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ORIGINAL

Prototype of Virtual Linguistic Landscape (VLL)-Based Mobile Application in West Sumatra

Prototipo de una Aplicación Móvil Basada en el Paisaje Lingüístico Virtual (VLL) en Sumatra Occidental

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ABSTRACT

Introduction: language in public spaces embodies not only communication but also cultural identity and regional branding. In West Sumatra, where tourism reached over 19 million visitors in 2024, the integration of local linguistic elements and Minangkabau cultural symbols presents strong potential for promoting sustainable tourism through digital innovation.
Objective: this study aims to design a prototype of a Virtual Linguistic Landscape (VLL)-based mobile application and to evaluate its expert validity in terms of content, language, quality assurance (QA), and user interface (UI/UX).
Method: employing a Research and Development (R&D) approach with a 4-D model (Define, Design, Develop, and Disseminate), the study combines field observation and document analysis from 8 regencies and cities in West Sumatra with 48 tourism heritage sites and attractions. Furthermore, the prototype was validated by three expert panels assessing 32 indicators across four aspects.
Results: results show that content and language achieved an overall validity score of 76 % (Valid), indicating strong relevance for tourism promotion and cross-cultural understanding, though minor revisions are required in bilingual consistency and instructional clarity. Meanwhile, QA and UI/UX aspects obtained an average score of 91 % (Highly Valid), demonstrating excellent stability, aesthetics, navigational clarity, and system security.
Conclusions: the findings confirm that the prototype is feasible and ready for pilot implementation with targeted refinements. This research contributes to the growing field of Virtual Linguistic Landscapes by providing a digital framework for cultural preservation and regional tourism promotion in Indonesia.

Keywords: Prototype; Virtual Linguistic Landscape (Vll); Mobile Application; Cultural Heritage; Tourism; West Sumatra.

RESUMEN

Introducción: el lenguaje en los espacios públicos no solo representa un medio de comunicación, sino también una expresión de identidad cultural y de marca regional. En Sumatra Occidental, donde el turismo alcanzó más de 19 millones de visitantes en 2024, la integración de elementos lingüísticos locales y símbolos culturales minangkabau presenta un gran potencial para promover un turismo sostenible a través de la innovación digital.
Objetivo: el presente estudio tiene como objetivo diseñar un prototipo de una aplicación móvil basada en el Paisaje Lingüístico Virtual (VLL, por sus siglas en inglés) y evaluar su validez experta en términos de contenido, lenguaje, aseguramiento de la calidad (QA) e interfaz de usuario (UI/UX).
Método: empleando un enfoque de Investigación y Desarrollo (I+D) con el modelo 4-D (Definir, Diseñar,

Desarrollar y Difundir), el estudio combina observación de campo y análisis documental en ocho regencias y ciudades de Sumatra Occidental, que abarcan 48 sitios y atractivos turísticos patrimoniales. Asimismo, el prototipo fue validado por tres paneles de expertos que evaluaron 32 indicadores distribuidos en cuatro aspectos.

Resultados: los resultados muestran que el contenido y el lenguaje alcanzaron una puntuación de validez general del 76 % (Válido), lo que indica una fuerte pertinencia para la promoción turística y la comprensión intercultural, aunque se requieren revisiones menores en la coherencia bilingüe y la claridad de las instrucciones. Por otro lado, los aspectos de QA y UI/UX obtuvieron una puntuación promedio del 91 % (Altamente Válido), lo que demuestra una excelente estabilidad, estética, claridad de navegación y seguridad del sistema.

Conclusiones: los hallazgos confirman que el prototipo es factible y está listo para su implementación piloto con mejoras específicas. Esta investigación contribuye al creciente campo de los Paisajes Lingüísticos Virtuales al proporcionar un marco digital para la preservación cultural y la promoción del turismo regional en Indonesia.

Palabras clave: Prototipo; Paisaje Lingüístico Virtual (VLL); Aplicación Móvil; Patrimonio Cultural; Turismo; Sumatra Occidental.

INTRODUCTION

Language in West Sumatra, renowned for its rich Minangkabau culture, holds both historical and strategic importance in Indonesia's national development. The province once served as the center of the Emergency Government of the Republic of Indonesia under Sjafruddin Prawiranegara in 1948 and is also the birthplace of national figures such as Mohammad Hatta. Economically, West Sumatra is one of the largest wholesale trade centers in Sumatra, especially in textiles and clothing, highlighting its dynamic socio-economic landscape.[1] In tourism, the province ranks among Indonesia's top ten destinations, welcoming over 19 million visitors in 2024. With its diverse cultural heritage and natural beauty, West Sumatra offers significant potential to strengthen city branding and preserve cultural identity through digital media.[2] Iconic landmarks such as Jam Gadang in Bukittinggi and Fort de Kock symbolize a strong regional identity that continues to attract both domestic and international visitors.

However, amid rapid digitalization, challenges emerge in sustaining local language and cultural representation in online spaces.[3] The Minangkabau language, though vibrant in daily life, faces marginalization in digital domains dominated by Indonesian and foreign languages. While the Indonesian Language Law No. 24 of 2009 emphasizes the primacy of Bahasa Indonesia, it also acknowledges the cultural and historical significance of local languages in public domains. Yet, practical strategies to integrate local linguistic identity into the digital ecosystem remain underdeveloped.

The concept of the Virtual Linguistic Landscape (VLL) extends the traditional notion of Linguistic Landscape from physical public spaces into digital environments such as websites, mobile applications, and social media platforms.[4,5] In this virtual space, languages appear not only as symbols of communication but also as markers of identity, cultural heritage, and collective memory. VLL provides a promising avenue to balance language preservation and cultural promotion, especially for regions rich in local traditions like West Sumatra. Through digital representation, minority and regional languages can gain renewed visibility and prestige, countering their gradual marginalization in physical domains dominated by national and global languages.[6] Moreover, VLL can function as more than a promotional tool; it can act as an instrument of cultural education and linguistic documentation. By embedding multilingual texts, images, and narratives related to local heritage, digital platforms can both educate users and archive valuable linguistic data for future generations.[7] Despite its potential, scholarly exploration of VLL in Indonesia, particularly in West Sumatra, remains limited.

The first research gap lies in the lack of empirical studies exploring the digital transformation of linguistic landscapes in Indonesia. Most prior research focuses on physical LLs, such as street signage and billboards, while virtual representations of language use in tourism, culture, and identity remain largely unexamined.[4,7,8] This leaves an unexplored opportunity to conceptualize how VLL can function as a tool for sustainable cultural tourism and language preservation in the Indonesian context.

The second gap concerns the absence of a digital prototype that operationalizes the VLL concept for cultural and linguistic purposes. While LL studies have expanded theoretically, few have advanced into technological innovation through mobile or web-based applications.[9,10] A prototype-based study could provide practical evidence of how linguistic and cultural data can be digitized, visualized, and experienced interactively to enhance regional branding.

The third gap involves the limited validation research assessing the quality and feasibility of VLL-based

digital tools. Existing studies seldom include expert validation across content, language, quality assurance (QA), and user interface/user experience (UI/UX) dimensions.[11,12] Such validation is crucial to ensure that a VLL-based mobile platform is not only conceptually sound but also pedagogically and technically reliable for real-world implementation.

Addressing these gaps, this study aims to develop and validate a prototype of a Virtual Linguistic Landscape (VLL)-based mobile application for West Sumatra. First, the study focuses on designing the prototype to integrate linguistic identity with digital innovation in order to support local language preservation and cultural tourism. Second, it evaluates the prototype through expert judgment to determine the quality of its design, the accuracy of its content, the appropriateness of its language, and the feasibility of its technical features.

Related Study of Virtual Linguistic Landscape (VLL)

The concept of the Linguistic Landscape (LL) has evolved from the study of physical signage in public spaces to a broader examination of how languages visually represent identity, ideology, and power in society.[13,14] They argue that LL is not merely about written texts on signs, but about how languages coexist and compete in constructing social meanings. Signs and visual texts, from street billboards to institutional plaques, function as symbolic resources that express belonging, authority, and cultural memory. LL therefore serves as a visible site of ideological negotiation, illustrating tensions between official, top-down discourse and community-driven and bottom-up initiatives. More recently, the LL framework has expanded into the digital realm, giving rise to the concept of the Virtual Linguistic Landscape (VLL), where languages are represented on websites, mobile platforms, and social media spaces. Alkhalaf[15] and Moshnikov[16] highlight that VLL offers new modes of linguistic representation that blur the boundaries between the physical and the virtual, allowing local languages to gain global visibility in online environments.

The use of LL and VLL in language and cultural studies has opened up new directions for research in multilingualism, identity, and digital heritage.[17] It emphasize that LL contributes to understanding how linguistic signs function as cultural texts, reflecting both social inclusion and exclusion. Similarly, Landry and Bourhis on Hallett et al.[18] describe LL as an indicator of ethnolinguistic vitality, revealing the social status of languages within a region. In multilingual societies, the visibility or invisibility of local languages on public and virtual platforms mirrors broader sociopolitical ideologies. Studies such as those by Zeng et al.[19] and Lu et al.[20] have demonstrated that LL analysis is instrumental in uncovering how linguistic representation intersects with power relations, tourism, and identity politics. In digital contexts, this visibility becomes even more crucial, as online platforms often amplify dominant languages while marginalizing local or minority tongues. Consequently, developing tools like VLL-based applications can help sustain linguistic diversity while promoting regional culture through technology.

From a pedagogical and cultural perspective, the integration of LL into educational practice has gained momentum. Gorter et al.[21] suggest that LL analysis helps bridge formal learning and authentic language exposure by encouraging learners to interpret real-world texts. In addition, LL-based tasks develop students' intercultural competence, critical thinking, and awareness of sociolinguistic realities. Expanding this idea, Xue et al.[6] observes that LL promotes higher-order thinking by linking linguistic forms with social meanings. These insights have inspired educators to design project-based and experiential learning models that draw from the linguistic environment. However, despite its potential, LL's digital adaptation of VLL has not been fully explored in formal or informal education, especially in Indonesia. Research on VLL remains largely descriptive and conceptual, without operationalizing its pedagogical or cultural applications in digital form.[22,23]

The relationship between LL/VLL and tourism is another growing area of inquiry. Fitriawati et al.[5] demonstrate how linguistic landscapes contribute to place branding and cultural identity construction in tourist destinations. In Indonesia, studies by Rosa et al. and Putrie et al.[1] reveal that linguistic landscapes in tourism hubs such as Bali and Yogyakarta showcase the coexistence of local and global cultures, yet few initiatives have used these insights to create digital tools for cultural preservation. In the context of West Sumatra, research on LL has focused primarily on physical signage, leaving a gap in understanding how local languages and symbols can be integrated into digital tourism strategies. The development of a VLL-based mobile application prototype can thus serve as an innovative response to these challenges by combining linguistic, cultural, and technological dimensions in promoting regional identity.[24]

Furthermore, the design and validation of educational or cultural technology demand rigorous evaluation across multiple dimensions. As outlined by Oliveira et al. [24] prototype validation in Research and Development (R&D) studies typically involves assessing content relevance, linguistic accuracy, and technical feasibility. In the case of VLL-based applications, validation should also extend to Quality Assurance (QA) and User Interface/User Experience (UI/UX) to ensure that the product is user-friendly, reliable, and culturally sensitive. Studies by Bartra et al.[25] emphasize that a prototype's success depends not only on its technological innovation but also on expert judgments that verify its alignment with instructional, aesthetic, and contextual needs. Despite the importance of such evaluations, empirical studies validating VLL-based applications in Indonesia

are almost nonexistent. Thus, establishing expert validation procedures for a VLL prototype can provide both methodological and practical contributions to future research on language, culture, and digital innovation.

In summary, the literature underscores that while LL research has matured globally, its digital transformation into VLL particularly within Indonesia's multilingual and multicultural context remains limited. The intersection between digital linguistics, cultural preservation, and tourism promotion has yet to be fully realized through technology-driven initiatives. Addressing these gaps, the present study focuses on designing and validating a prototype Virtual Linguistic Landscape (VLL)-based mobile application for West Sumatra. By evaluating the prototype's content, language, QA, and UI/UX through expert review, this research aims to bridge theoretical, empirical, and practical dimensions of VLL development to support sustainable cultural tourism and language preservation.

METHOD

Type of Study, Period, and Location

This study employed the 4-D design model (Define, Design, Develop and Disseminate). The research took place from January to July 2024 across eight regencies and cities in West Sumatra, namely Padang, Bukittinggi, Tanah Datar, Agam, Sawahlunto, Solok, Pesisir Selatan, and Lima Puluh Kota. Throughout this period, the study concentrated on constructing and validating a prototype of a Virtual Linguistic Landscape (VLL)-based mobile application.

Population, Sample, and Sampling Technique

The population consisted of all linguistic signs and cultural representations found in public spaces and tourism sites throughout West Sumatra. From this population, a sample of 48 heritage tourism sites was selected using purposive sampling, with selection based on cultural relevance, linguistic visibility, and accessibility. The inclusion criteria encompassed permanent signs related to tourism, cultural identity, or public communication containing Indonesian, Minangkabau, or English, whereas temporary, damaged, or commercial-only signs without cultural significance were excluded. Signs with unreadable or incomplete information were removed based on exit criteria. Expert validation involved three specialists selected through criterion sampling, consisting of a linguist, a cultural studies scholar, and an information technology specialist.

Variables Analyzed

The study analyzed four major variables consisting of content, language, quality assurance, and user interface/user experience. These variables reflect the central dimensions of digital prototype evaluation and align with standard R&D validation indicators by examining accuracy and cultural relevance, linguistic clarity and consistency, technical functionality and stability, as well as navigation and usability.

Instruments, Techniques, and Procedures

Three main instruments were employed during the research process, namely observation sheets, documentation forms, and expert validation rubrics. The observation sheets were used to record physical and digital linguistic landscape data, while the documentation forms captured textual, visual, and cultural elements from each site. The expert validation rubric contained 32 indicators across the content, language, quality assurance, and UI/UX components, adapted from established R&D product evaluation guidelines and refined through expert consultation. Prior to implementation, the validation instrument underwent content validity confirmation through expert discussion.

Data Collection Process

Data collection was conducted in alignment with the Define and Design stages of the 4-D model. Permanent public signs meeting the inclusion criteria were photographed on-site using smartphones and digital cameras, and each sign's text, cultural symbols, and contextual information were documented systematically. The collected data were then organized into a multilingual content database in Indonesian, Minangkabau, and English. During the Develop stage, the prototype was constructed using Flutter for the application interface and MySQL for database management. Expert validation took place asynchronously, during which evaluators assessed the prototype using the standardized rubric and provided written comments for refinement.

Data Analysis Process

The study employed a mixed-method analysis approach. A qualitative content analysis was used to examine linguistic patterns, cultural markers, and representations of regional identity in the collected visual and textual data. Expert comments obtained during validation were analyzed thematically to guide further revisions. A quantitative analysis was carried out by calculating percentage scores from the expert validation results using descriptive statistics to determine the validity levels of the content, language, quality assurance, and UI/UX

variables, interpreted according to established R&D validity categories.

Ethical Considerations

Ethical procedures were maintained throughout the study. All data were collected in public spaces with no personal or sensitive information recorded, ensuring that the research posed no risk to individuals. Expert participation was entirely voluntary, supported by written consent obtained before validation activities. All digital materials were stored securely and used exclusively for academic and research purposes.

RESULTS

The prototype of the Virtual Linguistic Landscape (VLL)-based mobile application designed to support language preservation and cultural tourism promotion in West Sumatra

The prototype of the Virtual Linguistic Landscape (VLL)-based mobile application was developed using the Flutter framework with the Dart programming language. Figure 1 presents a snippet of the application's source code showing the implementation of the evaluation interface that connected content, linguistic data, and user interaction features. The code structure defined the layout and visual components such as containers, text widgets, and scrollable views to ensure smooth navigation and readability. During the design and development stages, this interface was programmed to display bilingual information, cultural descriptions, and digital representations of 48 tourism heritage sites across eight regencies and cities in West Sumatra. The modular coding approach allowed flexibility for future updates, including database expansion and integration of multimedia content. Overall, this code snippet demonstrated the technical foundation of the VLL-based mobile application, reflecting the combination of linguistic, cultural, and technological elements in a functional prototype.

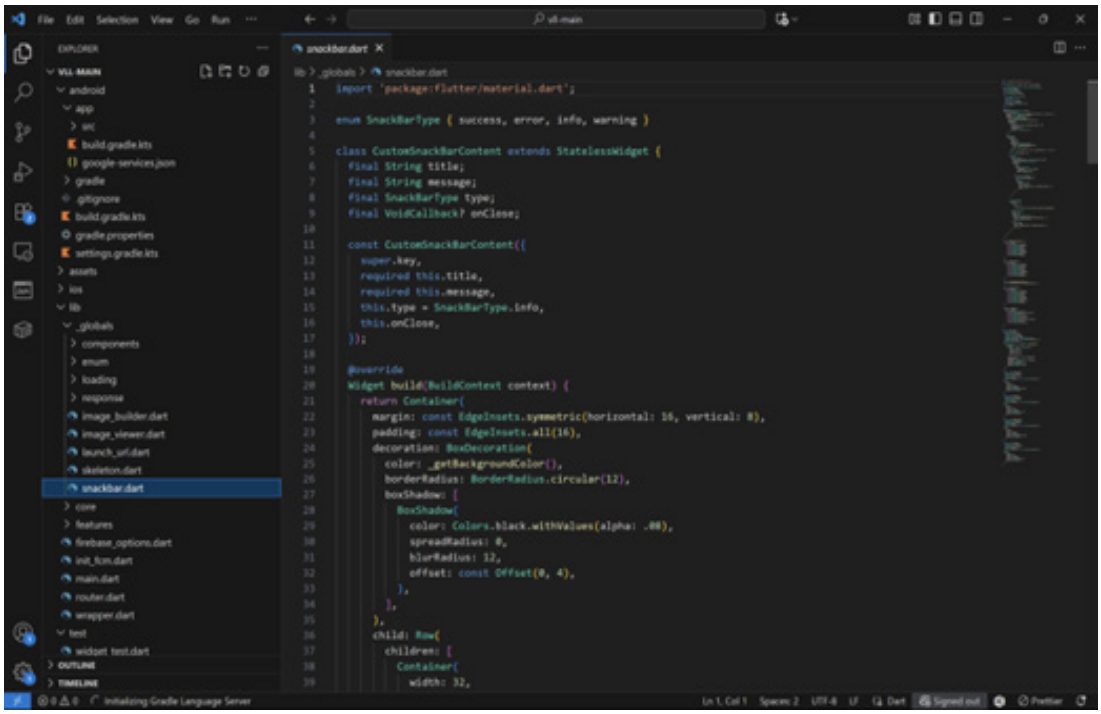

Figure 1. Source code snippet of the VLL-based mobile application

The database of the Virtual Linguistic Landscape (VLL)-based mobile application was designed using MySQL 8.0 to support efficient data storage, retrieval, and management of linguistic and cultural information. As shown in figure 2, the database consisted of several interrelated tables, including banner, city, event, place, lanskap_linguistik, and user, which together enabled the integration of tourism, linguistic, and cultural data. Each table stored specific attributes: for instance, place and place_image contained geolocation and visual information of 48 tourism heritage sites across eight regencies and cities, while lanskap_linguistik managed textual and multilingual data representing the linguistic elements displayed in the application. Additional tables such as place_reviews, personal_notification, and broadcast_notification supported user interaction, feedback, and system updates. The relational structure ensured data consistency and scalability, allowing the prototype to process bilingual content, user-generated inputs, and multimedia attachments effectively. This database design provided a stable and extensible foundation for the VLL-based mobile application, aligning technical functionality with linguistic and cultural objectives.

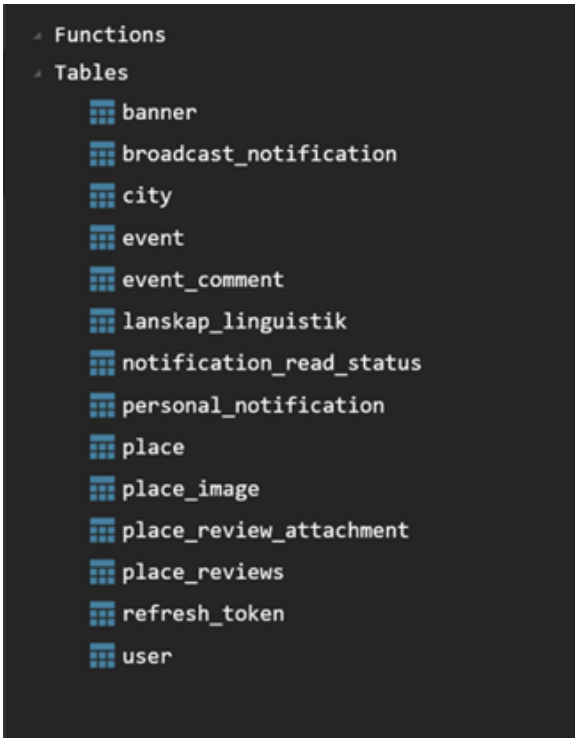

Figure 2. Database structure of the VLL-based mobile application

The login page of the Virtual Linguistic Landscape (VLL)-based mobile application was designed to ensure secure and user-friendly access for both administrators and general users. As presented in figure 3, the interface included standard authentication fields such as email and password, supported by a visibility toggle for password input to enhance usability. The minimalist layout adopted a red-and-white color scheme inspired by Indonesia's national identity, combined with the VLL logo that visually represents cultural harmony in West Sumatra.

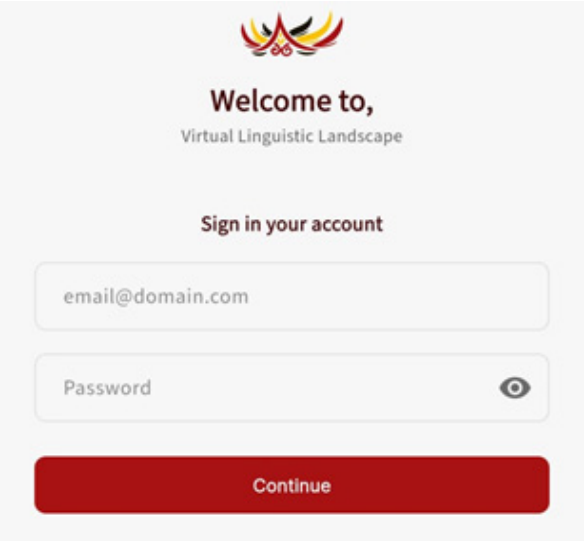

Figure 3. Login page of the VLL-based mobile application

The home page of the Virtual Linguistic Landscape (VLL)-based mobile application was developed as the central interface connecting users to linguistic, cultural, and tourism content. As shown in figure 4, the page displayed a personalized greeting, dynamic banners, and shortcut menus leading to key features such as Map (Peta), Games (Permainan), and Linguistic Landscape (Lanskap Linguistik). The recommendation section presented curated tourism heritage sites, including landmarks such as Pantai Air Manis dan Batu Malin Kundang and Museum Adityawarman, reflecting the integration of linguistic and cultural data collected from 48 locations across eight regencies and cities in West Sumatra. The design adopted a red, yellow, and white color palette symbolizing Minangkabau identity and cultural warmth. Functionally, the home page allowed users to navigate seamlessly through bilingual content and explore digital representations of local culture.

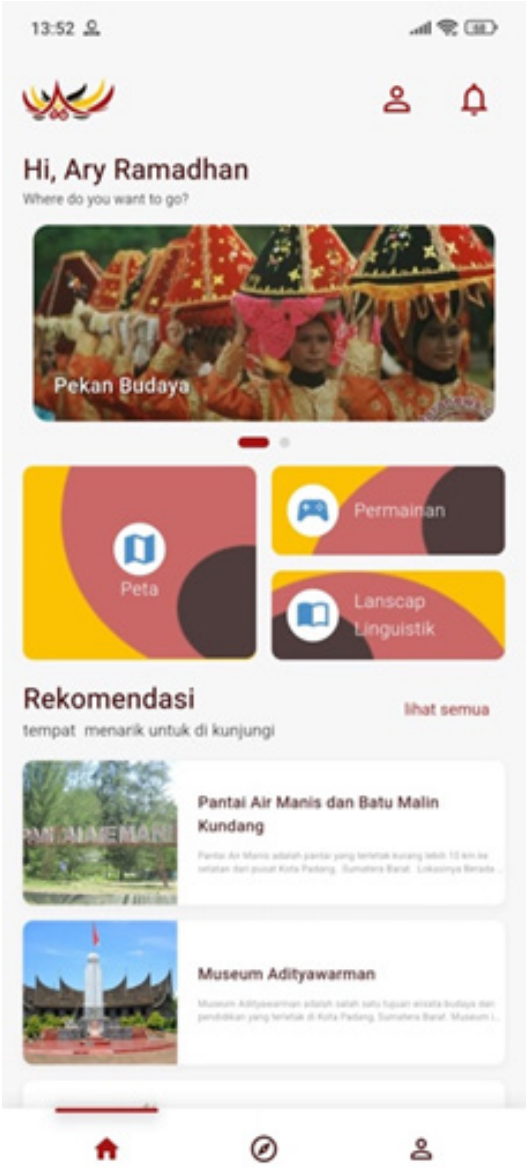

Figure 4. Home page of the VLL-based mobile application

The map page of the Virtual Linguistic Landscape (VLL)-based mobile application was designed to visualize geolocated linguistic and cultural data from eight regencies and cities across West Sumatra. As shown in figure 5, each pin on the map represented a verified heritage or tourism site enriched with bilingual information and visual documentation. The interactive interface allowed users to explore landmarks in Padang City such as Pantai Air Manis, Museum Adityawarman, and Jembatan Siti Nurbaya, which were part of the 48 curated cultural sites embedded in the database. The map employed real-time GPS integration to help users navigate physical and virtual landscapes simultaneously.

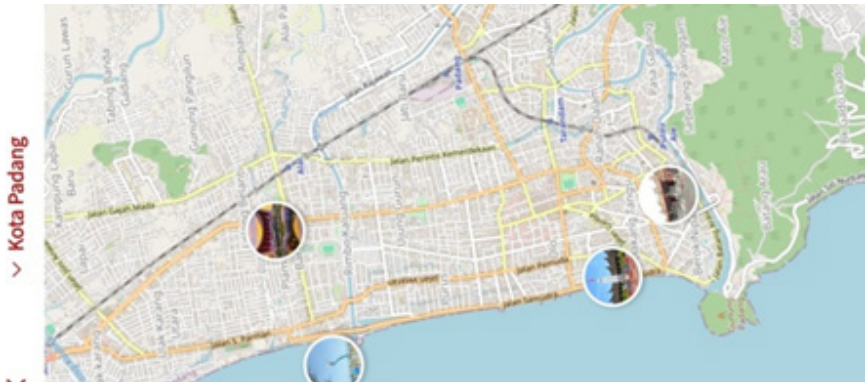

Figure 5. Map page of the VLL-based mobile application

The description page of the Virtual Linguistic Landscape (VLL)-based mobile application provided multilingual information in Indonesian, Minangkabau, and English, as shown in figure 6. Each site description was carefully curated to highlight linguistic diversity and cultural heritage while maintaining accessibility for both local and international audiences. The trilingual presentation aimed to promote the use of the Minangkabau language in digital space, aligning with language preservation goals and regional identity promotion. The content included brief historical, geographical, and cultural explanations of each heritage site, supported by visual elements and user-generated reviews.

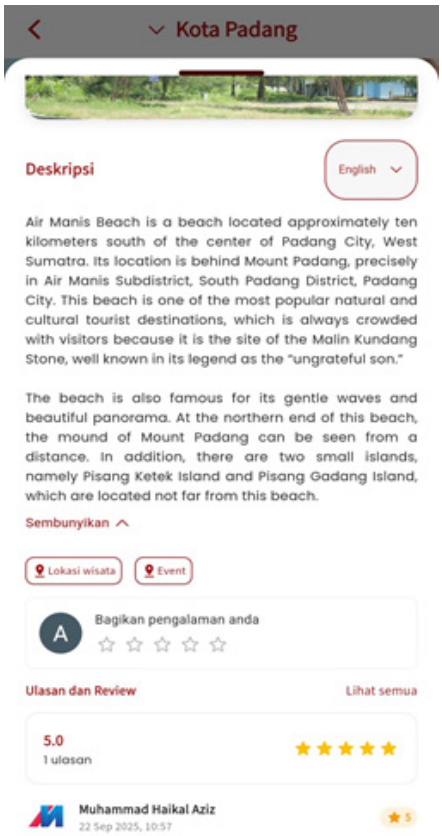

Figure 6. Description in three languages (Indonesian, Minang and English)

The events and notification feature of the VLL-based mobile application, as presented in figure 7, was designed to inform users about ongoing and upcoming cultural activities across West Sumatra. Each event entry included details such as location, date, and brief descriptions in multiple languages, ensuring accessibility for diverse audiences. The system integrated both automatic notifications and manual updates from administrators, allowing timely dissemination of cultural and tourism-related information. Events like Pekan Budaya, Tour de Singkarak, and traditional festivals were linked to linguistic and heritage sites already mapped in the application database.

Figure 7. List of Events and Notification

The valid of the prototype of the Virtual Linguistic Landscape (VLL)-based mobile application according to expert judgment

The validity test of the Virtual Linguistic Landscape (VLL)-based mobile application prototype was conducted through expert evaluation across three main aspects: content, language, and QA/UI–UX design. The overall results indicated that the prototype was categorized as Valid and ready for pilot implementation with several recommendations for improvement.

In terms of content validity, the prototype obtained an average score of 76 %, which fell within the Valid category. Most indicators scored around 73 %, while several reached up to 80 %–87 %, reflecting strong relevance and data accuracy for international tourism promotion. The content was also deemed appropriate in aligning text and visuals with real-world cultural representations and supporting cross-cultural understanding. However, experts noted that some items required further enhancement in the depth of explanations, representation of local cultural uniqueness, adherence to social norms, and multimedia integration. Recommended improvements included adding contextual cultural narratives, providing concise references, enriching multimedia formats, and developing clearer content curation guidelines.

Regarding the language aspect, the prototype achieved an average validity score ranging from 67 % to 87 %, also classified as Valid. The strongest points were found in the consistency of local and cultural terminology, the accuracy of place names, and overall readability supported by typographic clarity. The lowest ratings (67 %) were related to English grammatical accuracy and the clarity of user instructions. To address these issues, experts suggested conducting a bilingual audit by developing an Indonesian–English glossary, implementing professional proofreading, simplifying instructional text using concise sentences, and performing direct readability tests with target users to ensure clarity and prevent ambiguity.

The QA and UI/UX aspects received the highest average validity score of 91 %, placing them in the Highly Valid category. Technical quality and interface design were proven to be strong, with some indicators reaching up to 100 %, particularly in visual aesthetics, layout consistency, interactive performance, and data security. Only one indicator scored 80 %, related to menu organization and interpretability. Minor revisions were suggested, including conducting card sorting to validate menu structure, adding clearer icons and labels, and integrating search and breadcrumb features to improve accessibility. These results confirmed that the QA and UI/UX components were highly reliable and ready to support pilot-scale implementation.

In summary, the expert validation confirmed that the VLL-based mobile application prototype was feasible and valid for limited use, requiring only minor to moderate revisions in content and language components. The QA and UI/UX aspects were found to be technically excellent and ready for wider application. With systematic follow-up revisions, the overall validity level of the prototype is expected to reach the Highly Valid category in subsequent development cycles.

DISCUSSION

The development of the Virtual Linguistic Landscape (VLL)-based mobile application prototype represented an innovative step in linking linguistic preservation with cultural tourism promotion in West Sumatra. The design followed the 4-D model emphasizing the integration of linguistic, cultural, and technological dimensions. During the Define and Design stages, data were collected from eight regencies and cities (Padang, Bukittinggi, Tanah Datar, Agam, Sawahlunto, Solok, Pesisir Selatan, and Lima Puluh Kota) and 48 cultural heritage and tourism sites. Each entry included multilingual content in Indonesian, Minangkabau, and English, consistent with Haji-Othman[26] concept of linguistic landscape as a symbolic representation of language vitality and cultural identity. This multilingual structure was intentionally designed to preserve the visibility of the Minangkabau language in the digital sphere, countering the dominance of national and global languages, a concern also emphasized by Shang[27], and Grey[28] in their studies on digital multilingualism.

The design phase produced a functional prototype consisting of four key interfaces: login, homepage, map page, and multilingual description. The interface allowed users to explore cultural sites virtually while accessing information in three languages, thus strengthening language visibility in public digital space. This approach aligns Bartra et al.[24] argument that linguistic landscapes can function as dynamic learning and cultural environments. By transforming physical signs into digital representations, the prototype extended the idea of the LL into a virtual linguistic landscape (VLL), a concept also supported by Kress et al.[29] who asserts that digital linguistic representations reshape public identity and sociocultural discourse. The integration of tourism events and notifications further supported the communicative function of the VLL, enabling users to experience language, place, and culture simultaneously consistent with Protassova[30] who view LL as a reflection of collective identity and social structure.

The second research question addressed the validity of the prototype according to expert judgment. The validation results confirmed that the prototype achieved a Valid category for content and language and a Highly Valid category for QA and UI/UX. The content validity score (76 %) indicated that the application successfully represented linguistic and cultural elements relevant to West Sumatra's heritage and tourism contexts. Experts

emphasized that the inclusion of historical narratives, authentic images, and cultural references strengthened the communicative and educational functions of the application. These findings resonate with De Sousa et al.[31] who argues that LL research should not merely describe signs but interpret their cultural meanings and pedagogical implications. The experts' recommended adding contextual cultural explanations and improving multimedia integration.

In terms of language, expert evaluations placed the prototype in the Valid range (67–87 %), showing strengths in lexical consistency and readability but weaknesses in English grammar and instruction clarity. These results align with Guarin et al.[8] who highlights the challenge of maintaining balance between linguistic accuracy and cultural authenticity in multilingual learning materials. The recommendation to conduct bilingual proofreading and develop a glossary reflects Xue et al.[6] call for linguistic appropriateness in digital learning interfaces, ensuring accessibility for diverse user groups.

The QA and UI/UX aspects received the highest average score (91 %), confirming that the prototype met technical and usability standards. Experts rated highly the design consistency, interactivity, and data security factors that align with Biró[32] principles of usability, particularly learnability, efficiency, and satisfaction. The clarity of icons, color contrast, and layout organization were praised for enhancing user navigation and engagement. These results also supported by Bonsignori et al.[33] findings that culturally sensitive interface design increases user trust and participation in tourism-based applications. Minor feedback, such as improving menu hierarchy and adding breadcrumb navigation, reflected an attention to long-term scalability rather than major design flaws.

This study has several limitations. First, the prototype was evaluated only by experts and has not yet been tested by real users, so its actual usability in tourism or educational settings remains unknown. Second, the data were limited to 48 sites in eight regencies and cities, meaning many cultural and linguistic elements of West Sumatra are not yet included. Third, the multilingual content relied on researcher-generated translations, which may not fully capture local linguistic nuances. Fourth, the application is still a basic prototype and does not include advanced features such as offline access or real-time updates. Lastly, the study was carried out within a short timeframe, so its long-term impact on cultural preservation and tourism engagement could not be assessed. These limitations provide opportunities for future improvement and development.

Overall, the discussion confirms that the VLL-based mobile application was both technically feasible and culturally valid as a tool for linguistic and heritage preservation. The integration of Minangkabau, Indonesian, and English languages in one digital platform not only fulfilled communicative functions but also embodied symbolic representation of local identity, as proposed by Agustina et al.[34] The expert validation provided empirical support for the application's readiness for pilot testing and its potential contribution to sustainable tourism in West Sumatra. Consistent with Sari et al.[35] notion of geosemiotics, the VLL prototype demonstrates how spatial and linguistic data can converge in digital media to construct collective cultural meaning. Thus, this research contributes to expanding LL theory into the digital domain and illustrates how mobile-based VLLs can serve as both a repository of linguistic heritage and an interactive platform for cultural promotion in the 21st century.

CONCLUSIONS

This study concluded that the prototype of the Virtual Linguistic Landscape (VLL)-based mobile application is feasible and valid to support language preservation and cultural tourism in West Sumatra. Developed through the 4-D model, the prototype successfully integrates linguistic, cultural, and digital elements representing eight regencies and forty-eight heritage sites. Its multilingual interface in Indonesian, Minangkabau, and English enhances accessibility and promotes local identity within a global context. Expert validation confirmed that the prototype met the standards of both functional quality and cultural representation, showing readiness for pilot implementation. The application also demonstrates how digital technology can serve as an effective platform for documenting and revitalizing regional languages while strengthening tourism promotion.

In conclusion, the VLL-based mobile application offers an innovative model that bridges language, culture, and technology. It provides a sustainable approach to preserving linguistic diversity and promoting West Sumatra's cultural heritage in the digital era. Future research may focus on pilot testing, user experience, and community-based adoption to maximize its practical impact.

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CONFLICT OF INTEREST

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