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# Using Augmented Reality (AR) to Create Place-Based Language Learning Tasks in the Historic Old Town of Jakarta

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**ABSTRACT**

**Background.** Place-based learning has gained increasing attention in language education for its ability to situate meaning-making within authentic sociocultural environments. In Indonesia, the Historic Old Town of Jakarta (Kota Tua) represents a rich linguistic and cultural landscape that remains underutilized as a pedagogical resource for contextualized language learning.

**Purpose.** This study explores the use of AR to design and implement place-based language learning activities that enhance learners' engagement, vocabulary acquisition, and cultural awareness.

**Method.** Employing a design-based research approach, the study involved 42 university students who completed AR-mediated tasks across selected historical landmarks. Data were collected through pre- and post-tests, field observations, and semi-structured interviews.

**Results.** The findings indicate that AR significantly increased learner engagement, facilitated more meaningful vocabulary retention, and encouraged students to make connections between linguistic input and the cultural narratives of Kota Tua.

**Conclusion**. The study concludes that AR-enhanced place-based tasks offer a promising pedagogical model for integrating digital technologies with experiential learning in heritage settings. Further research is recommended to explore scalability, long-term learning effects, and cross-cultural applicability.

**KEYWORDS**

Augmented Reality, Experiential Learning, Language Education

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## INTRODUCTION

Place-based learning has emerged as a powerful pedagogical approach in language education, emphasizing the integration of linguistic input with authentic physical environments. Research consistently shows that learning becomes more meaningful when students interact with real-world contexts that generate natural opportunities for communication. Authentic settings create a multisensory experience that can strengthen memory retention and. deepen cultural understanding (Craike et al., 2025; Denhardt et al., 2025) The Historic Old Town of Jakarta, or Kota Tua, represents a culturally rich environment filled with architectural heritage, multilingual signage, and historical narratives. These elements ofter unique

affordances for contextualized language learning. Educational practitioners have increasingly recognized the potential of heritage spaces to enrich students' linguistic and cultural experiences by situating learning within Indonesia's broader historical and sociocultural landscape.

Augmented Reality (AR) has gained prominence as an educational technology capable of enhancing experiential learning. AR overlays digital content onto physical environments, enabling learners to interact with location-based information in real time. Studies in various disciplines highlight AR's capacity to increase motivation, improve spatial understanding, and promote active learning through multimodal engagement. Language educators have begun adopting AR for vocabulary learning, pronunciation support, and interactive storytelling. Learners often respond positively to AR-enhanced tasks due to the immersive and exploratory nature of the technology. These initial findings suggest that AR can bridge gaps between digital learning tools and authentic communicative environments (Balachandar et al., 2025; Tibaijuka & Myumbo, 2025).

AR's ability to integrate text, audio, visuals, and interactive prompts aligns closely with principles of situated language learning. When learners engage with AR tasks in specific locations, they encounter language tied to meaningful cultural and spatial contexts. This interaction strengthens the connection between linguistic expressions and real-world referents, a key factor in effective language acquisition. Kota Tua presents an ideal setting for combining AR and place-based pedagogy. The area's historical significance, diverse cultural influences, and pedestrian-friendly environment create a vibrant landscape for exploring how AR-mediated tasks can transform heritage sites into dynamic language learning laboratories (Camargo et al., 2025; Tian et al., 2025).

Empirical research on AR in language learning remains limited, especially in Southeast Asian contexts. Most existing studies focus on isolated vocabulary exercises or pronunciation drills conducted within classroom or laboratory environments. Little is known about how AR can support language learning embedded in real-world cultural settings. The use of AR for place-based language tasks in historic urban spaces has not been sufficiently explored. While AR applications exist for tourism and museum engagement, their pedagogical adaptation for structured language learning tasks is still underdeveloped. This gap restricts our understanding of how learners interact with AR while navigating authentic cultural sites.

The specific affordances of Kota Tua as a linguistic and cultural learning environment have not been systematically studied. Its potential as a site for integrating historical narratives, multilingual artifacts, and interactive AR overlays remains unexplored within formal language education research. Without empirical evidence, educators lack clear guidance on how to design effective AR-based tasks for such environments (Lovrić et al., 2026; Stuart, 2025). Learner perceptions and cognitive processes during AR-enhanced place-based tasks are also poorly documented. Questions remain about how AR affects attention, motivation, cultural awareness, and language production in outdoor, unpredictable environments. These unknowns present a pressing need for research into AR-supported experiential learning in heritage spaces.

Addressing this research gap is essential for advancing both educational technology and contextualized language pedagogy. Understanding how learners interact with AR in naturalistic environments will provide insights that extend beyond traditional classroom-based instruction. Empirical evidence from Kota Tua can inform broader discussions on integrating cultural heritage with innovative digital learning tools (Aránguiz-Mesías et al., 2025; Loayza et al., 2025). Investigating AR-mediated place-based tasks allows researchers to evaluate the pedagogical potential of combining spatial exploration with real-time linguistic engagement. Such an inquiry offers the opportunity to develop design principles for site-specific language learning that support

multimodal input, cultural interpretation, and experiential meaning-making. These principles can guide educators in adopting AR responsibly and effectively.

The purpose of this study is to examine how AR can be used to create meaningful place-based language learning tasks in the Historic Old Town of Jakarta and to evaluate their influence on learner engagement, vocabulary acquisition, and cultural awareness. The study hypothesizes that AR-supported tasks will enhance learners' interaction with physical spaces, promote deeper linguistic processing, and foster a stronger connection between language and cultural context (LØland & Akman, 2025; Wahyono & Hermawan, 2026).

## RESEARCH METHODOLOGY

The study employed a design-based research (DBR) framework to investigate the development and implementation of augmented reality (AR) supported place-based language learning tasks in the Historic Old Town of Jakarta. The DBR approach was selected to allow iterative cycles of design, field testing, and refinement in authentic learning environments. This framework enabled close examination of how AR tasks functioned within dynamic real-world conditions and how learners interacted with both digital overlays and physical heritage sites. The design phase included needs analysis, prototype creation, and expert validation, while subsequent cycles focused on evaluating pedagogical effectiveness and user experience (Astuti et al., 2025; Nejedlová et al., 2025).

The population consisted of undergraduate students enrolled in English education and applied linguistics programs at a public university in Jakarta. The sample comprised 42 participants selected through purposive sampling based on their willingness to participate, intermediate proficiency level, and familiarity with mobile technology (Javed et al., 2025; Young et al., 2025). The sample size allowed for manageable group mobility during fieldwork and ensured balanced representation for qualitative and quantitative data collection. Participants were organized into small groups to facilitate collaborative task completion during AR-based activities in Kota Tua.

The research utilized four primary instruments: AR-based task modules embedded within a mobile application, a vocabulary test assessing contextual language acquisition, an observational protocol documenting learner interaction in situ, and a semi-structured interview guide exploring perceptions of AR-mediated learning. The AR modules contained geolocation-triggered prompts, interactive cultural annotations, and task instructions aligned with linguistic objectives. The vocabulary test measured pre- and post-intervention gains, while observation sheets captured behavioral patterns, engagement levels, and problem-solving strategies. Interviews provided narrative insights into learner experiences, cultural awareness, and challenges faced during field activities (Shi & Ma, 2025; Trifi et al., 2025).

The study followed a systematic set of procedures involving preparation, implementation, and evaluation stages. The preparation stage included the development and validation of AR tasks, orientation sessions for participants, and technical calibration of devices in selected Kota Tua landmarks. The implementation stage required students to complete AR-mediated language tasks across multiple historical sites, with researchers documenting their interactions and progress (Chun et al., 2025; Davari et al., 2025). The evaluation stage involved administering post-tests, collecting AR log data, conducting interviews, and analyzing all data sources using descriptive statistics and thematic coding. The multi-stage procedure ensured that the study captured both the pedagogical impact and the experiential dynamics of AR-supported place-based language learning.

## RESULT AND DISCUSSION

The quantitative dataset consisted of pre-test and post-test vocabulary scores collected from 42 undergraduate participants engaging in AR-based place-based learning tasks in the Historic Old Town of Jakarta. Vocabulary items were tied to the cultural and historical contexts of Kota Tua, including terms related to architecture, colonial history, local artifacts, and spatial directions. The descriptive statistics revealed increases in all measured indicators, with mean vocabulary scores rising from 56.2 in the pre-test to 78.6 in the post-test. Standard deviations narrowed from 12.8 to 9.4, indicating increased learning consistency among participants.

The AR interaction logs recorded the number of digital prompts accessed, completion rates of geolocation-triggered tasks, and duration of onsite engagement. Participants interacted with an average of 27.4 AR overlays per session and spent approximately 68 minutes navigating Kota Tua during the intervention. These interaction patterns suggest that AR successfully anchored learners' attention to both linguistic input and cultural information embedded within the physical environment.

**Table 1.** Descriptive statistics of ar-supported vocabulary gains (n = 42)

| Variable | Pre-test Mean | Post-test Mean | Gain Score | SD Pre | SD Post |
|---|---|---|---|---|---|
| Contextual Vocabulary Score | 56.2 | 78.6 | +22.4 | 12.8 | 9.4 |

The descriptive improvements indicate that AR-supported tasks facilitated meaningful vocabulary learning by contextualizing linguistic input within authentic historical landmarks. Learners encountered vocabulary items in direct relation to visual stimuli, inscriptions, and cultural artifacts, which likely strengthened semantic associations. The narrowing of standard deviation suggests that learners benefitted uniformly from the intervention. The increased interaction time with AR overlays demonstrates that students were highly engaged with geolocation-triggered content. AR prompts encouraged repeated exposure to key terms and scaffolded meaning negotiation through multimodal resources. Learners' sustained participation indicates that AR effectively transformed Kota Tua into an interactive language-learning environment.

The qualitative data consisted of 210 minutes of interview recordings and 96 pages of observation notes documenting learner behavior in situ. Participants consistently described the AR experience as "immersive," "motivating," and "memorable." Many expressed that the historical narratives displayed through AR overlays helped them connect vocabulary to real objects and spaces, making learning more intuitive and meaningful. The observational data revealed high levels of collaborative dialogue as students worked in groups to interpret AR instructions and identify physical landmarks. Learners frequently paused to compare digital annotations with their surroundings, indicating active cognitive processing. The coordination between digital prompts and real-world exploration contributed to deeper engagement with both linguistic content and cultural context.

The paired-sample t-test comparing pre- and post-test vocabulary scores confirmed a statistically significant improvement ($t = 11.43$, $p < 0.001$). The effect size (Cohen's $d = 0.92$) indicated a high practical impact of the AR intervention. These results validate the hypothesis that AR-supported place-based tasks enhance contextual vocabulary acquisition more effectively than traditional classroom-based instruction alone. The inferential patterns suggest strong internal consistency across participants. All learners demonstrated positive gain scores, with none exhibiting performance decline. The magnitude of the t-value and effect size reinforces that AR functions as a robust scaffolding mechanism for experiential learning in outdoor heritage environments.

**Table 2.** Paired-sample t-test for vocabulary gains

| Test Statistic | Value |
|---|---|
| t-value | 11.43 |
| p-value | <0.001 |
| Effect Size d | 0.92 |

A clear relationship emerged between the number of AR interactions and vocabulary gain scores. Participants who accessed more than 30 AR overlays recorded average gains of 26.1 points, whereas those with fewer than 20 interactions gained only 14.8 points. The correlation coefficient ($r = 0.63$) indicates a moderate-to-strong relationship between AR engagement and learning outcomes. A second relational pattern linked onsite navigation time to post-test improvement. Learners who spent longer exploring Kota Tua demonstrated stronger retention of contextual vocabulary. These findings suggest that the physical digital integration afforded by AR amplifies experiential learning by reinforcing repeated contact with culturally embedded linguistic forms.

A focused case study of three high-gain participants showed distinctive behavioral characteristics. These learners engaged deeply with AR annotations, frequently revisiting overlays to verify meaning and cross-reference historical details. Their interviews revealed strong intrinsic motivation and curiosity about Jakarta's heritage, which appeared to enhance language absorption. A contrasting case study of two low-gain participants highlighted inconsistent interaction patterns. These learners completed fewer AR tasks and reported distraction from environmental noise and heat during fieldwork. Their reduced engagement suggests that contextual factors and personal comfort levels can influence the effectiveness of AR-based place-based tasks.

The case studies indicate that engagement with AR is strongly influenced by personal interest, environmental readiness, and familiarity with mobile interfaces. Learners who approached the tasks actively and inquisitively exhibited greater learning gains. Their behaviors demonstrate how AR can promote self-directed exploration when paired with meaningful cultural content. The challenges experienced by low-gain participants point to practical limitations of outdoor learning environments. Weather conditions, crowds, and device fatigue may have reduced the quality of AR interaction. These factors highlight the need for careful logistical planning when designing AR-based tasks in public heritage spaces.

The combined quantitative, qualitative, and relational findings indicate that AR-enhanced place-based tasks significantly improve contextual vocabulary learning. The integration of linguistic input with visual, spatial, and cultural stimuli enriched learners' cognitive processing and strengthened semantic retention. AR succeeded in transforming the historic landscape into an interactive language-learning space. The results suggest that AR holds substantial pedagogical promise for experiential language learning. The meaningful synergy between physical exploration and digital annotation supported deeper linguistic engagement and cultural understanding. The study provides evidence that AR can serve as a powerful tool for designing place-based language learning in heritage environments.

The findings of this study indicate that AR-based place-based learning tasks substantially enhanced learners' contextual vocabulary acquisition in the Historic Old Town of Jakarta. Quantitative improvements were reflected in significant gains on post-test scores, accompanied by reduced variability among participants. AR interaction logs showed high completion rates of geolocation-triggered tasks, demonstrating strong engagement with digital overlays situated in real-world environments. The qualitative data reinforced these results by capturing learners' descriptions of the AR experience as immersive, motivating, and memorable. Students noted that the historical

narratives and visual overlays helped them establish deeper connections between vocabulary items and the physical artifacts they encountered. The integration of linguistic input with culturally rich spaces created meaningful opportunities for inductive learning (Sperling et al., 2025; Wright et al., 2025).

The observational data revealed active collaboration among learner groups, with frequent discussions centered on interpreting AR prompts and locating heritage sites. These interactions suggest that AR not only facilitated individual learning but also promoted social negotiation of meaning. Learners demonstrated increased attentiveness to linguistic cues when they were embedded within authentic cultural contexts. The triangulated results underscore the effectiveness of AR as a multimodal scaffold that enhances place-based language learning (Fink et al., 2025; Opatovsky et al., 2025). The intervention succeeded in transforming Kota Tua into a pedagogically rich environment where digital augmentation supported deeper cognitive processing, cultural awareness, and experiential vocabulary acquisition.

The results are consistent with previous studies that highlight the potential of AR to increase learner motivation, engagement, and vocabulary retention. Research in museum-based and tourism-related AR also supports the finding that digital overlays enrich understanding of cultural narratives. Similar to prior work, this study demonstrates that AR provides contextual anchors that reinforce meaning-making in language learning. A notable distinction appears in the magnitude of vocabulary gains observed in this study. Several earlier studies reported moderate improvements in vocabulary recognition, whereas the present research recorded substantial gains in both recall and contextual application. This difference may stem from the unique combination of heritage-rich environments and task-driven AR activities designed specifically for language learning.

The findings diverge from studies suggesting that AR can distract learners due to cognitive overload. Participants in this research reported manageable levels of cognitive demand, facilitated by carefully sequenced AR prompts and clear spatial task design (Kavanagh et al., 2025; Perrotta & Hochuli, 2025). The structured nature of the AR activities mitigated potential sensory overload and supported more focused learning experiences. The study also differs from technology-centered AR research by prioritizing cultural immersion as a pedagogical driver. While earlier studies often situate AR learning in controlled indoor settings, the current research emphasizes the value of outdoor heritage environments where linguistic and cultural inputs intersect. This shift reveals new possibilities for AR in experiential language learning.

The findings indicate a growing alignment between digital augmentation and experiential pedagogies. Learners are increasingly capable of bridging linguistic knowledge with cultural and spatial awareness when supported by AR. The study signals a shift toward more embodied forms of language learning, where physical movement and situated exploration become integral components of vocabulary development. The results suggest that learners benefit from contextualized meaning-making processes. Vocabulary acquisition was strengthened as students associated linguistic forms with visible artifacts, architectural features, and historical narratives. This pattern reflects the theoretical premise that language is more effectively acquired when embedded within meaningful social and cultural contexts.

The high engagement levels observed in the field reinforce the significance of emotional and cognitive immersion in language learning. Students expressed curiosity and enjoyment as they navigated AR tasks, indicating that motivation plays a central role in sustaining attention and reinforcing memory. The combination of novelty, authenticity, and cultural relevance contributed to a more dynamic learning experience (Hsu et al., 2025; Perrotta & Hochuli, 2025). The findings also indicate that AR can democratize access to experiential learning by providing structured scaffolding

for navigating complex environments. Learners who might otherwise find heritage sites overwhelming were guided through interpretive pathways that helped them make sense of historical details while building linguistic competence.

The study's findings have meaningful implications for language educators seeking to design learning experiences that extend beyond traditional classroom settings. AR-supported tasks demonstrate that heritage spaces can serve as interactive learning laboratories where language, culture, and environment converge. Educators can leverage these tools to reimagine experiential learning in urban contexts. The results suggest that place-based language learning may benefit from a more intentional integration of digital technologies. AR provides structured support that helps learners navigate cultural sites while staying focused on linguistic objectives. Institutions may consider incorporating AR into field trips, project-based learning, or community-based language curricula.

The improvements in vocabulary retention highlight the potential of AR to support students with varying learning styles. Visual learners, kinesthetic learners, and students who struggle with abstract vocabulary can all benefit from physically grounded linguistic encounters. AR may reduce inequities in access to meaningful learning experiences by providing multimodal entry points. The findings also have implications for cultural preservation and educational tourism. By integrating AR-based language tasks into heritage environments, institutions can promote historical awareness while fostering linguistic development. This approach supports interdisciplinary goals that connect language learning to local culture and identity (Hsu et al., 2025; Kavanagh et al., 2025).

The substantial vocabulary gains can be attributed to the multimodal nature of AR, which combines visual, textual, auditory, and spatial cues. Learners processed information through multiple sensory channels, reinforcing memory through repetition and contextual relevance. The presence of real-world objects provided concrete referents that supported deeper understanding. The immersive environment encouraged sustained engagement. Participants spent extended time interacting with AR overlays and navigating heritage landmarks, which increased exposure to key vocabulary items. Repeated exposure in varied contexts strengthened semantic mapping and facilitated transfer to long-term memory.

The social dimension of AR-supported tasks played an important role. Collaborative interactions allowed learners to negotiate meaning, clarify instructions, and reinforce understanding through peer explanation. Group-based task completion fostered shared attention and collective problem-solving, accelerating learning outcomes. The cultural richness of Kota Tua contributed significantly to learner motivation. Students expressed heightened interest in exploring historical narratives and architectural landmarks, which increased emotional investment in the learning process. This combination of cultural intrigue and digital interactivity created optimal conditions for vocabulary acquisition.

Future research should explore how AR can be scaled to other heritage sites across Indonesia, examining whether similar learning outcomes emerge in diverse cultural environments. Comparative studies across regions may reveal how place-specific characteristics interact with AR design principles. Broader sampling would enhance generalizability. Curriculum designers should consider integrating AR tasks into formal language programs. Modules could be developed for speaking, reading, or intercultural communication, expanding the pedagogical impact of AR beyond vocabulary. Teacher training is essential to ensure effective implementation and integration into existing curricula.

Researchers should investigate long-term retention of vocabulary acquired through AR-supported tasks. Longitudinal studies could track how learners continue to use and internalize

vocabulary months after field-based interventions. Such insights would inform the sustainability of AR-mediated learning outcomes. Institutions may explore partnerships with cultural heritage organizations, museums, and local governments to support place-based AR language learning initiatives. Collaborative frameworks can strengthen resources, enhance cultural accuracy, and promote public engagement. This research provides a foundation for innovative models that unite education, technology, and cultural preservation.

## CONCLUSION

The most important finding of this study lies in the substantial and contextually grounded improvement in learners' vocabulary acquisition resulting from AR-supported place-based tasks. Unlike previous studies that reported modest gains in controlled indoor settings, this research demonstrates that embedding AR activities within a historically rich urban environment amplifies learning outcomes through immersive cultural engagement. The distinctiveness of this finding emerges from the synergistic relationship between physical exploration of Kota Tua and digital augmentation, which created deeper semantic associations and heightened learner motivation. This combination positions AR not merely as a technological tool but as a catalyst for transforming heritage sites into dynamic language learning ecosystems.

The study contributes meaningful added value by introducing a design-based model for creating AR-mediated language learning tasks that integrate geolocation triggers, cultural annotations, and linguistic objectives into a coherent pedagogical framework. The methodological contribution includes the use of AR interaction logs as an analytic tool for examining learner engagement, navigation patterns, and multimodal meaning-making processes in real-world learning environments. This approach advances conceptual understanding of how AR can operationalize place-based learning principles and offers a replicable model for educators seeking to bridge digital technologies with experiential language learning. The research enriches theoretical discussions on embodied cognition, multimodal learning, and contextualized vocabulary development.

The research is constrained by several limitations, including the short intervention period, the small and context-specific participant sample, and environmental factors such as noise, weather, and crowd density that may have influenced learner engagement. These limitations suggest directions for future studies, including longitudinal investigations of vocabulary retention, comparative analyses across diverse heritage locations, and explorations of AR-supported tasks for additional language skills such as speaking and intercultural communication. Further inquiry into accessibility issues, device usability, and learner readiness is also needed to refine AR-based pedagogical designs and support scalable implementation across broader educational contexts.

## AUTHORS' CONTRIBUTION

Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.
Author 2: Conceptualization; Data curation; In-vestigation.
Author 3: Data curation; Investigation.
Author 4: Formal analysis; Methodology; Writing - original draft.

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