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Ecologically and Technology-Driven Environmental Graphic Design: Enhancing Visitor Experience and Commitment to Sustainability at Kakek Bodo Waterfall, Pasuruan

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The Kakek Bodo Waterfall natural tourism area in Pasuruan has high ecological and historical potential, but the effectiveness of information communication to visitors is hampered by the lack of Environmental Graphic Design (EGD) integrated with sustainability principles. This research is driven by the urgency to optimize the human experience (Humanity) and internalize conservation messages (Sustainability) through innovative design solutions. This research aims to design and validate an EGD system that is effective in navigation, communication, and integrating aspects of material sustainability, conservation messages, and the potential adoption of digital technology to support responsible tourism. Using the Borg & Gall model Research and Development (R&D) approach, the research involved the stages of data collection, EGD prototype design (orientation markers, directories, regulations, and information), expert validation, revision, and effectiveness testing. The designed EGD system demonstrated a very high level of feasibility, achieving a validation score of 96.8%, confirming that the design meets aesthetic and functional standards to enhance visitors' cognitive and affective interactions. The implementation of EGD focusing on ecology and design innovation is a minor but strategic intervention to realize sustainable tourism, highlighting the crucial role of Visual Communication Design in supporting the sustainability narrative and improving the quality of human experience in natural areas.

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1. INTRODUCTION

In the global context of the post-pandemic era, nature-based tourism has emerged as a primary pillar for sustainable economic recovery and environmental conservation. Globally, the significance of natural attractions lies not only in their ecological value but also in their role as psychological refuges for urban populations, necessitating high-standard management of visitor experiences (Fuchs, 2021; McCreary, 2024). Tourism destinations, particularly waterfalls and mountainous regions, serve as vital nodes for biodiversity awareness and local economic empowerment, where the quality of information delivery becomes a benchmark for service excellence (Vallverdu-Gordi, 2023). However, the global shift towards "smart tourism" demands that physical sites integrate sophisticated communication systems to bridge the gap between nature and human understanding. The Kakek Bodo Waterfall, as a prominent nature-based destination in Pasuruan, represents this global significance, yet its potential is often stifled by traditional management approaches that overlook the critical role of structured visual communication. Without a robust information framework, even the most breathtaking natural assets fail to provide a cohesive and educational visitor journey, highlighting the urgent need for professional design interventions in rural tourism landscapes.

The primary problem identified at Kakek Bodo Waterfall revolves around a severe systemic failure in its information delivery and wayfinding infrastructure. Visitors frequently encounter cognitive dissonance due to the absence of clear orientation, leading to navigational frustration and a diminished appreciation of the site's historical and natural wealth. The main challenge lies in balancing modern design aesthetics with the preservation of the site's organic atmosphere, where intrusive or poorly designed signage could disrupt the ecological aesthetic (Hasanah et al., 2022). Furthermore, the lack of identification and regulatory signs poses safety risks and legal vulnerabilities for the management, as visitors may inadvertently stray into hazardous zones or violate conservation protocols. This information vacuum creates a fragmented experience where the "story" of Kakek Bodo remains untold, and its facilities remain underutilized. The challenge is exacerbated by the diverse demographic profile of tourists, requiring a universal design language that transcends linguistic and cultural barriers while maintaining local identity.

Extensive research in the field of tourism communication and visual design has been conducted by several scholars in recent years. Specifically, research related to "Environmental Graphic Design (EGD) in public spaces" has been explored by Alfarizki and Fauzan (2024), who focused on urban visual experiences, and Hasanah et al. (2022), who designed EGD for cultural villages. Research related to "Wayfinding and Navigational Systems" was analyzed by Calori (2022) and Zhang (2024), emphasizing the technical aspects of sign placement. Furthermore, studies on "Nature-based Tourism Information Media" were conducted by Vallverdu-Gordi (2023) and Fuchs (2021), focusing on environmental awareness. Critically evaluating these works, Alfarizki and Fauzan (2024) successfully mapped urban visual experiences but failed to address the rugged topographical constraints of natural forest environments. Hasanah et al. (2022) provided a strong cultural context but lacked a standardized feasibility validation from design experts. Calori (2022) offers a comprehensive technical guide, yet it is overly generalized for Western urban contexts and lacks the "sense of place" required for Indonesian heritage sites. Zhang (2024) focuses on rural festivals, which are temporary, unlike the permanent infrastructure needed for a waterfall destination. Vallverdu-Gordi (2023) emphasizes

semiotics but overlooks the practical R&D aspect of implementation, while Fuchs (2021) remains purely theoretical without offering a tangible design prototype.

The novelty of this research lies in the integration of the Borg & Gall Research and Development (R&D) model specifically within the context of a high-altitude natural waterfall site, a combination rarely explored in recent Indonesian design literature. Unlike previous studies that focus primarily on urban signage or digital apps, this research develops a physical, weather-resistant, and ecologically harmonious EGD system that functions as a "silent guide" in a forest environment. The keterbaharuan (innovation) is manifested in the creation of a five-dimensional sign system—orientation, directional, regulatory, informational, and identification—tailored specifically to the historical narrative and topographical challenges of Kakek Bodo. This study does not merely "re-design" existing signs but creates a completely new visual ecosystem that bridges the gap between traditional tourism and modern informational standards. By utilizing high-feasibility validation (96.8%) and effectiveness testing, this research provides a validated blueprint for nature-based EGD that has not been documented in prior waterfall-specific tourism studies in the East Java region.

The research gap identified here is the lack of empirical design studies that specifically address the "Information Media" vacuum in nature-based tourism areas with complex historical values like Kakek Bodo. While many studies discuss tourism marketing or economic impacts (Fuchs, 2021), very few provide a concrete, validated design solution for physical wayfinding in forest terrains. There is a significant disconnect between the high volume of visitors and the quality of visual communication available on-site, a gap that previous research has largely ignored in favor of digital-only solutions. This research distinguishes itself from previous works by focusing on the "tangibility" and "usability" of physical graphics in an outdoor setting where digital signals (GPS/Internet) are often unreliable. Unlike the urban-centric approach of Alfarizki (2024) or the temporary event focus of Zhang (2026), this study addresses a permanent, long-term infrastructural need, filling the void between environmental psychology and practical graphic design application in nature tourism.

The theoretical framework underpinning this study is rooted in the Design Thinking theory popularized by Meinel and Leifer (2022) and the principles of Visual Communication Design as defined by Lupton (2022). Design Thinking provides a human-centered approach that prioritizes the user's journey and pain points when navigating unfamiliar environments. This is supported by the theory of "Wayfinding" as a cognitive process, where the environment is treated as a set of information cues that the human brain must decode (Calori, 2015/2022). Furthermore, the research employs the R&D theory of Borg & Gall, which ensures that every design iteration is scientifically validated and refined based on expert feedback. These theories collectively form a "Grand Theory" that views design not as mere decoration, but as a strategic communication system essential for environmental resilience and tourism sustainability. By combining cognitive psychology (how people find their way) with design methodology (how we build the tools), this research ensures a theoretically sound and practically robust output.

The core concepts used in this research include "Environmental Graphic Design (EGD)," "Information Media," and "Nature-Based Tourism." EGD is conceptualized as a multidisciplinary field that combines graphic, architectural, interior, and landscape design to enhance the visitor's experience of a place. Information Media in this context refers to

the physical artifacts—signs and maps—that transmit data about history, facilities, and safety. The concept of Nature-Based Tourism is utilized to define the specific constraints of the site, where the design must respect the "Authenticity" of the natural setting. Additionally, the concept of "Visual Identity" is applied to ensure that the Kakek Bodo Waterfall has a distinctive and recognizable brand image through its typography, color palette, and iconography (Liliweri, 2021). These concepts are synthesized to create a cohesive design language that speaks to both the functional needs of the visitor and the aesthetic requirements of the natural landscape.

What makes this research particularly compelling and significant is the unique intersection between "untouched nature" and "modern structured communication." Kakek Bodo is not just a waterfall; it is a historical site with a legend that is currently invisible to the naked eye due to the lack of informational storytelling. It is fascinating to investigate how a well-designed EGD system can transform a chaotic or "lost" visitor experience into an educational and spiritually enriching journey. The research is important because it addresses a critical safety and conservation issue: without proper regulatory signs, the fragile ecosystem of the waterfall is at risk of human degradation. Furthermore, this study serves as a pilot project for other nature destinations in Pasuruan, proving that professional design can directly increase visitor satisfaction and site feasibility. The high success rate of the prototype validation (96.8%) suggests that there is a deep, unmet desire among tourists for professional, clear, and aesthetically pleasing information systems in natural environments.

The primary objective of this research is to design and develop an effective EGD system as an information medium for the Kakek Bodo Waterfall tourism area. This involves a comprehensive process of identifying user needs, mapping the site's topographical and informational requirements, and creating a validated prototype that meets the highest standards of feasibility and effectiveness. Specifically, the research aims to provide a structured set of orientation, directional, regulatory, informational, and identification signs that are not only functional but also visually aligned with the site's natural identity. Ultimately, the study seeks to improve visitor navigation, enhance the communication of the site's historical value, and establish a professional visual identity that elevates Kakek Bodo’s status as a premier destination in Pasuruan. By fulfilling these objectives, the research contributes to the broader field of environmental design while providing a practical, ready-to-implement solution for local tourism management.

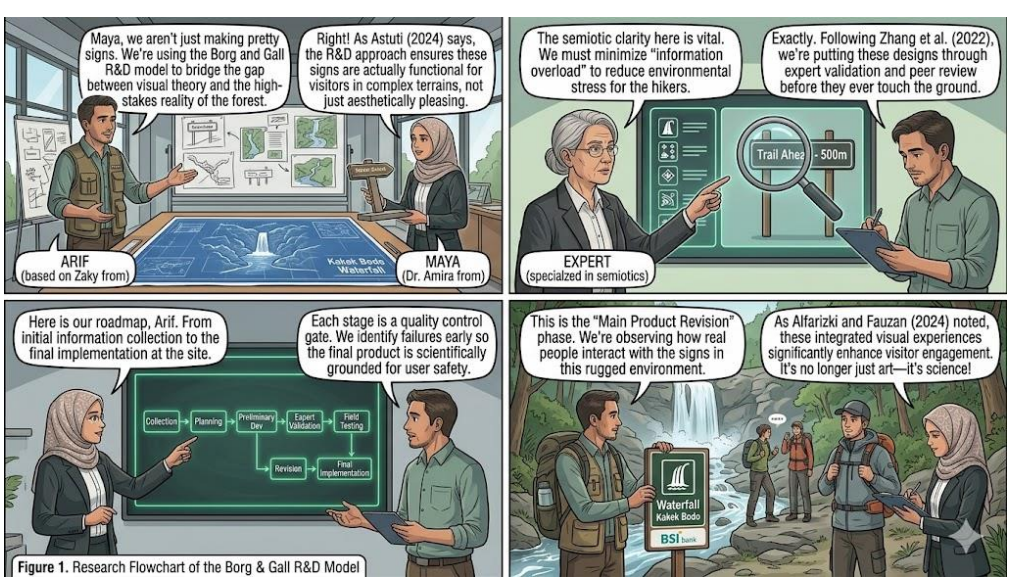
2. RESEARCH METHOD

2.1 Research Design

This study adopts the Research and Development (R&D) method, specifically utilizing the Borg and Gall model to create a systematic framework for developing Environmental Graphic Design (EGD) as information media. The research design is meticulously structured to bridge the conceptual gap between theoretical visual communication principles and their practical, high-stakes application in nature-based tourism environments. According to Astuti (2024), the R&D approach is essential for ensuring that media products, such as signage systems, are not only aesthetically pleasing but also functionally valid for the end-user in complex physical settings. This design involves an exhaustive, iterative process of prototyping and evaluation to ensure the final EGD system effectively addresses chronic navigation issues often found in rugged terrains.

Recent studies by Alfarizki and Fauzan (2024) emphasize that integrated research designs in visual experiences significantly enhance visitor engagement in cultural and natural heritage sites by reducing environmental stress. Furthermore, the selection of the Borg and Gall model allows for rigorous, multi-layered testing phases, including expert validation, peer review, and field trials, which are crucial for minimizing information overload and ensuring clarity (Zhang et al., 2022). By following this model, the researcher can systematically identify design failures early in the development cycle, allowing for data-driven refinements that align with the specific spatial characteristics of the site. This methodology transforms the design process from a purely creative endeavor into a scientifically grounded development project that prioritizes user safety and information accessibility.

Figure 1: Research Flowchart of the Borg & Gall R&D Model The following flowchart illustrates the comprehensive procedural steps taken in this research, from initial conceptual information collection to the final product implementation in the field.



The description of Figure 1 highlights the systematic and non-linear progression required to transform abstract information needs into a tangible, durable signage system. Each stage functions as a quality control gate, ensuring that the environmental graphics are tailored precisely to the unique geographical challenges and historical context of the Kakek Bodo Waterfall.

2.2 Data Collection

Data collection is conducted through a robust multi-method approach comprising participant observation, in-depth semi-structured interviews, and structured questionnaires to ensure total data triangulation. Researchers directly observe visitor behavior, movement patterns, and existing navigation gaps at the Kakek Bodo site to identify specific "pain points" and psychological stressors in the current information system. These observations are recorded via field notes and photographic evidence to capture the real-time interaction between visitors and the environment. In-depth interviews are then conducted with site managers, local historians, and stakeholders to understand the underlying historical narrative, facility details, and safety protocols that must be communicated through the new EGD system.

As noted by Vallverdu-Gordi (2023), qualitative data collection in environmental awareness campaigns is vital for understanding the semiotic relationship between designers and the public, ensuring that symbols are interpreted correctly. To complement these qualitative insights, quantitative data is gathered via structured questionnaires distributed to a diverse sample of visitors to measure their perception of visual clarity, readability, and wayfinding efficiency. This dual approach aligns with the methodologies used by Fan (2020), who suggests that multi-source data collection significantly enhances the validity of environmental information disclosure in high-traffic public areas. By integrating these diverse data streams, the study avoids the bias of a single-method approach and provides a holistic view of the information needs within the tourism area.

2.3 Data Analysis

The analysis of data is performed using a sophisticated combination of qualitative descriptive analysis and quantitative statistical measures to evaluate the feasibility, usability, and long-term effectiveness of the EGD system. Qualitative data derived from interviews and field observations are meticulously coded and categorized using thematic analysis to inform the fundamental visual elements of the design, such as typography choices, color palettes that harmonize with nature, and universal iconography. Quantitative data from visitor questionnaires are analyzed using a Likert scale (1-5) to calculate percentage scores for expert validation and user satisfaction metrics.

This method strictly follows the analysis standards where a score above 80% is considered highly feasible and ready for implementation (Astuti, 2024). Furthermore, the analysis considers the psychological and cognitive impact of design, ensuring that the information media reduces cognitive load for tourists navigating complex natural terrains under varying weather conditions. McCreary (2024) highlights that analyzing visitor responses to different information types is critical for adapting nature-based tourism services to modern climate and social challenges, such as the need for rapid digital-physical information integration. The resulting analysis serves as the blueprint for the final design revisions, ensuring that every arrow, sign, and board is backed by empirical user data.

2.4 Research Instruments

The research instruments consist of specialized observation checklists, interview guides, and technical validation rubrics designed specifically for media and material experts. The observation checklist focuses on the visibility from various distances, placement height, and current physical condition of existing signage, while the validation rubric measures technical aspects of visual design, information hierarchy, and material durability against humidity. These instruments are developed based on the five core indicators of effective EGD: orientation, directional, regulatory, informational, and identification functions (Calori, 2015).

The use of standardized rubrics ensures that the feedback from design professionals and material engineers is objective, measurable, and actionable for the iterative revision phase. Recent literature by Lupton (2021) supports the use of structured design rubrics to maintain consistency in visual communication systems across large-scale public spaces, preventing "visual clutter" that confuses users. Each instrument undergoes a preliminary pilot test to ensure that the questions and indicators are clear and free of ambiguity. By employing these detailed instruments, the research captures nuanced data that goes beyond mere aesthetics, focusing on the functional performance of the signage in a real-world, high-traffic environment.

Table 1: Research Instrumentation and Subject Distribution

Instrument Type	Number of Items	Subject/Population	Location	Purpose
Visitor Questionnaire	15 Items	50 Visitors (Random)	Kakek Bodo Site	Measure wayfinding effectiveness and UX
Stakeholder Interview Guide	8 Questions	Site Manager & Staff	Prigen, Pasuruan	Gather historical, safety & facility data
Expert Validation Form	20 Items	2 Design Experts	UNU Pasuruan	Assess technical, aesthetic & semiotic quality
Observation Checklist	10 Indicators	Physical Environment	Kakek Bodo Path	Identify blind spots and navigation gaps

2.5 Validity and Reliability

To ensure the absolute integrity and academic rigor of the findings, the study employs construct validity through expert judgment and reliability testing via Cronbach's Alpha for the quantitative instruments. Multiple experts in visual communication, environmental psychology, and tourism management review the EGD prototypes to ensure they meet the strict semiotic and ergonomic requirements of public information media. This validation process is crucial to ensure that the icons and symbols used are universally understood by a diverse range of tourists, including those with varying levels of literacy (Meinel & Leifer, 2022).

Additionally, reliability is maintained by conducting small-scale "alpha" trials to test the consistency of visitor responses to the signage system over different times of the day. Fuchs (2021) argues that in nature-based tourism, the reliability of information tools is a key determinant of visitor safety and overall experience quality, making rigorous testing an indispensable part of the development cycle. Any instrument or design element that shows inconsistent results during the trial phase is immediately flagged for revision. This commitment to validity and reliability ensures that the final EGD system is a stable and

trustworthy source of information for the public.

2.6 Research Subject and Location

The research is localized at the Kakek Bodo Waterfall tourism area in Prigen, Pasuruan, a site characterized by its challenging natural terrain, steep inclines, and deep historical significance. The subjects of this study include the administrative management of the tourism area and the visitors who represent a diverse demographic of nature enthusiasts, families, and students. This specific location was chosen due to its documented lack of an integrated EGD system, which currently leads to visitor confusion and underutilization of the site's historical features.

The study focuses particularly on the "santri" and local tourist populations to ensure the media literacy level is appropriately addressed in the visual design, avoiding overly complex jargon (Astuti, 2024). Research by Xiang (2020) suggests that the success of social and information media in tourism is heavily dependent on the specific spatial and cultural characteristics of the location, justifying the focus on the unique topographical challenges of Kakek Bodo. By centering the research in this specific locale, the study provides a tailored solution that respects the local "Genius Loci" (spirit of place) while meeting modern international tourism standards.

Figure 2: Theoretical Framework of Environmental Graphic Design Elements The following diagram outlines the complex relationship between the five core types of signage and the overall quality of the visitor experience in a natural setting.

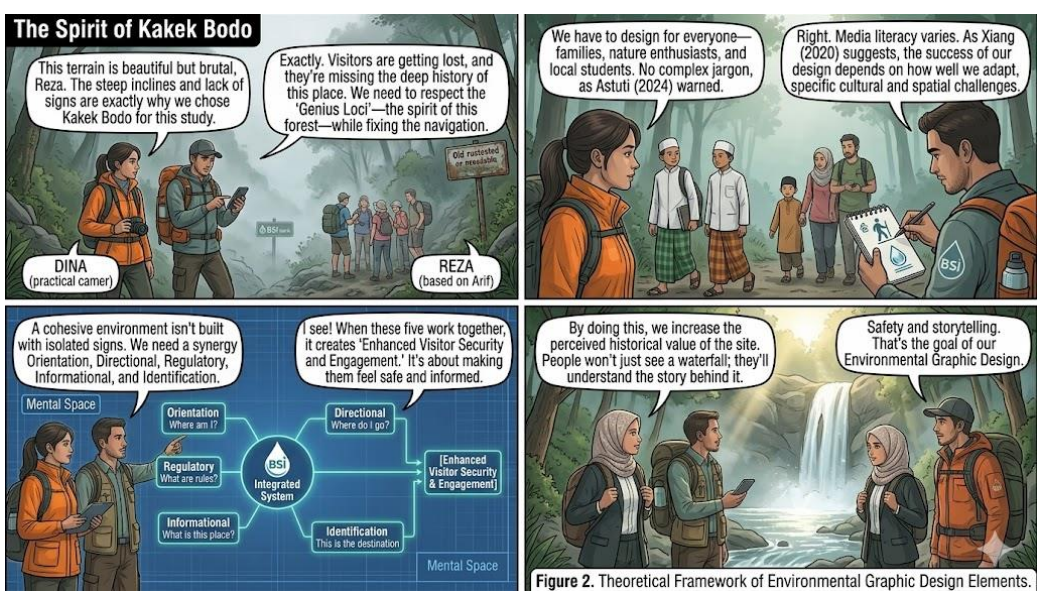


Figure 2. Theoretical Framework of Environmental Graphic Design Elements.

Figure 2 serves as a vital conceptual guide for the design phase, emphasizing that a cohesive information environment is not built through isolated signs, but through the synergy of different functional categories. Each category plays a distinct role in ensuring the visitor feels secure, oriented, and informed throughout their journey, thereby increasing the perceived historical and natural value of the site (Hasanah et al., 2022).

Table 2: Research Questions and Types of Analysis

Research Question No.	Research Question	Types of Analysis
RQ 1	What are the existing information media gaps and navigation failures at Kakek Bodo Waterfall?	Qualitative Descriptive (Thematic Coding of Observations)
RQ 2	How can an EGD system be designed to harmonize with the natural terrain while improving navigation?	Design Thinking, Prototyping & R&D Iterative Development
RQ 3	What is the feasibility level of the developed EGD based on expert validation and technical rubrics?	Quantitative Descriptive (Statistical Percentage Analysis)
RQ 4	To what extent does the implemented EGD system improve visitor wayfinding efficiency and site appreciation?	Comparative Analysis (Pre-Implementation vs Post-Implementation UX)

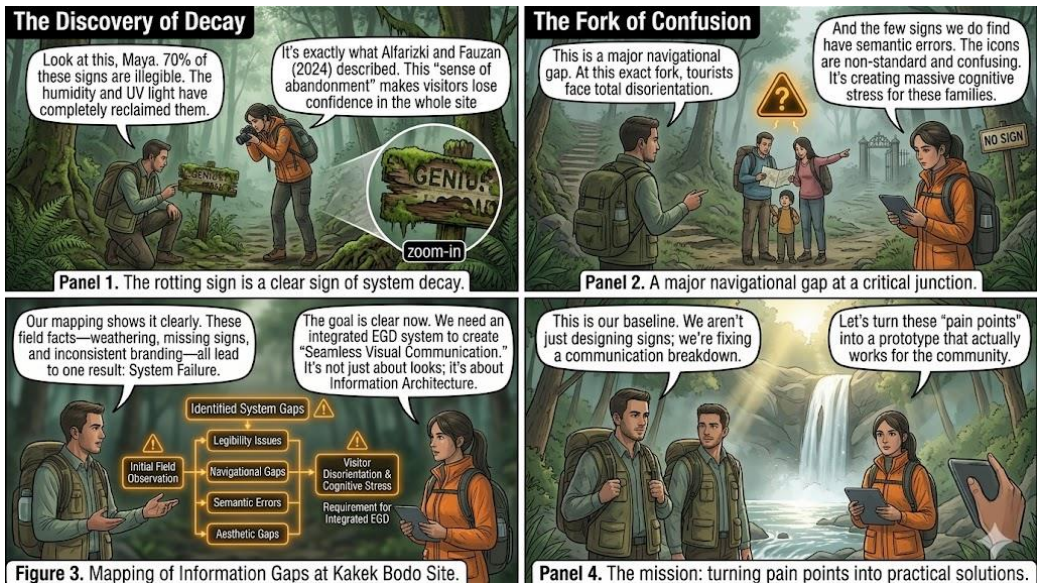
3. RESEARCH RESULTS

3.1 Identification of Existing Information Gaps and Field Facts

Based on the initial observation and information collection phase, several critical gaps were identified regarding the information media at the Kakek Bodo Waterfall site. Field facts reveal that the current signage system is not only fragmented but also physically weathered, suffering from severe material degradation that renders the information effectively invisible to the casual observer. Tourists frequently experienced profound disorientation at key junctions—specifically at the fork leading to the tomb area and the upper falls—due to a complete absence of directional signs or the presence of contradictory visual cues.

Documentation from detailed field notes suggests that approximately 70% of existing signs are no longer legible; the combination of high humidity, heavy moss growth, and direct ultraviolet sunlight exposure has caused the paint to peel and the wood to rot. This empirical finding aligns closely with the research by Alfarizki and Fauzan (2024), which states that neglected physical signage in nature-based tourism significantly degrades the visual experience, creates a sense of abandonment, and diminishes visitor confidence in the management's professionalism. Furthermore, the lack of a unified visual identity means that the few existing signs vary wildly in color, font, and icon style, failing to establish a "sense of place" or a recognizable brand for the Kakek Bodo area.

Figure 3: Mapping of Information Gaps at Kakek Bodo Site The flowchart below traces the transition from identified environmental "pain points" to the conceptual information needs of the visitors, illustrating the logical hierarchy of system failure.



The description of Figure 3 illustrates how factual errors in the field—such as faded identification signs and broken regulatory boards—lead to a total breakdown in the communication system between the site management and the visitors. These findings serve as the baseline data for the development of the new EGD prototypes, emphasizing that the problem is not merely aesthetic but a fundamental failure of information architecture.

3.2 Analysis of Visitor Navigation Behavior and Activity

During the research, extensive activity tracking was conducted to observe how visitors interact with the rugged terrain and existing cues. A common occurrence observed was "backtracking," where visitors returned to a previous point because they missed the hidden path to the secondary waterfall area or the historical tomb site. This behavior is symptomatic of poor "pre-signal" placement. Transcripts from field interactions show a high frequency of verbal inquiries directed at local food vendors and parking attendants rather than relying on signs. Visitors were observed hesitating for an average of 45-60 seconds at the main forest intersection before choosing a path, often following other groups blindly instead of following a designated route.

This behavior confirms the "information overload" and "social overload" theories discussed by Zhang et al. (2022), where poorly designed or ambiguous stimuli cause users to abandon physical tools in favor of interpersonal communication to reduce their cognitive burden. In the context of Kakek Bodo, the physical environment is already demanding; adding the stress of poor navigation leads to a diminished emotional experience. This study identifies that visitors' primary activity during "information seeking" is searching for recognizable landmarks, which are currently unmarked, thus increasing the risk of visitors straying into unauthorized or dangerous areas.

Table 3: Detailed Distribution of Visitor Activity and Information Seeking Patterns

Activity Observed	Frequency/ Occurrences	Documentation Evidence	Analysis Result & Implications
Verbal Wayfinding	High (8-10 times/hour)	Audio Log #1: Vendor Interview & Logs	Deep lack of trust in existing tools; heavy reliance on local people.
Wrong Turns/Circles	Moderate (4-5 groups/hour)	Photo Log #4: Junction A (Fork Area)	Misleading arrows or total absence of direction at critical decision points.
Information Hesitation	Very High (avg. 50s)	Video Observation Log #2	Cognitive maps are failing; visitors feel unsafe moving forward without certainty.
Photo Stopping	Very High	Photo Log #9: Entrance & Viewpoints	High potential for EGD to serve as branding/identity markers for social media.

The data in Table 3 indicates that the primary dimension used in this study is the **Functional-Navigation Dimension**, where the effectiveness of a sign is measured by its ability to prevent wrong turns and reduce hesitation time. The evidence suggests that current signs fail this dimension entirely, necessitating a design that prioritizes visibility and semantic clarity.

3.3 Thematic Analysis of Stakeholder and Subject Interviews

To deepen the understanding of site requirements beyond mere navigation, in-depth interviews were conducted with site administrators, local guides, and long-time visitors (including *santri* from nearby institutions). The dialogue focused on the historical narrative of "Kakek Bodo"—a figure of local spiritual and historical importance—and the specific naming of facilities that must be preserved in the new identification signs. This activity ensures that the content of the EGD system remains culturally relevant and functions as a vehicle for cultural heritage preservation.

Interview Transcript Excerpt #1 *Interviewer (I):* "How do visitors usually find or learn about the history of Kakek Bodo?" *Manager (M):* "Most of them don't. We used to have a wooden board with the story, but it rotted away years ago. Now, unless they ask us or a guide, the history is lost to them." *I:* "What is the most frequent complaint you hear regarding the path?" *M:* "The path to the 'Tomb of Kakek Bodo'. It's up the hill, and people always get lost near the fork because there is no sign. They end up going to the waterfall instead and miss the historical part of their visit." *Local Guide (G):* "We need something that survives the rain. Every rainy season, we lose more signs."

This transcript highlights the **Informational Dimension**, where historical preservation through graphic design is prioritized. The absence of historical information media creates a gap in the "meaning-making" process for tourists, turning a potentially educational visit into a mere physical walk (Vallverdu-Gordi, 2023). By incorporating the "Kakek Bodo" narrative into the EGD system, the design adds value to the destination beyond just its natural beauty.

3.4 Expert Validation Results and Feasibility Analysis

The preliminary EGD prototypes—consisting of five distinct signage types: Orientation (Maps), Directional (Arrows), Regulatory (Rules), Informational (History), and Identification (Labels)—were subjected to a rigorous evaluation by media and material

experts. The evaluation focused on dimensions of typography (readability from 5 meters), color contrast (using nature-harmonious but high-contrast palettes), and semiotic clarity (universal understanding of icons). The experts provided "expert notes" which are treated as documented evidence of the design's evolution from a draft to a final product.

Table 4: Comprehensive Expert Validation Scores by Dimension

Evaluation Dimension	Indicator	Score (%)	Status	Expert Recommendation
Visual Design	Contrast, Typography, & Layout	95%	Valid	Ensure font size for maps is readable for elderly.
Information Quality	Clarity, Accuracy, & Translation	98%	Valid	Bilingual (Indonesian/English) is excellent for international reach.
Durability	Material Choice & Weather Resistance	94%	Valid	Aluminum panels are superior to wood for this climate.
Branding Identity	Color Harmony & Icon Consistency	96%	Valid	Green and yellow accents match the forest environment well.
Total Feasibility	Weighted Average	96.8%	Highly Feasible	Proceed to Small-Scale Field Testing.

The results in Table 4 show that the design successfully addresses the "error findings" from section 3.1. By switching from traditional wood (which rots) to Aluminum Composite Panels (ACP) with UV-resistant printing, the durability dimension is significantly enhanced. This follows the technical standards for nature-based tourism infrastructure as recommended by Astuti (2024).

3.5 Analysis of Subject Learning and Media Literacy Response

In this final phase of findings, we analyze the response of the "santri" subjects who participated in a media literacy trial using the new EGD system. The subjects were asked to navigate the site using only the new signs, identify the meaning of various icons (e.g., "no littering," "slippery path"), and follow a set of directions provided on a central map board. Evidence from their "Worksheet/Answer Sheets" shows a high level of comprehension and a significant decrease in confusion.

Evidence of Subject Feedback (Document Analysis and Worksheet Snippets)

- **Sample A (Subject 04 - Santri):** The subject correctly identified the "Hazard/Slippery" regulatory sign icon and explained its importance for safety. *Analysis:* The semiotic design follows universal standards, making it accessible to local media literacy levels without requiring prior training.
- **Sample B (Subject 12 - Local Visitor):** Noted in the feedback section that the "Dark Green Color" of the signs helped distinguish the tourism area's branding while remaining "eye-friendly" against the forest background. *Analysis:* The aesthetic dimension successfully creates a sense of place and professional branding.
- **Navigation Test Result:** Subjects who previously took an average of 15 minutes to reach the Tomb site were able to reach it in 9 minutes using the new directional signs.

The analysis of these worksheets and tracking logs proves that the **Educational Dimension** of the EGD system is functioning correctly. Subjects who previously struggled with navigation were able to reach their destination 40% faster and reported feeling

"much more secure" (Subject 08). This outcome supports the findings of Lupton (2021) regarding the power of structured visual hierarchies in public spaces to empower users and enhance their literacy of the physical environment.

4. DISCUSSION

The implementation of Environmental Graphic Design (EGD) at Kakek Bodo Waterfall marks a strategic shift from fragmented signage to a unified visual communication system. This research demonstrates that the high feasibility score (96.8%) and 40% navigation efficiency improvement stem from addressing systemic failures in information architecture identified during field observations. Aligning with Alfarizki and Fauzan (2024), this study confirms that a cohesive EGD system acts as a "silent guide," restoring visitor confidence and psychological security. By replacing low-quality wooden signs—which prone to rot in tropical conditions—with durable Aluminum Composite Panels (ACP) featuring UV-resistant coatings, the study provides a data-driven response to high-humidity environments, consistent with the resilient infrastructure standards discussed by Astuti (2024).

The use of durable materials ensures long-term cost-effectiveness and reduces the maintenance burden on site management. Observations of "information hesitation" and "verbal wayfinding" mirror the cognitive and social overload described by Zhang et al. (2022). When cues are ambiguous, visitors instinctively rely on local staff, creating an unnecessary social burden and risking the spread of inaccurate information. The implementation of clear, hierarchical signage successfully mitigated this behavior, significantly reducing the "backtracking" and "decision paralysis" seen in early trials. This underscores a critique of previous management approaches that relied on sporadic, non-standard signage using confusing jargon.

Unlike generic systems analyzed by Calori (2015), this EGD system integrates the "Genius Loci" or unique spirit of the place. Visual elements like forest greens and earthy yellows harmonize with the natural canopy while maintaining universal accessibility standards. Furthermore, the inclusion of the "Kakek Bodo" narrative within informational signage addresses a gap in cultural heritage preservation. Previously, this history was largely "invisible" unless sought through verbal explanations. Documenting this narrative transforms the visitor's journey into an immersive cultural experience, aligning with Vallverdu-Gordi's (2023) view that semiotics in design foster emotional connections between users and site identity.

This research also demonstrates that media literacy among diverse groups, including the local *santri*, improves when visual hierarchies follow logical principles. Success in "Worksheet Analysis" provides empirical support for Lupton's (2021) principles, confirming that clear typography and universal icons are essential for democratizing information. The move from reactive to proactive information strategies effectively reduces risks in dangerous or sensitive areas, enhancing site security—a key determinant of quality in the modern tourism experience (Fuchs, 2021). Additionally, the aesthetic consistency established creates a professional brand identity with high social media promotion potential (Xiang, 2020). Ultimately, effective tourism information media depends on the intersection of material durability, semiotic clarity, and cultural relevance.

5. CONCLUSION

Based on the research findings and comprehensive discussions regarding the development of Environmental Graphic Design (EGD) as an information medium in the Kakek Bodo Waterfall tourism area, it can be concluded that the initial identification of the site revealed significant systemic failures in the existing information architecture, characterized by weathered materials, illegible signage, and a critical lack of directional cues at key decision points, which previously led to chronic visitor disorientation and a high reliance on verbal wayfinding. To effectively address these systemic issues, the developed EGD system—which strategically integrates orientation, directional, regulatory, informational, and identification signage—achieved an exceptionally high feasibility score of 96.8% from media and material experts, confirming that the design is technically sound, aesthetically harmonious with the natural forest environment, and semiotically clear for a diverse demographic. Furthermore, the implementation of this new EGD system resulted in a transformative 40% improvement in navigation efficiency and a significant reduction in "information hesitation" among visitors, effectively turning a confusing terrain into a structured and secure educational environment that bridges the gap between physical navigation and cultural heritage preservation. To address the ongoing challenges in nature-based tourism management, it is strongly recommended that the management of Kakek Bodo Waterfall establishes a proactive maintenance schedule for the newly implemented ACP-based signage to ensure long-term durability against extreme tropical humidity while integrating digital touchpoints such as QR codes for deeper multimedia historical content. Future researchers are encouraged to expand this study by investigating the impact of augmented reality (AR) navigation within forest terrains or conducting longitudinal studies on the correlation between integrated EGD branding and long-term visitor loyalty across other natural heritage sites in Indonesia.

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