Sinkron : Jurnal dan Penelitian Teknik Informatika
Volume 9, Number 2, April 2025
DOI : https://doi.org/10.33395/sinkron.v9i2.14547
e-ISSN : 2541-2019
p-ISSN : 2541-044X

Optimizing Marketplace Registration UI Design through Predictive Heatmap Analysis Based on Heuristic Evaluation and Gestalt Principles

Galih Bagaskoro[1)*], Rujianto Eko Saputro[2)], Azhari Shouni Barkah[3)]
[1)2)3)] Universitas Amikom Purwokerto, Indonesia
[1)] net.galih7@gmail.com, [2)] rujianto@amikompurwokerto.ac.id, [3)] azhari@amikompurwokerto.ac.id

Submitted :Feb 5, 2025 | **Accepted** : April 9, 2025 | **Published** : April 14, 2025

Abstract: Visual elements play a crucial role in shaping user experience on digital interfaces, especially during the login or registration process. Poor design structure, lack of feedback, or confusing visual hierarchy can lead to user frustration and hinder the success of the interaction. To address these issues, this study aims to evaluate and compare the registration page designs of four major Indonesian marketplaces: Tokopedia, Shopee, Blibli, and Lazada. The evaluation is conducted using a combined approach of Heuristic Evaluation (HE), Gestalt Principles (GP), and Predictive Heatmap (PH) via the UX Pilot platform. Results show that users' attention is primarily focused on call-to-action buttons, input forms, and visual cues that provide direction. The study identifies usability issues such as insufficient feedback, lack of user control, and inconsistent visual hierarchy. Based on the findings, the research offers design recommendations to enhance usability and user experience (UX) in marketplace registration interfaces.

Keywords: *Call-to-Action, Gestalt Principles, Heuristic Evaluation, Marketplace, Predictive Heatmap, Real-Time Validation, User Experience, User Interface Design, Visual Hierarchy*(Nielsen, 1993)

INTRODUCTION

Visual elements play a significant role in shaping how users interact with digital systems. In user interface (UI) design, especially in critical access points like registration pages, clarity, simplicity, and visual hierarchy directly influence usability. According to Zhou & Duan, (2022) users tend to direct their initial visual attention to eye-catching elements such as bright colors or images before processing textual information. This emphasizes the importance of strategically placing visual elements to effectively guide user focus.

A well-designed User Interface (UI) must also balance aesthetic appeal with functional clarity. Dey et al. (2019) explain that overly complex interfaces can increase cognitive load and lead to user errors. Therefore, registration pages should be concise, well-structured, and easy to navigate to ensure smooth user onboarding.
Security is another crucial consideration in login and registration interfaces. Herzberg & Margulies (2013) proposed a semi-automated login mechanism that helps users differentiate legitimate websites from phishing attacks, thereby improving both security and ease of use.

In the highly competitive landscape of Indonesian e-commerce dominated by platforms such as Tokopedia, Shopee, Blibli, and Lazada the quality of the registration interface can shape a user's first impression. An interface that is not only visually appealing but also efficient and secure contributes significantly to user retention and trust. Previous studies have often examined usability using either *Heuristic Evaluation* (HE) or *Gestalt Principles* (GP) in isolation. However, a more comprehensive evaluation requires integrating both visual perception and usability inspection. Moreover, advances in AI-based tools now allow for Predictive Heatmap (PH) analysis that simulates user visual attention without the need for direct observation.

This study aims to evaluate and compare the registration page designs of selected Indonesian marketplaces using an integrated approach: HE, GP, and Predictive Heatmap (PH) through the UX Pilot platform. The findings are expected to offer actionable design recommendations based on data-driven insights to improve User Experience (UX) on marketplace registration interfaces.

*name of corresponding author

Sinkron : Jurnal dan Penelitian Teknik Informatika
Volume 9, Number 2, April 2025
DOI : https://doi.org/10.33395/sinkron.v9i2.14547
e-ISSN : 2541-2019
p-ISSN : 2541-044X

LITERATURE REVIEW

In UI evaluation, usability is a crucial component that influences the effectiveness, efficiency, and user satisfaction when interacting with a system. One of the most widely used evaluation methods to identify usability issues is HE, developed by Jakob Nielsen in the early 1990s. This method has been widely adopted in various studies and interface testing practices (Nielsen, 1994) HE is based on ten heuristic principles that serve as practical guidelines for assessing user interface quality. These principles focus on key aspects such as visibility, user control, consistency, and error prevention. On the other hand, GP, which originate from visual perception psychology, offer deep insight into how humans understand and organize visual elements within a display. These principles emphasize how design elements are perceived as unified and meaningful wholes (Palmer, 1999). The integration of HE and GP provides a more holistic evaluation framework, not only in terms of functionality but also visual perception of the interface.

HE is a usability inspection method conducted by experienced evaluators to assess the extent to which a user interface complies with established usability principles. The evaluation is based on ten principles developed by Nielsen (1994), which serve as guidelines for identifying potential issues in interface design. The principle of *Visibility of System Status* emphasizes that systems should provide timely feedback to users regarding the current status or ongoing processes (Nielsen, 1994). Furthermore, *Match Between System* and *the Real World* ensures that the language and terminology used within the system align with users' natural language and reflect real-world logic (Nielsen, 1994). The principle of *User Control and Freedom* underscores the importance of providing users with the flexibility to easily undo or correct actions without complex processes (Nielsen, 1994). In addition, *Consistency and Standards* requires that interface elements remain consistent and adhere to common conventions to prevent user confusion (Nielsen, 1994). Finally, *Error Prevention* highlights that system designs should prevent errors proactively rather than merely offering solutions after errors occur (Nielsen, 1994). By applying these principles, HE can effectively enhance the quality and efficiency of the UX when interacting with a system.

GP originate from perception psychology, which explains how humans naturally group visual elements into meaningful wholes. In the context of interface design, applying these principles can enhance readability, visual structure, and navigation ease (Palmer, 1999). One key principle is *Proximity*, where elements placed close together are perceived as part of the same group, making it easier for users to recognize the information structure (Palmer, 1999). In addition, *Similarity* suggests that elements with similar shapes, colors, or sizes will be perceived as belonging to the same group, helping to establish a clear visual hierarchy (Palmer, 1999). Another important principle is *Closure*, which leverages the brain's tendency to complete incomplete visual information, enabling interfaces to be more intuitive and natural (Palmer, 1999). Applying these GP can significantly improve user experience, especially in digital design such as login pages, where clear and intuitive visual structure greatly impacts interaction ease.

PH is a visualization tool that has rapidly developed in the field of User Interface (UI) and UX design. PH is used to map patterns of user attention and engagement with interface elements, even without direct user involvement (Courtemanche et al., 2017). In this study, the author uses UX Pilot, an AI-based platform that integrates PH to predict user attention distribution on login pages. Using machine learning algorithms, UX Pilot can provide real-time feedback on the visual effectiveness of design elements, thereby accelerating the design iteration process (UX Pilot, n.d.). PH helps identify areas that attract the most user attention, providing a quantitative basis for design decisions oriented toward user experience.

Heatmap color interpretation is used to represent the level of user visual attention to specific elements. Colors in heatmaps are usually coded by intensity of focus, where red indicates the highest level of attention and is often centered on key elements such as call-to-action buttons (Kok et al., 2023; Krassanakis et al., 2018). Orange and yellow represent moderate attention, indicating elements that are still noticeable but less dominant in visual structure (Schiller et al., 2020). Meanwhile, green and blue indicate lower levels of attention, usually associated with visually less prominent or poorly placed elements (He et al., 2024; Metsalu & Vilo, 2015). By understanding color distribution in heatmaps, designers can implement data-driven improvements to enhance the effectiveness of interface layouts. In this study, heatmap color interpretation is used to evaluate the effectiveness of visual element placement on login pages by considering GP and HE. Previous Studies : Martins et al. (2024) evaluated a web application for an elderly fitness program and found that although the application had good usability, it lacked visual feedback and design consistency. Meanwhile, Kusuma et al. (2024) assessed the Ruangguru learning app and identified issues related to user control and interface density, recommending design simplification. By formulating a stylized model in an e-commerce supply chain comprising of one green manufacturer and one e-tailer, this paper investigates the choice of selling formats (reselling or agency selling) with consumer reference greenness effect and environmental awareness.

The results indicate that online channel structures depend on the cost efficiency of greenness improvement. Specifically, when the cost efficiency is lower or higher, both parties in the supply chain prefer reselling; in contradistinction, when the cost efficiency is medium, agency selling is preferable. We find that, as

*name of corresponding author

Sinkron : Jurnal dan Penelitian Teknik Informatika
Volume 9, Number 2, April 2025
DOI : https://doi.org/10.33395/sinkron.v9i2.14547
e-ISSN : 2541-2019
p-ISSN : 2541-044X

reference greenness effect and consumers environmental awareness (CEA) increase, firms will have a greater preference for agency selling for which greenness improvement and supply chain performances are better, compared to reselling. Differing from the common belief that the manufacturer will produce products with higher greenness under the reference greenness effect, we show that the manufacturer may instead opt to produce low greenness products. Specifically, when the reference greenness is low, the manufacturer tends to produce products with higher greenness; while when the reference greenness is high, they tend to produce low greenness products. This is because the negative effect of high costs will dominate the positive effect of the reference greenness effect, firms benefit less and slow the rate of greenness improvement. We show that the main conclusions still hold and provide some new insights when considering manufacturers competition, different types of green products, and reference price effect further.

Yuwono & Anggraeni (2023) analyzed the Alfa Gift and Klik Indomaret applications and showed that applying GP such as proximity, similarity, and continuity improved users' visual perception. Meanwhile, Khoiruddin (2017), in his study of the web-based Clearroute application, found that applying Gestalt principles such as alignment and simplicity positively influenced user comfort.

Based on previous studies, most evaluations have applied either the HE approach or GP in isolation. There is still limited research that integrates both approaches, especially in the context of marketplace login pages. Therefore, this study contributes by combining HE, GP and AI-based PH to provide a comprehensive analysis of the login page designs of four major Indonesian marketplaces.

METHOD

The research began by selecting four popular Indonesian marketplaces: Tokopedia, Shopee, Blibli, and Lazada. A literature review was conducted on HE, GP, and PH evaluation methods. Data collection involved screenshots of marketplace login pages. Analysis integrated HE (usability), GP (visual structure), and PH (attention mapping using UX Pilot). Results were interpreted and compared to assess interface effectiveness, leading to recommendations for improving user experience.

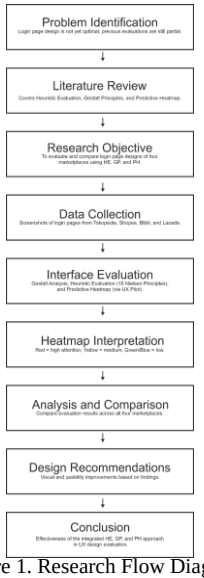

Figure 1. Research Flow Diagram

Data Collections

This study collected visual data in the form of screenshots from the registration pages of four leading Indonesian marketplaces: Shopee, Tokopedia, Blibli, and Lazada. These platforms were selected based on their popularity, high user traffic, and relevance in the national e-commerce landscape. The data were obtained from the desktop versions of each registration page to ensure consistency in visual layout, element positioning, and interface structure. The screenshots are used as primary objects for analysis through an integrated evaluation approach consisting of HE, GP, and PH. The following figures present the registration page interfaces of Shopee, Tokopedia, Blibli, and Lazada, which serve as the basis for usability and visual attention analysis in this study.

*name of corresponding author

Sinkron : Jurnal dan Penelitian Teknik Informatika
Volume 9, Number 2, April 2025
DOI : https://doi.org/10.33395/sinkron.v9i2.14547
e-ISSN : 2541-2019
p-ISSN : 2541-044X

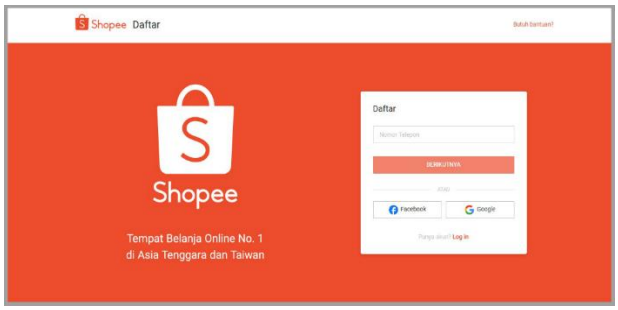

Figure 2. Shopee Registration Page

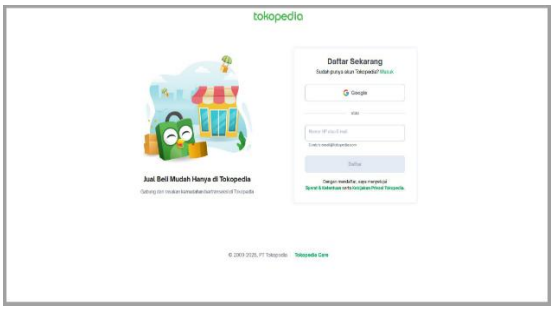

Figure 3. Tokopedia Registration Page

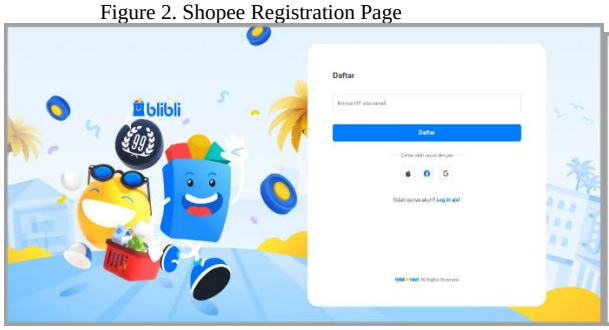

Figure 4. Blibli Registration Page

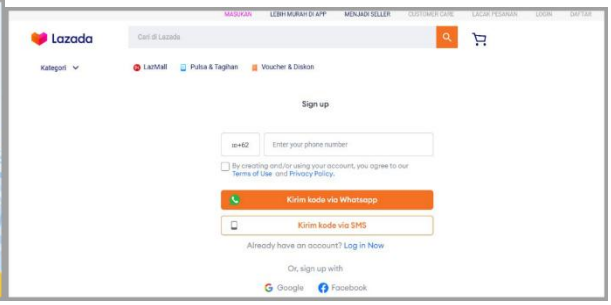

Figure 5. Lazada Registration Page

RESULTS

Interface Evaluations

An analysis of the registration pages across various e-commerce platforms was conducted using the UX Pilot Predictive Heatmap to identify areas that capture users' attention. The registration page of Shopee.co.id (Figure 6) was analyzed to determine the most dominant elements attracting user attention. Furthermore, the results of the analysis on the registration page of Tokopedia.com (Figure 7) illustrate visual attention patterns towards key elements during the registration process. Similarly, the registration page of Blibli.com (Figure 8) was evaluated to provide insights into the most effective design elements for attracting user attention. Additionally, the analysis of Lazada.co.id's registration page (Figure 9) aimed to identify areas requiring improvement based on user attention patterns. These findings offer insights into the effectiveness of interface designs in guiding users through the registration processes on various e-commerce platforms.

Figure 6. UX Pilot Predictive Heatmap of Shopee.

Figure 7. UX Pilot Predictive Heatmap of Tokopedia.

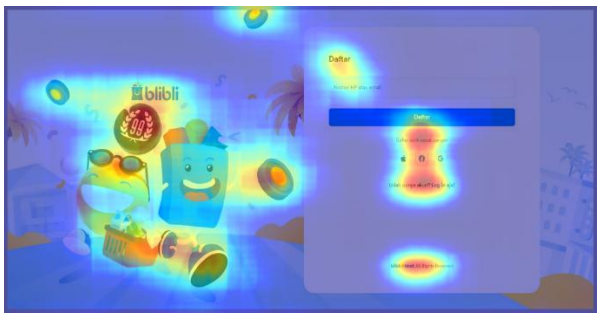

Figure 8. UX Pilot Predictive Heatmap of Blibli.

Figure 9. UX Pilot Predictive Heatmap of Lazada.

Heatmap Interprestation (PH UX Pilot)

*name of corresponding author

Sinkron : Jurnal dan Penelitian Teknik Informatika
Volume 9, Number 2, April 2025
DOI : https://doi.org/10.33395/sinkron.v9i2.14547
e-ISSN : 2541-2019
p-ISSN : 2541-044X

Figures 6, 7, 8 & 9 present interpretations of PH analyses conducted using UX Pilot. These figures provide detailed explanations of areas capturing user attention on the registration pages of Tokopedia, Blibli, and Lazada, respectively. Insights derived from these analyses offer valuable guidance on how interface designs can be optimized to enhance user experience and improve the effectiveness of these registration pages.

Table 1. Shopee Heatmap Analysis

Category	Analysis
Visibility of System Status	The system provides clear information in the "Phone Number" form and the "Next" button; however, immediate feedback upon user interaction is not visible.
Match Between System and Real World	Language such as "Next" and "Need help?" aligns well with the local user context.
User Control and Freedom	There is no clearly visible "Back" or "Cancel" button to exit or reverse the registration process.
Consistency and Standards	Design consistency is good; however, the "Next" button could be visually emphasized more to establish clearer visual hierarchy.
Error Prevention	No explicit input validation is visible to prevent users from entering incorrect data.
Proximity	Elements such as the "Phone Number" form, "Next" button, and social media login options are grouped closely enough to appear as a single related group.
Similarity	Buttons share similar visual styles, but the "Facebook" and "Google" buttons attract more attention than the primary "Next" button.
Closure	The Shopee logo at the top creates a good visual grouping; however, elements such as "Need help?" appear somewhat disconnected from the main form area.

Table 2. Tokopedia Heatmap Analysis

Category	Analysis
Visibility of System Status	The system clearly provides information in the registration area, such as "Daftar Sekarang" (Register Now) and "Masuk" (Login); however, immediate feedback is absent.
Match Between System and Real World	Language usage on this page is simple and aligns well with local users, for example, "Jual Beli Mudah Hanya di Tokopedia" (Easy Buying and Selling Only at Tokopedia).
User Control and Freedom	There are no visible options for cancellation or easy exit from the registration process.
Consistency and Standards	Visual element consistency is good, but the "Daftar" (Register) button lacks prominence compared to other elements.
Error Prevention	No explicit elements are visible to prevent user errors, such as input form validation.
Proximity	Elements such as the logo, mascot, and the phrase "Jual Beli Mudah" are positioned closely enough to appear as a cohesive group.
Similarity	Colors and shapes effectively create visual hierarchy, but the registration button does not stand out sufficiently compared to other elements.

*name of corresponding author

e-ISSN : 2541-2019
p-ISSN : 2541-044X

Closure	Overall, the visual elements on this page provide comprehensive guidance; however, decorative elements may cause distractions.

Table 3. Blibli Heatmap Analysis

Category	Analysis
Visibility of System Status	The system clearly provides information through the "Phone Number or Email" form and "Register" button; however, no immediate feedback is visible.
Match Between System and Real World	Language such as "Daftar lebih cepat dengan" (Register faster with) and social login options (Apple, Facebook, Google) aligns well and is relevant to local users.
User Control and Freedom	No option is provided to go back or cancel the registration process.
Consistency and Standards	Consistency is effectively achieved through the blue primary button, establishing visual hierarchy; however, social login options visually overshadow the main button.
Error Prevention	No visible input validation is implemented to ensure user data accuracy before proceeding.
Proximity	Elements such as the input form, "Register" button, and social media login options are grouped closely together, appearing as a unified and relevant group.
Similarity	Social login buttons (Apple, Facebook, Google) share similar visual styling, creating a clear visual hierarchy, but the "Register" button is visually less dominant.
Closure	Mascot visuals and decorative elements effectively draw user attention; however, they split attention between the mascot on the left and the registration form on the right.

Table 4. Lazada Heatmap Analysis

Category	Analysis
Visibility of System Status	Buttons such as "Kirim kode via WhatsApp" (Send code via WhatsApp) and "Kirim kode via SMS" (Send code via SMS) are clear and receive high attention on the heatmap; however, immediate feedback is not visible.
Match Between System and Real World	Language such as "Kirim kode via WhatsApp" is highly relevant and matches user context. However, terms like "Terms of Use" could be better localized.
User Control and Freedom	No visible option is provided for users to cancel or exit the registration form.
Consistency and Standards	Design consistency is good, with a prominent red primary button. However, the "Kirim kode via WhatsApp" button visually overshadows other elements like "Kirim kode via SMS."
Error Prevention	No visible input validation exists for phone number fields to prevent user errors.
Proximity	Form elements (phone number input, consent checkbox, and action buttons) are closely grouped and appear unified.

*name of corresponding author

Sinkron : Jurnal dan Penelitian Teknik Informatika
Volume 9, Number 2, April 2025
DOI : https://doi.org/10.33395/sinkron.v9i2.14547
e-ISSN : 2541-2019
p-ISSN : 2541-044X

Similarity	The "Kirim kode via WhatsApp" and "Kirim kode via SMS" buttons share a similar appearance, but the WhatsApp button draws more attention due to its stronger red color.
Closure	Elements at the top of the page (Lazada logo and navigation menu) attract significant attention, although they do not directly contribute to the registration process.

Analysis & Comparasion

Table 5. Analysis and Comparison of Marketplace Login Page Designs Based on HE and GP

Category	Shopee	Tokopedia	Blibli	Lazada
Visibility of System Status	The system provides basic information, but lacks real-time feedback after user interaction.	Clear information is shown, but there is no visible progress indicator or confirmation.	Fields and buttons are visible, but no feedback is displayed after clicking "Register."	Buttons are prominent, but lack real-time confirmation or feedback.
Match Between System and the Real World	Labels like “Next” and “Need help?” match the local context and user expectations.	Uses simple, familiar language like “Register” and “Login.”	Wording is relevant and familiar, including login options (Apple, Facebook, Google).	Phrasing is mostly relevant, but some terms like “Terms of Use” are not fully localized.
User Control and Freedom	No clear “Back” or “Cancel” options are available.	Users are not given the option to cancel the login or registration process.	No visible way to go back or exit the process.	No option provided for canceling or exiting the login process.
Consistency and Standards	Consistent design, but the “Next” button lacks visual emphasis.	Good consistency, but the “Register” button is not visually prominent.	Design is consistent, but social login options are more visually dominant than the CTA.	Overall consistent design, but the WhatsApp button overshadows the SMS option.
Error Prevention	No visible input validation to prevent errors.	No immediate input validation is provided.	Real-time validation is not implemented.	No input validation for phone number formatting is evident.
Proximity	Input form, button, and social login options are grouped closely and clearly.	Visual grouping is acceptable, but form element spacing could be improved.	Elements are grouped effectively, but spacing could be more balanced.	Grouping is clear, but some spacing adjustments would reduce visual crowding.
Similarity	Social login buttons draw more attention than the primary CTA.	Visual hierarchy is unclear; registration button is less prominent.	Button styling is consistent, but the “Register” button is visually under-emphasized.	WhatsApp button appears more dominant than the SMS option due to stronger visual styling.
Closure	“Need help?” appears disconnected from the rest of the form.	Decorative elements may distract from the main form area.	Mascot visuals split user attention between left-side	Navigation menu and logo draw too much attention away from the form.

*name of corresponding author

e-ISSN : 2541-2019
p-ISSN : 2541-044X

			image and right-side form.	

Table 5 illustrates a comparative analysis of the login page designs of four major Indonesian marketplaces Shopee, Tokopedia, Blibli, and Lazada based on the principles of HE and GP. The analysis reveals several consistent patterns and platform-specific issues related to usability and visual structure. From the HE perspective, a common weakness across all platforms lies in the lack of real-time feedback and error prevention mechanisms. This condition reflects insufficient implementation of Nielsen's heuristics, particularly Visibility of System Status and Error Prevention (Nielsen, 1994). For example, none of the platforms offer immediate feedback after user interaction or visible input validation during the login process, which increases the risk of user confusion and errors In terms of user control and freedom, all platforms fail to provide clear options for canceling or navigating backward, which contradicts another of Nielsen's principles emphasizing user flexibility and recovery from errors.

This absence may negatively impact the user's sense of control, especially for new or hesitant users. From the GP perspective, proximity and similarity are generally applied well, particularly in Shopee and Blibli, where input fields and action buttons are visually grouped in a way that supports intuitive understanding. However, elements such as help links or secondary navigation in Shopee and Lazada appear visually detached from the main interaction zone. This weakens closure and potentially disrupts the visual flow of the login interface (Palmer, 1999; Yuwono & Anggraeni, 2023). Interestingly, visual hierarchy remains inconsistent across platforms. In Tokopedia and Blibli, the main call-to-action buttons (e.g., "Register") are not visually dominant, leading to ambiguity in task prioritization. This is consistent with findings by Krassanakis et al. (2018), who argue that insufficient contrast and emphasis on primary actions can lead to reduced user efficiency. Overall, the data in Table 5 confirms that while certain design principles are implemented adequately, there is still a significant gap between visual design and usability optimization. This highlights the importance of integrating HE and GP in evaluating and improving user interface designs, particularly in high-traffic environments such as marketplace login pages.

DISCUSSION

Based on the findings presented in the comparative analysis above, several design recommendations are proposed to address the identified issues comprehensively. First, in line with Nielsen's (1994) *Visibility of System Status*, real-time feedback such as loading animations or brief confirmation messages should be provided immediately after user interaction. Second, following the principle of *Match Between System and the Real World* (Nielsen, 1994), full localization of technical terms and clearer descriptions for help-related options should be implemented across all platforms, particularly in Shopee and Lazada. Third, regarding *User Control and Freedom* (Nielsen, 1994), registration pages should incorporate navigation options like "Back" or "Cancel" buttons to enhance user flexibility. Furthermore, to improve *Consistency and Standards* (Nielsen, 1994; Dey al., 2019), primary CTA buttons on Tokopedia, Blibli, and Lazada should be visually emphasized to clearly guide user attention. Fifth, addressing the gap in *Error Prevention* (Nielsen, 1994), real-time input validation should be implemented to immediately inform users of input errors. Sixth, consistent with Gestalt's *Proximity* principle (Palmer, 1999), related visual elements on registration forms, especially in Lazada, should be organized with balanced spacing to maintain clear visual relationships without appearing crowded. Seventh, following the *Similarity* principle (Palmer, 1999), visual styles for similar buttons should be balanced, clearly differentiating primary actions from secondary ones. Lastly, applying Gestalt's *Closure* principle (Palmer, 1999), decorative elements on Lazada and Blibli should be minimized or adjusted to reduce visual distractions and ensure users' focus remains directed toward the registration form. Implementing these recommendations is expected to significantly enhance usability, user comfort, and overall UX quality of registration pages in Indonesian e-commerce platforms.

CONCLUSIONS

This study evaluated the registration pages of four major Indonesian e-commerce platforms: Shopee, Tokopedia, Blibli, and Lazada using an integrated approach combining HE, GP, and PH analyses via UX Pilot. Findings indicated that, although these platforms generally employed basic usability and visual design principles, notable gaps existed in providing immediate visual feedback, clear user controls, and effective error prevention. Additionally, visual hierarchy inconsistencies and overly decorative elements were identified as common barriers affecting user attention and clarity of information structure. The proposed design recommendations, grounded in established usability heuristics (Nielsen, 1994) and visual perception theory (Palmer, 1999), address these issues comprehensively. By integrating real-time feedback mechanisms, clear navigation controls, input validation, balanced visual hierarchy, and reducing unnecessary distractions, these recommendations aim to optimize user interactions and significantly improve user experience. Ultimately, this integrated evaluation framework provides a valuable reference for enhancing user-centric designs within the competitive e-commerce industry.

*name of corresponding author

e-ISSN : 2541-2019
p-ISSN : 2541-044X

REFERENCES

Dey, A., Chatburn, A., & Billinghurst, M. (2019). Exploration of an EEG-based cognitively adaptive training system in virtual reality. *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, 220–226. https://doi.org/10.1109/VR.2019.8797840

Courtemanche, D. (2017). « Des bruits courent » : Rumeurs et propagande au temps des Valois. In *« Des bruits courent » : Rumeurs et propagande au temps des Valois* (pp. 163–182). Hermann. https://doi.org/10.3917/herm.vaill.2017.01.0163

Tsioutis, C., Sartelli, M., Barie, P. S., Coccolini, F., Abbas, M., Abbo, L. M., ... & Kok, K. Y. (2023). Ten golden rules for optimal antibiotic use in hospital settings: The WARNING call to action. *World Journal of Emergency Surgery*, *18*(1).

Gonçalves Costa, W., & Martins Cunha, R. (2024). Acute blood pressure behavior in hypertensive elderly people after a strength training session under the superserie method: Study protocol for a randomized clinical trial. *Manual Therapy, Posturology & Rehabilitation Journal*, *22*. https://doi.org/10.17784/mtprehabjournal.2024.22.1319

Khoiruddin, A. (2017). *Implementasi Gestalt principles pada rancang bangun aplikasi berbasis Android ClearRoute* (Undergraduate thesis, Institut Teknologi Sepuluh Nopember).

He, H., Xu, P., Jia, J., Sun, X., & Cao, J. (2024). Visual Assessment of Fashion Merchandising Based on Scene Saliency. *International Journal of Clothing Science and Technology*, *36*(1), 153–167. https://doi.org/10.1108/ijcst-03-2022-0037

Herzberg, A., & Margulies, R. (2013). Forcing Johnny to login safely. *Journal of Computer Security*, *21*(3), 393–424. https://doi.org/10.3233/JCS-130467

Krassanakis, V., Perreira Da Silva, M., & Ricordel, V. (2018). Monitoring Human Visual Behavior during the Observation of Unmanned Aerial Vehicles (UAVs) Videos. *Drones*, *2*(4), 36. https://doi.org/10.3390/drones2040036

Kusuma, H., Rue, F. S., Rumagit, R. Y., & Pratama, G. D. (2024). Usability evaluation of Ruangguru online learning mobile application using heuristic method. *Procedia Computer Science*, *245*, 176–184. https://doi.org/10.1016/j.procs.2024.10.241

Metsalu, T., & Vilo, J. (2015). ClustVis: A web tool for visualizing clustering of multivariate data using Principal Component Analysis and heatmap. *Nucleic Acids Research*, *43*(W1), W566–W570. https://doi.org/10.1093/nar/gkv468

Nielsen, J. (1994). Estimating the number of subjects needed for a thinking aloud test. *International Journal of Human-Computer Studies*, *41*(3), 385–397. https://doi.org/10.1006/ijhc.1994.1065

Palmer, S. (1999). *Vision Science: From Photons to Phenomenology* (Vol. 1).

Schiller, D., Huber, T. B., Dietz, M., & André, E. (2020). Relevance-Based Data Masking: A Model-Agnostic Transfer Learning Approach for Facial Expression Recognition. *Frontiers in Computer Science*, *2*. https://doi.org/10.3389/fcomp.2020.00006

Yuwono, A. R., & Anggraeni, N. S. (2023). Persepsi Elemen Visual dan Layout User Interface Aplikasi Alfa Gift dan Klik Indomaret. *GESTALT*, *5*(1), 55–72. https://doi.org/10.33005/gestalt.v5i1.135

Zhou, H., & Duan, Y. (2022). Online channel structures for green products with reference greenness effect and consumer environmental awareness (CEA). *Computers & Industrial Engineering*, *170*, 108350. https://doi.org/10.1016/j.cie.2022.108350

Blibli. (n.d.). *Login page.* Retrieved between December 2024 and January 2025, from https://account.bliblitiket.com/login?ref=https%3A%2F%2Fwww.blibli.com%2Fbackend%2Fcommon%2Fsso-login%3FisExternal%3Dtrue&clientId=3ca1ed67701249861819ba4850f4f135

Lazada. (n.d.). *Homepage.* Retrieved between December 2024 and January 2025, from https://www.lazada.co.id/#

Shopee. (n.d.). *Buyer login page.* Retrieved between December 2024 and January 2025, from https://shopee.co.id/buyer/login

Tokopedia. (n.d.). *Login page.* Retrieved between December 2024 and January 2025, from https://www.tokopedia.com/login

UX Pilot. (n.d.). *Predictive heatmaps for user experience.* Retrieved between December 2024 and January 2025, from https://www.uxpilot.com/predictive-heatmaps

*name of corresponding author