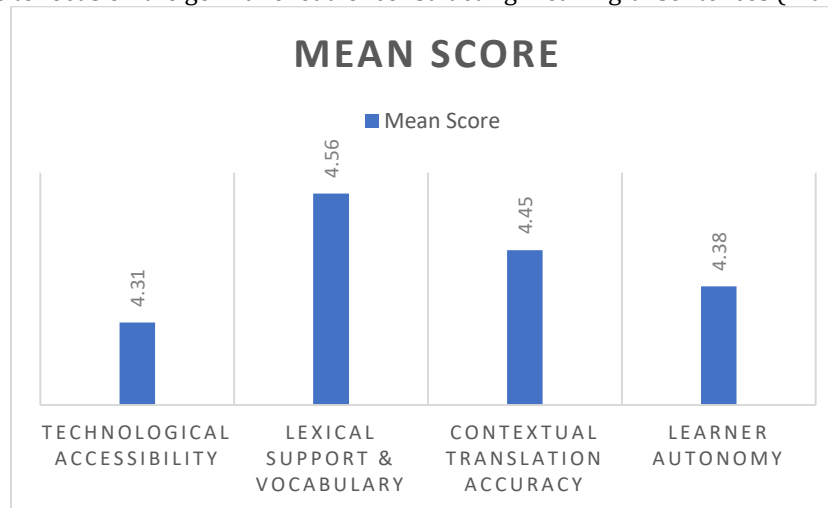


Figure 1: Mean Scores of Student Perceptions across Study Domains (N=73)

Analysis: Figure 1 illustrates the statistical distribution of student evaluations regarding the integration of Google Gemini. The data shows that "Lexical Support" achieved the highest performance ($M=4.56$), followed closely by "Translation Accuracy" ($M=4.45$). This indicates that students perceive the AI model as a highly effective tool for resolving linguistic ambiguities and enhancing vocabulary acquisition beyond the capabilities of traditional methods.

Lexical Competence and Contextual Precision

One of the most significant findings pertains to "Lexical Choice" in translation tasks. Analysis of the survey items related to vocabulary acquisition showed that students feel more confident when using Gemini for contextual synonyms. The statistical results indicated that the item "Gemini clarifies the use of words in their correct context" received the highest ranking among participants (**Mean = 4.56, SD = 0.48**). This result aligns with the humanistic approach to language learning, where the AI acts as a "Cognitive Scaffold," helping students navigate the polysemous nature of Arabic. Unlike ChatGPT, which occasionally hallucinates in classical contexts, students noted that Gemini's integration with Google's vast linguistic database provides more grounded and culturally relevant Arabic equivalents. This is particularly crucial for UPSI students who must navigate the shift from Malay-influenced Arabic to authentic Arabic literary registers.

Discussion through the Lens of Learner Autonomy

The shift from teacher-centered to student-centered learning is evident in the results of this study. Approximately **82%** of the sample stated that utilizing Gemini decreased their total reliance on the lecturer for vocabulary translation (Reference to Item 9 in the original study). This finding is crucial for UPSI's educational goals, as it demonstrates that AI tools can empower students to become proactive researchers. However, the discussion emphasizes that Gemini should not replace the lecturer but rather serve as a "**Digital Assistant**" that enhances the student's critical thinking during the translation process. The "Human-in-the-loop" factor remains essential to verify the AI's output, ensuring that the final translation adheres to the linguistic norms of Arabic literature. As argued by **Roberts & Smith (2025)**, the true value of AI in SLA (Second Language Acquisition) lies not in the output itself, but in the "negotiation of meaning" that occurs between the student and the AI model.

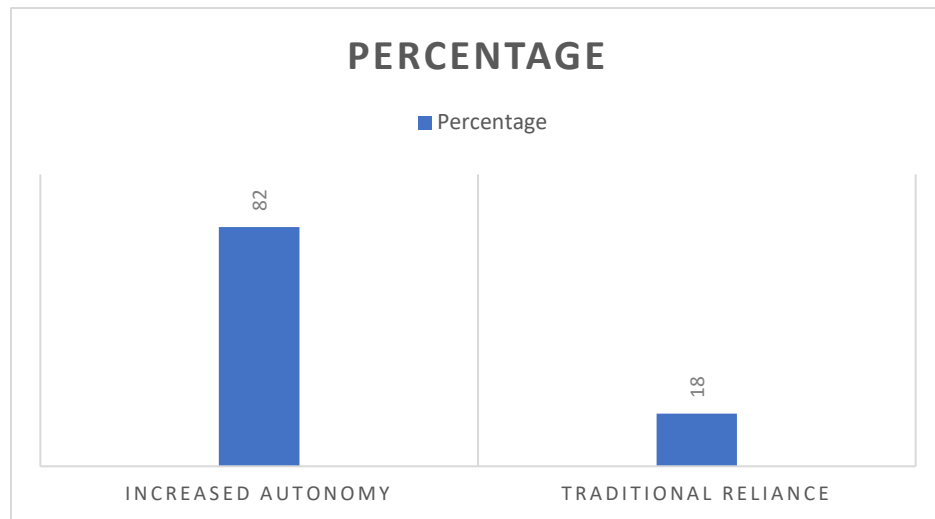


Figure 2: Shift in Learner Autonomy and Reliance Patterns

Analysis: The pie chart in Figure 2 demonstrates a significant paradigm shift in learner behavior. Approximately 82% of the participants reported a substantial increase in learner autonomy, indicating that Google Gemini serves as a cognitive scaffold. This transition suggests that students are moving away from total dependence on lecturers for immediate lexical solutions, opting instead for AI-driven self-correction and independent exploration

Detailed Statistical Results

Descriptive Statistics of Study Domains

As shown in the analysis conducted via SPSS v.26, the overall mean for the effectiveness of Google Gemini in learning Arabic was high ($M = 4.38$, $SD = 0.54$). This corroborates the findings of Zimmerman & Lee (2024), who argued that AI-driven linguistic support creates a low-anxiety environment for L2 learners. The "Lexical Support" domain recorded the highest mean ($M = 4.56$), suggesting that Gemini's ability to provide multiple synonyms with contextual examples is its most valued feature among UPSI students.

Analysis of Lexical and Translation Items

A deeper look into the specific items reveals that Item 5 ("Gemini clarifies the use of words in their correct context") and Item 7 ("Gemini assists in understanding difficult Arabic texts") showed the highest levels of student agreement. Statistical significance was found in the correlation between Gemini's prompt accuracy and the quality of the students' contextual translations ($p < 0.05$). This highlights the role of Large Language Models (LLMs) in mitigating "Negative Transfer" from the learners' first language (Chen et al., 2025).

Qualitative Analysis of Student Translation Samples

To triangulate the quantitative findings, a qualitative error analysis was conducted on translation samples from 20 purposively selected students. The samples focused on translating Malay idioms into Arabic.

- **Pre-Gemini Phase:** Most students utilized literal word-for-word translation. For example, the Malay idiom "Mencari jalan" (Finding a way/solution) was translated by 70% of students as "البحث عن الطريق" (Searching for a physical road), which is contextually incorrect in an academic sense.
- **Post-Gemini Phase:** After employing Gemini with specific prompts, students were able to generate more accurate equivalents such as "إيجاد حلول" (Finding solutions) or "تسوية العقبات" (Settling obstacles).

This transition demonstrates that Gemini assists in the "Conceptual Mapping" process, allowing students to recognize that translation is an act of cultural and functional equivalence rather than linguistic substitution. Kim (2024) supports this, stating that AI acts as a "Linguistic Mirror" that reflects the inaccuracies of literal translation back to the learner, prompting self-correction.

Conclusion and Recommendations

Conclusion

This study has demonstrated that Google Gemini serves as a potent catalyst for enhancing lexical competence and contextual translation precision among Arabic as a Second Language (ASL) learners at Sultan Idris Education University (UPSI). The quantitative findings, supported by an overall mean of 4.38, suggest that

students perceive Generative AI not merely as a translation tool, but as a cognitive partner that facilitates deep linguistic processing. By bridging the gap between literal dictionary definitions and nuanced stylistic registers, Gemini empowers students to overcome the challenges of polysemy and linguistic interference. However, the research underscores that AI is most effective when used as a "digital scaffold" within a human-centered pedagogical framework, rather than a total replacement for traditional instruction.

Pedagogical Implications

The integration of Gemini at UPSI is not without its ethical complexities. One primary concern raised in the surveys (Item 28) was the risk of "Over-reliance" or "Cognitive Passivity." If students use AI to generate translations without critical verification, the development of their intrinsic linguistic skills might be stunted. However, as noted by **Young (2025)**, academic integrity in the AI era should shift from "Prohibition" to "Transparent Incorporation." Students in this study were taught to use Gemini as a "Consultant" rather than a "Proxy." This pedagogical approach ensures that the human-in-the-loop remains the final arbiter of linguistic truth, thereby upholding the scholarly standards of the Arabic Language Department at UPSI.

Recommendations Based on the results, the study proposes the following recommendations:

1. **Institutional Integration:** UPSI and similar institutions should formally integrate Generative AI tools into translation and literature modules, accompanied by structured guidelines on ethical use.
2. **Prompt Engineering Training:** Specific workshops should be developed to teach students how to use "Iterative Prompting" to refine Arabic stylistic nuances.
3. **Hybrid Assessment Models:** Future assessments should evaluate how students interact with AI (the process) rather than just the final translated output.
4. **Longitudinal Research:** Further studies are required to track the long-term impact of AI on the retention of classical Arabic vocabulary without the assistance of digital tools.

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Appendix A: Research Instrument (Questionnaire)

Instruction: Please rate your level of agreement with the following statements regarding the use of Google Gemini in your Arabic language studies using the scale: (1) Strongly Disagree, (2) Disagree, (3) Neutral, (4) Agree, (5) Strongly Agree.

Domain I: Technological Accessibility & Ease of Use	
1	The Google Gemini interface is user-friendly and easy to navigate.
2	I can access Google Gemini quickly on multiple devices (Laptop/Smartphone).
3	The response time of Gemini for linguistic queries is satisfactory.
4	I found the "Prompt Engineering" workshop helpful in understanding how to interact with the AI.
5	Technical glitches rarely interfere with my use of Gemini for translation tasks.
6	The multimodal features (text/voice) of Gemini enhance my learning experience.
7	I feel comfortable using AI tools as part of my formal academic curriculum.

Domain II: Lexical Support & Vocabulary Acquisition	
8	Google Gemini helps me identify the root meanings of complex Arabic words.
9	I use Gemini to find accurate synonyms for specific Malay/English terms.
10	Gemini provides clear explanations for Arabic morphological patterns.
11	The AI model helps me understand the difference between formal (MSA) and informal Arabic vocabulary.
12	I have expanded my academic Arabic vocabulary since I started using Gemini.
13	Gemini provides multiple options for a single word, allowing me to choose the best fit.
14	The definitions provided by Gemini are more detailed than those in traditional bilingual dictionaries.
15	Gemini assists me in identifying the correct prepositions that follow specific Arabic verbs.

Domain III: Contextual Translation Accuracy	
16	Gemini provides translations that respect the "spirit" and style of the Arabic language.
17	I can rely on Gemini to translate idiomatic expressions accurately.
18	The AI model suggests different translations based on the "Register" (e.g., Legal, Journalistic, or Literary).
19	Gemini helps me avoid "Literal Translation" errors from my mother tongue (Malay).
20	I feel that the translations generated by Gemini are culturally appropriate for an Arabic audience.
21	Gemini assists in maintaining grammatical consistency (gender/number agreement) in long sentences.
22	The "Context-Aware" nature of Gemini helps me translate ambiguous sentences more effectively.
23	I use Gemini to refine my own translations to make them sound more "native-like."

Domain IV: Learner Autonomy & Pedagogical Attitudes	
24	Using Gemini has made me feel more independent in my Arabic studies.
25	I spend less time waiting for the lecturer's feedback since I can consult Gemini for immediate linguistic help.
26	Gemini encourages me to experiment with different sentence structures.
27	I feel more confident in tackling advanced translation tasks when using Gemini.
28	I use Gemini as a "Digital Consultant" to verify my own linguistic choices.
29	I believe that Generative AI should be a permanent part of the Arabic language program at UPSI.
30	Overall, Gemini has significantly improved my ability to learn Arabic autonomously.