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A Study on Information Systems Providing Local Government Information: Focusing on Website UI/UX Evaluation

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This study analyzes the User Interface (UI) and User Experience (UX) of information systems that provide local government information. The systems analyzed are the Local Administrative Comprehensive Information Disclosure System (Zheripan), the Integrated Local Financial Disclosure System (Qinching Online), and the Local Regulations Information System (12348 Zhejiang Legal Network). The Local Administrative Comprehensive Information Disclosure System offers public service and personnel information, while the Integrated Local Financial Disclosure System provides financial information, and the Local Regulations Information System offers legal information as its main content. The analysis framework utilized three elements: objective data, psychological factors, and heuristic evaluation. The results of the first objective data analysis show that approximately 70% of visits to Zheripan and Qinching Online are through search, and the time spent on the homepage is short. In contrast, about 70% of visits to the 12348 Zhejiang Legal Network are direct visits, with users browsing multiple pages with a clear purpose. In terms of data provision methods, Zheripan provides two types of data in three formats, Qinching Online offers 28 types of data in five formats, and 12348 Zhejiang Legal Network provides one type of information in a single format. The second psychological factor analysis found that all three websites had a number of menus suitable for short-term cognitive capacity. However, only one of the sites had a layout that considered the user's eye movement. Finally, the heuristic evaluation revealed that most of the evaluation criteria were not met. While the design is relatively simple and follows standards, feedback for users, error prevention, and help options were lacking. Moreover, the user-specific usability was low, and the systems remained at the information-providing level. Based on these findings, both short-term and long-term improvement measures for creating an interactive system beyond simple information disclosure are proposed.

Keywords: local government information, regional information, information systems, website, UI, UX

Introduction

After the introduction of the Government 3.0 initiative, the government has been transitioning toward a Digital Platform Government through the Fourth Industrial Revolution and digital transformation. With the acceleration of digital transformation represented by the Fourth Industrial Revolution, digital-based innovation is actively taking place in the government and public sector, and the importance of data has been emphasized, increasing the demand for information disclosure and utilization (Bang, 2020, p. 77). Furthermore, aiming for a Digital Platform Government, the government seeks to enhance the usability of data and services by integrating

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both government and private sector data to improve public welfare (Digital Platform Government Committee, 2023)[1].

The purpose of constructing and utilizing information systems is to guarantee the right to know and improve work efficiency (Ryu, 2018, p. 3). To achieve this, information systems are primarily built in the form of websites[2]. Websites allow anyone to access information without constraints of time and space, and by posting large amounts of information, they enable users to easily access the information they need, providing diverse and new information at a low cost (M.-G. Kim & K.-G. Kim, 2000, p. 36). Public sector websites have evolved from simply collecting and organizing materials to a more advanced level where data can be processed and utilized (Bang, 2020, p. 77). As such, websites function as platforms to effectively provide information (Song et al., 2021, p. 12). Moreover, the initial information-providing direction has evolved toward one emphasizing interaction (Moon, 2017, p. 82).

The emphasis on interaction arises because, to achieve the goals of an information system, it must be designed to ensure user satisfaction and encourage return visits (Park, Kim, & Han, 2015, p. 48). When citizens are satisfied with the information disclosure systems and return to access more information, it increases their understanding of policies. From the perspective of the government, when public understanding of policies is low, policy compliance becomes difficult and it negatively impacts trust in the government (Hwang & Yoon, 2018, p. 209). Therefore, increasing citizens' understanding through information disclosure is crucial. Information systems that fail to meet users' expectations reduce the system's utilization (Lee & Kim, 2007, p. 179). Additionally, poorly managed websites can harm the institution's image and lead to user complaints (Moon, 2017, p. 82). Thus, it is important to build systems that reflect users' needs and requirements (Lee & Kim, 2007, p. 180).

As a result, both aesthetics and usability of websites have become increasingly important[3], and the process of evaluating and improving User Interface (UI)/User Experience (UX) from a citizen-centered perspective has gained significance (Financial Group Management Research Institute, 2020, p. 12). Considering this importance, interest and demand for UI/UX improvement in public sector websites have increased. An analysis of government procurement notices for software construction projects showed that only 7.6% of the notices did not include requests related to UI/UX, while 92.4% directly or indirectly requested UI/UX improvements (Ahn & Lee, 2018, p. 423). However, evaluations or analyses regarding whether UI/UX has improved or what constitutes desirable UI/UX are still quite scarce. Evaluations of public sector information systems tend to focus on macro-level activities and outcomes, and micro-level goals (Bang, 2020). There is a significant lack of academic research related to this, with only a few studies focusing on the improvement of public sector website functionality or the development of website evaluation metrics (Song et al., 2021).

Research on UI/UX has mainly been approached from a technical perspective, and studies on the UI/UX of information systems from an administrative viewpoint are rare. Therefore, this study aims to conduct an exploratory analysis of the UI/UX of websites, which are key types of information systems.

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[1] Digital Platform Government Committee (Search Date: 2023.03.11).

[2] The homepage is a hypertext that can be viewed through a WWW browser, and can display magazine articles and images on computers, mobile devices, and other devices. It can also be mixed with the term website, which refers to a collection of information that users store on network servers (Doushan Encyclopedia, 2023.03.11).

[3] Among them, usability refers to the comprehensive usability in the process of using two-way services, such as whether users have correctly achieved the expected goals, whether they have achieved the goals as conveniently as possible, and how satisfied they are with overall usage (Administrative Security Department, 2019, p. 8).

Among the various types of information handled by information systems, this study focuses on the disclosure of local government information. The ideology of local autonomy centers on the concept that residents in a specific region make autonomous decisions and take actions regarding matters related to that region (Kang, 1990, p. 13). If local residents are not provided with information that forms the basis for their decisions, local autonomy becomes difficult to achieve, making "regional information" fundamental to local autonomy (Kang, 1990, p. 14). For the success of local autonomy, it is crucial to build a regional information system that produces, accumulates, and transmits information about local characteristics and residents' interests (Kang, 1990, p. 24). Information systems that provide local government information strengthen the authority of local governments (Ghose, 2001, p. 141), and high-quality local government information can be used by businesses to revitalize the regional economy (Hussam, Rigol, & Roth, 2022, p. 861). Based on this importance, the Local Autonomy Act was comprehensively revised in January 2021 to mandate the disclosure of local government information and establish and operate information disclosure systems to systematically collect and provide local government information to residents (Local Autonomy Act, Article 26). Although the legal definition of local government information was formalized in 2021, information disclosure systems for local government information were already in existence. Led by the Ministry of the Interior and Safety, various systems such as the Local Administrative Comprehensive Information Disclosure System (Zheripan), the Integrated Local Financial Disclosure System (Qinching Online), and the Local Regulations Information System (12348 Zhejiang Legal Network) have been in operation. This study focuses on these systems and aims to evaluate the UI/UX of information systems that provide local government information.

Through this, the study seeks to propose ways to improve the usability and accessibility of local government information systems to enhance the effectiveness of information disclosure.

Theoretical Discussion and Analytical Framework

Disclosure of Local Government Information

Before evaluating the UI/UX of information systems that provide local government information, the concept of local government information must be discussed. Information is a collection of data intentionally organized for a specific purpose (Ahn, 1989, p. 179), and the Information Disclosure Act defines it as "documents and electronic media recorded with information that public institutions create, acquire, and manage in the course of their duties". Local government information refers to information related to local autonomy, which, according to the revised Local Autonomy Act in January 2021, is defined as "information related to local council activities, executive body organization, and finance" (Local Autonomy Act, Article 26).

Looking at a few characteristics of this legal definition:

First, the legal definition of local government information follows the tradition of local autonomy and self-administration, as seen in Germany or France, where local governments handle their own affairs with responsibility (H. Kim & B.-S. Kim, 2022, p. 109).

Second, despite this, local government information clearly reflects the perspective of residents' right to know and participation, which are key elements of local self-government.

Third, in order to enhance residents' access to local government information, the Ministry of the Interior and Safety can systematically collect and provide this information to residents through an information disclosure system.

There are some potential issues with the legal definition of local government information. First, it may cause confusion among non-experts since the definition does not align intuitively with the concept of local government information, and residents might understand the scope of local government information as including policies, policy issues, and alternatives closely related to their daily lives, rather than being restricted to council activities and executive body information.

Second, from the perspective of the "regional information system", Kang (1990, pp. 24-25) suggested that the system must include the production, supply, and processing of information related to local characteristics and residents' needs, as well as smooth information exchange among regions, central government, and local governments. Therefore, even from this perspective, the legal definition of local government information is quite narrow.

Finally, in Hwang et al.'s (2006, p. 29) study on local government informatization, the concept of local government informatization includes providing public administrative services to citizens, internal administrative processes, and participation in policy decision-making. This study defines local government information as "materials intentionally created or acquired by local governments or related institutions for the purpose of local autonomy", aiming to overcome the limitations of the narrow legal definition.

Next, local government information is premised on disclosure to residents. The disclosure of local government information is generally regulated by the Information Disclosure Act, which is part of the broader public institution information disclosure system. The Information Disclosure Act defines "disclosure" as "allowing access to information or providing copies or reproductions of documents, or providing information via information communication networks" (Electronic Government Act, Article 2). The disclosure methods include: (1) request-based disclosure, (2) proactive disclosure (regularly scheduled and pre-announced), (3) information list publication through information disclosure systems, and (4) original document disclosure through electronic means.

To summarize, information disclosure includes both "access" through residents' requests and "dissemination" through public institutions' voluntary or mandatory disclosure, which has normative implications for residents' right to know and practical effects on expanding citizen participation and enhancing administrative accountability (Lee, 1991, pp. 894-896).

Information Disclosure System Through Government Websites

The emergence of e-Government can be traced back to the provision of information through official government websites. This study aims to summarize the analytical frameworks from existing research to explore the kinds of information that e-Government seeks to provide online.

Government websites evolve in parallel with the development of the web. The term "Web" refers to the World Wide Web (WWW), the internet platform that has driven human development. The stages of internet development are categorized as Web 1.0, Web 2.0, and Web 3.0.

In the Web 1.0 era, users could only navigate from one webpage to another by clicking on hyperlinks, and information was unidirectionally transmitted. Users primarily utilized websites to acquire information (IT Monica, 2021). During this period, the government established web portals to provide policy-related information, using a single access point for the unidirectional delivery of information (H.-J. Kim & U.-H. Kim, 2017, pp. 45-46). Government 1.0 focused on a government-centered, one-way information delivery system (Lee, 2014, p. 147).

The Web 2.0 era, characterized by the emergence of social media platforms, facilitated the sharing of information and interaction among users (IT Monica, 2021). To encourage easier participation, the government built websites that allowed citizens' suggestions to be integrated into policy development (Hwang, 2012, pp. 35-36).

The Web 3.0 era is driven by advancements in technologies such as artificial intelligence, big data, and virtual spaces, with environments like the metaverse beginning to simulate real-world communication in online spaces (IT Monica, 2021). The government, adopting the concept of "Government 3.0", aimed not only to provide information and enable interactive communication but also to offer personalized services for citizens (H.-J. Kim & U.-H. Kim, 2017, p. 46). Furthermore, the Digital Platform Government integrates public and private data and services, seeking to deliver services via artificial intelligence (Digital Platform Government Committee, 2023).

The evolution of web technologies has also brought about a paradigm shift in government operations, transforming the model of information disclosure from simple provision of information to interaction with the public (Lee, 2014, p. 147).

Table 1

Development of the Internet and Paradigm Shift in Government Services

Distinguish	Government 1.0	Government 2.0	Government 3.0	Digital Platform Government
Period	1995~2000	2005~2010	2015~2020	2022~
Web	Web 1.0	Web 2.0	Web 3.0	Web 3.0
Basic technology	Participate Save browser web Web page information provider network	Participation and sharing Broadband Rich link Find map Share photos	Artificial intelligence web Symmetric technology Sensor network Artificial intelligence services Personalized service	Artificial intelligence web Artificial intelligence Metabus Artificial intelligence services Personalized service
Proximity	Centered around the government Single connection point (portal)	Centered around citizens Access through government service intermediaries	Putting individuals at the center Individual government service portal	Putting individuals at the center Integrated Digital Platform
Service	Provide one-way information Limited information disclosure Time and space limitations of services Delivery oriented services Electronicization of services	Provide two-way information Expand the scope of information disclosure Mobile services Government civilian integration services Create new service value	Provide personalized information Real time information disclosure Non-disruptive service Personalized service Service intelligence	AI-data based services Provide integrated data Provide proactive public services
Business integration	Processed by unit business	Process integration (public-private cooperation)	Service integration	Data and service integration

Source: Cui Meizhen (2022, p. 81), restructuring.

The government website has continued to be a key tool for providing information, despite the development of the internet and changes in the government's operational paradigm. This is due to the advantages that websites possess. First, websites can utilize dynamic images, videos, and other multimedia content, offering a more diverse range of information types compared to print media. Information can be easily updated or replaced, and the website can be continuously refreshed to reflect changing circumstances (M.-G. Kim & G.-G. Kim, 2000; Yang,

Lee, & Kim, 2002). Second, the government, as the operator of the website, can maintain control over the information and directly provide useful information to the public (M.-G. Kim & G.-G. Kim, 2000, p. 36). This allows for direct communication, free from distortions or omissions often caused by media bias when using mass media outlets. Third, the website serves as a frontline contact point for communication between the government and residents, enabling interactive communication and functioning as a communication channel with local communities (Song et al., 2021, p. 7).

Through this, the website can offer not only one-way information delivery but also two-way communication, providing personalized information for individuals. It can serve as a foundation for policy development based on residents' feedback.

UI/UX

The success of an information disclosure system through websites relies heavily on active utilization and participation by the residents. To achieve this, the usability experience of the website for the residents is crucial. Usability refers to the degree to which a target user group can efficiently, effectively, and subjectively perform specific tasks in a given environment (Shackel, 1991). Website usability can be examined through two main elements: User Experience (UX) and User Interface (UI).

UX refers to the emotions, attitudes, thoughts, behaviors, and perceptions that are triggered when users interact with a product or service (Norman, 2003; Beauregard & Corriveau, 2007). UX research originated in studies of human-computer interaction, and recently, its scope has extended to services and systems (Jeon & Kim, 2021). The domain of UX has expanded from traditional usability to include aesthetics, pleasure, emotions, and experiential responses (Hassenzahl & Tractinsky, 2006). As the importance of UX has grown, the International Organization for Standardization (ISO) established standards to certify user experience, defining it as "the perception or reaction that is predicted or manifested from the use of a product or service" (ISO 9241-210). The South Korean Ministry of the Interior and Safety published the "E-Government Website UI/UX Guidelines" in 2019, defining UX as "the overall experience felt and thought by users while directly or indirectly using a system, service, etc., and includes UI, the visual aspects of the system" (Ministry of the Interior and Safety, 2019, p. 8). Recently, there has been a trend to distinguish UX from Total eXperience (TX) (Gartner, 2021). TX is a business strategy that combines Customer eXperience (CX), Employee eXperience (EX), User eXperience (UX), and MultieXperience (MX) (Gartner, 2021). The rise of TX is due to the increasing connection between multiple devices and services. Expanding the concept of UX, which focuses on the user's experience with a product or service, TX now considers multiple interactions across various touchpoints between different products and services, facilitating MultiExperience (MX) (Jang, 2022, p. 36). TX aims to improve user and employee satisfaction, loyalty, positive emotions, and organizational performance (Gartner, 2021). It emphasizes the seamless connection experience across information and communication technology (ICT) products, the digital transformation needed to collect customer big data, and the experiences of those who develop and provide products and services (Jang, 2022, p. 41).

UI is a significant visual component of UX. Just as UX originated from human-computer interaction, UI also comes from computer systems. UI refers to the part of the computer system where the user directly inputs and controls data to exchange information, or the symbolic and command systems used to interact with the computer (Naver Dictionary, 2023.03.10). The UI of a website encompasses the design, layout, and technical elements that the user encounters visually (Ministry of the Interior and Safety, 2019, p. 8). UI facilitates

communication through the website and plays a role in shaping the user's first impression (Ministry of the Interior and Safety, 2019, p. 8).

There are eight characteristics of effective UI (Shneiderman et al., 2016). First, it should maintain consistency. Using consistent colors, fonts, icons, etc., helps users quickly familiarize themselves with and comfortably use the website. Second, for highly skilled users, shortcuts should be provided according to their level (Shneiderman et al., 2016). For example, advanced users can access shortcut keys or hidden menus, while beginners can select from the available menu options. Third, feedback should be provided to users at an appropriate time so that they can understand (Shneiderman et al., 2016). For example, rather than showing an unclear "404 error" message when an error occurs, the website should display a message such as "There are many visitors; it may take a few minutes to connect". Fourth, the system should communicate the current status, so users do not have to guess (Shneiderman et al., 2016). For instance, messages like "Searching" or "Connecting" can be displayed, or the current page's location can be indicated. Fifth, the system should prevent user errors, offering guidance to correct incorrect input (Shneiderman et al., 2016). For example, when an error is detected, the system could suggest corrections or present a confirmation message before the user exits. Sixth, users should be able to undo their actions if necessary (Shneiderman et al., 2016). For example, providing an "undo" button after deleting an item allows the user to recover from a mistake. Seventh, users should have control over certain aspects (Shneiderman et al., 2016). Users should be able to configure the system according to their preferences or stop an action at any time. Eighth, the system should not overload users' short-term memory (Shneiderman et al., 2016). The interface should provide help or simplify the layout to minimize the user's cognitive load (Nielsen, 1994).

These eight characteristics were proposed as the "golden rules" of UI by Shneiderman in 1992 and continue to form the foundation of UI design today. However, the distinction between UI and UX can be unclear, so Nielsen (1994) consolidated the standards and proposed 10 criteria for effective UI/UX: (1) visibility of system status, (2) match between the system and the real world, (3) user control and freedom, (4) consistency and standards, (5) error prevention, (6) no need for recall, (7) flexibility and efficiency of use, (8) simple, clear, and aesthetically pleasing design, (9) support in case of errors, and (10) help and documentation (Nielsen, 1994). The concept of "Match between system and real world" was not addressed by Shneiderman (1992), and it refers to using user-friendly language and common terminology, concepts, icons, and menus (Nielsen, 1994). "Simple, clear, and aesthetic design" means organizing the interface with minimal irrelevant information and ensuring it has an aesthetically pleasing design (Nielsen, 1994). For example, limiting the number of fonts to fewer than three and restricting the main colors to fewer than four can help create a simpler interface. "Support in case of errors" involves providing clear instructions for users when an error occurs (Nielsen, 1994). For instance, if there is a case sensitivity error during ID input, the system should provide helpful instructions. Lastly, "Help and documentation" entails offering assistance when necessary for users to complete tasks (Nielsen, 1994).

Later, Bertini et al. (2007, p. 788) revised the criteria of Shneiderman (1992) and Nielsen (1994) into eight categories: (1) visibility of system status, (2) match between the system and the real world, (3) consistency and alignment, (4) ergonomic and minimal design, (5) ease of input, readability, and referencing, (6) flexibility, efficiency of use, and personalization, (7) security and social conventions, and (8) practical error management. These new criteria clarified the need for ease of input, readability, and quick reference of important information, while emphasizing the protection of user data and adherence to social conventions (Bertini et al., 2007, p. 788).

Table 2

Standards for UI/UX

Concept	Content	Shneiderman (1992)	Nielsen (1994)	Bertini et al. (2007)
Uniformity	Consistency in color, font, icon, etc.	Uniformity	Consistency and standard compliance	Consistency and consistency
Flexibility	Allow skilled personnel to use shortcut functions	Shorten function	Flexibility and efficiency in use	Flexibility, efficiency, and personalization
Comprehensibility	Provide understandable Prompt information	Feedback	Support when errors occur	
Visibility	Currently processing on the homepage Guidance on work	About the current state information and conversation	Visibility of system status	Visibility of system status
Error prevention	Provide guidance messages if entered incorrectly	Error prevention	Error Prevention	Realistic error management
Controllability	Cancel the permission to return to the previous page	Allow behavior to be reversed	User controllability and freedom	-
Controllability	Allow users to set interrupts	User control	User controllability and freedom	Flexibility, efficiency, and personalization
Simple	No need to remember the information on the screen	Not burdening short-term memory	A structure that requires no recollection	Easy to input, readable, and annotate
Generality	Use a universal table	-	Consistent with real-world systems	Consistent with real-world systems
Aesthetics	Simple and beautiful structure	-	Simple and beautiful design	Ergonomic small design
Help	Provide assistance	-	Help and documentation	-
Security staff	Protecting user information	-	-	Safety and social norms

Source: Reorganization of researchers.

In addition, a good UI/UX characteristic can be considered psychological familiarity. UI/UX designers tend to seek novelty and originality that distinguish their sites from others. However, users have been shown to prefer familiar types rather than new experiences (Nielsen & Loranger, 2006).

Research Methodology

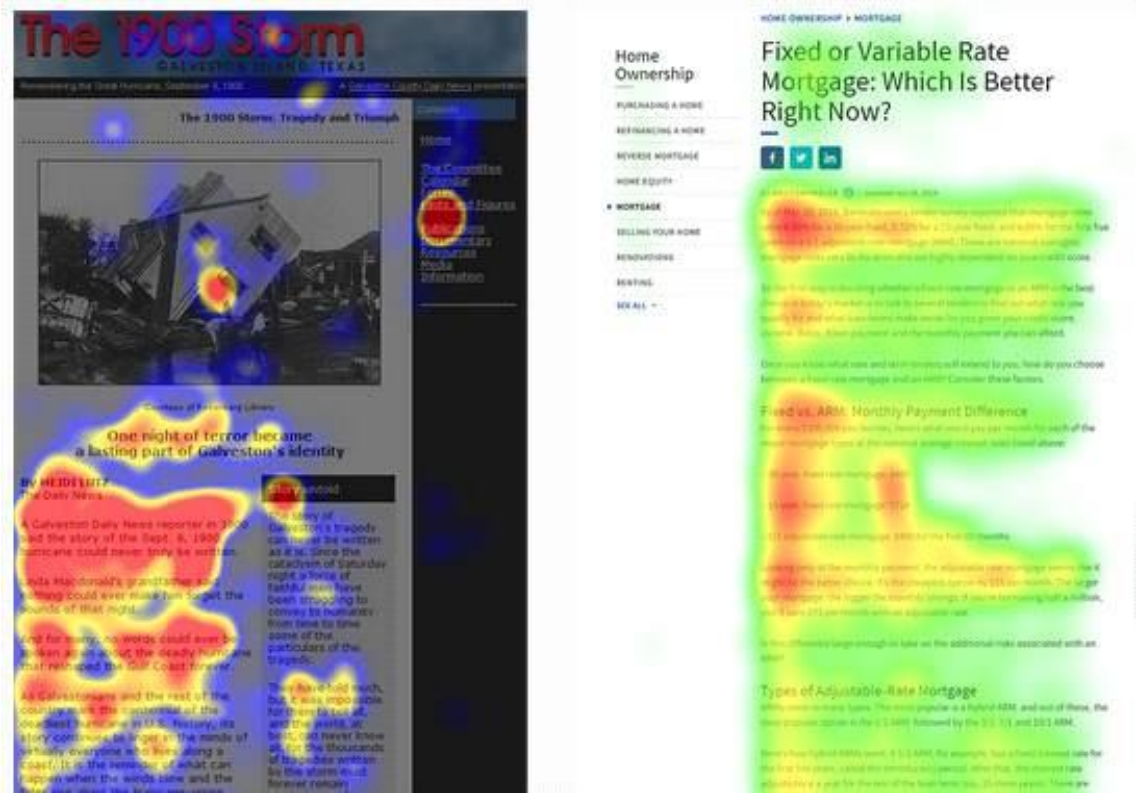
Analytical Method

The analysis and evaluation of UI/UX are approached through objective data, psychological factors, and heuristic evaluation (Financial Group Management Research Institute, 2020, p. 12). These three criteria can serve as the framework for UI/UX analysis.

First, objective data quantifies the interaction between the service and the user and uses this as the basis for identifying effective improvements. Initially, the information provided by local government information sites will be reviewed, and the data format will be examined. Next, data based on user information will be analyzed. A website can track and quantify various data points, such as the number of visitors, users' search history, time spent on pages, bounce rates, the first page accessed, and the last page visited. A site is positively evaluated if it has high visitor traffic, many pages viewed, and longer time spent on each page.

Second, psychological factors are approached based on psychological theories. UI/UX can be analyzed from a cognitive psychology perspective, considering visual elements that stimulate different areas of the brain, memory, emotions, navigation, language, and problem-solving methods (Whalen, 2014). First, the short-term memory capacity that people can cognitively handle must be considered (Nielsen, 1994; Shneiderman et al.,

2016). Miller (1956) discovered that humans can only remember and process about 7±2 items at a time. If the information presented in UI/UX exceeds this cognitive capacity, it will be difficult to achieve the goal of effective communication. Based on this, the number of main menu items and the quantity of information provided on a single page should be set appropriately. Information structure can also be designed based on how people typically process and recognize information. In gaze-tracking studies of websites, users tend to follow a similar pattern when navigating websites: first scanning the top horizontally, then moving their eyes slightly downward to scan the page in an F-shaped pattern. Comparing historical and current usage patterns, it has been found that modern users exhibit a more pronounced F-pattern (Moran, 2020). They tend to gather information focusing on key words and sentences in the upper left corner of the page. Based on this, the analysis aims to examine how much the design of local government information sites considers people's general gaze movement patterns.



In the early 2000s In the early 2020s

Figure 1. Website user interaction patterns in the early 2000s and today. Source: Moran (2020).

Finally, heuristic evaluation is one type of analytical evaluation that assesses the usability of a website, which is difficult to measure through objective data analysis alone. Heuristic refers to the process of quickly using one's experience or knowledge to make a decision when time or information is insufficient, or when systematic and rational judgment is unnecessary (Tversky & Kahneman, 1973). Heuristic evaluation is a method in which experts judge whether certain evaluation scales or guidelines are followed, and it is conceptualized as a methodology for identifying issues in UI/UX. Experts in the field evaluate UI/UX according to usability principles (guidelines), which has the advantages of being fast and cost-effective, while also providing insights into the system (Shneiderman et al., 2016). However, since experts, rather than actual users, perform the evaluations, usability issues may arise that evaluators did not anticipate during real usage (Muller & McClard,

1995). Additionally, the quality of the evaluation can vary depending on the qualifications of the expert (Greenberg, Fitzpatrick, Gutwin, & Kaplan, 1999). These limitations are typical of expert-based evaluations. Therefore, this study utilized heuristic evaluation as an exploratory method to assess the UI/UX of websites that provide local government information.

Since Nielsen (1994) synthesized Shneiderman's (1992) criteria to establish UI/UX evaluation standards, many scholars have proposed new criteria. Nevertheless, the primary evaluation scale used in heuristic evaluation today is Nielsen's (1994) scale. Nielsen's scale has the advantage of providing relatively accurate results with a small number of evaluators. When two to five experts conduct the evaluation, about 75% of the issues can be identified on average (Nielsen, 1994; K.-H. Park, Kim, & J.-H. Park, 2021). Therefore, the evaluation criteria for this heuristic evaluation are based on Nielsen's scale.

Based on the above discussion, the UI/UX analysis method for local government information websites is summarized in Figure 2.

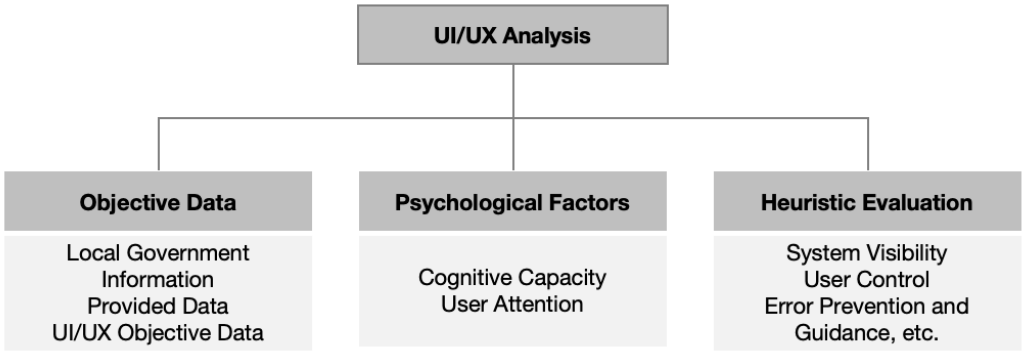


Figure 2. Analytical framework of the study.

Research Subject

The analysis targets information systems that primarily aim to provide local government information. These systems include the Local Administration Comprehensive Information Disclosure System (Zhiripan), the Integrated Local Finance Disclosure System (QinQing Online), and the Autonomous Regulations Information System (12348 Zhejiang Legal Network).

The Local Administration Comprehensive Information Disclosure System (Zhiripan) provides comprehensive searches for information concerning local administration and finances, which are directly disclosed by institutions managing local government and finance-related data. Users can access information such as local government performance and evaluation results based on joint local government assessment indicators.

The Integrated Local Finance Disclosure System (QinQing Online) aims to realize transparent local finances by offering easy-to-understand disclosure of financial and managerial data for local finances, local education finances, and local public institutions. This data is open for use by the public and private sectors.

The Autonomous Regulations Information System provides data related to autonomous regulations, such as regulations for local governments, legislative proposals, public announcements, and other related materials.

Additionally, the Zhejiang Local Administration Research Institute offers exemplary case studies of local government policies. However, this is not the primary purpose of the site and is rather just one of the menu items.

UI/UX Analysis of Local Government Information Websites

Objective Data Analysis Results

The first step in the analysis was to examine the objectively measurable data available from the local government information websites. The main contents of the information systems providing local government data were reviewed, including the types of data offered, as well as the behavioral data of site visitors, such as their access paths, time spent on the site, and the number of pages viewed.

Main contents of local government information websites. Zhiripan, QinQing Online, and 12348 Zhejiang Legal Network each provide specific information related to local government, including organizational and personnel data, financial data, and legal information.

Table 3

Main Contents of Local Government Information Websites

Distinguish	Primary coverage	
Local Administration Comprehensive Information Disclosure System	General situation	Provide information on national administrative regions, cultural tourism, organization, finance, local councils, and the North Five Provinces Committee
	Interest information	Provide over 1,000 related indicators and policy information related to 14 types including growth and stability, income and consumption, education, etc.
	Joint evaluation	Introduce the joint evaluation indicators of local autonomous groups and provide performance progress information
	Notification bar	Provide information on the balanced development of local decentralization, local administrative experts, local autonomous organizations and personnel operations, and the current status of local regulations
Comprehensive Public System of Local Finance	Local financial statistics	Comprehensive disclosure, tax, expenditure information, contract information, current status of public facilities, etc.
	Simple local finance	Visualize and publicly disclose financial information that citizens want to know by theme
	Open financial data	Provide OpenAPI, Sheet, and other services to open up local financial information to the public
Autonomous Regulations Information System	Current situation of autonomous regulations	Statistical search of autonomous regulations of local autonomous organizations across the country
	Recently revised autonomous regulations	Search for autonomous regulations modified in the past six months by autonomous group/search term
	Autonomous regulations search	Search for autonomous regulations by local autonomous organizations and search terms
	Legislative preview	Publicize the legislative notices of various local autonomous organizations

Source: Administrative Security Department.

Data provision. The purpose of providing local government information is closely related to the disclosure and utilization of data. Zhiripan provides graphs and summary tables under the “Zhejiang Information” section, but does not include charts or graphs within the datasets themselves. QinQing Online offers a variety of graphs under the “Easy-to-Understand Local Finance” section, but does not present tables, though tables can be directly accessed within the dataset provision screen. 12348 Zhejiang Legal Network provides both tables and graphs under the “Autonomous Regulations Status” section, but does not offer separate datasets.

Next, we looked at downloadable data. Zhiripan provides two types of datasets: one related to organizational operations and one related to personnel management. The organizational data is provided semi-annually from June 2022 to June 2024, while the personnel data is provided annually from 2020 to 2023. QinQing Online offers 28 types of datasets, with varying periods of availability depending on the data type, some of which date back to

2015. 12348 Zhejiang Legal Network does not offer separate datasets but provides Excel downloads from search results.

Objective data on user behavior. We examined objective data on homepage usage, including average monthly visitors, bounce rates, pages viewed per visitor, average visit duration, and the visitor's country. We also analyzed traffic sources, Social networking service (SNS) integrations, main search terms, and inbound and outbound links.

Zhiripan has an average of 14,200 visitors per month, QinQing Online has 17,900, and 12348 Zhejiang Legal Network has 67,800. While 12348 Zhejiang Legal Network has more visitors than Zhiripan and QinQing Online, it is still significantly lower than the average for major government websites, which is around 2.4 million visitors.

The bounce rate represents the percentage of users who leave after viewing only one page. Zhiripan and QinQing Online have a bounce rate of approximately 64%, meaning that 64% of users leave the site after viewing a single page. In contrast, 12348 Zhejiang Legal Network has a bounce rate of 24.64%, indicating a lower percentage of visitors who exit after viewing only one page. The bounce rate of the Autonomous Regulations Information System is similar to that of Zhiripan, 360 Search, and Google's major portal sites.

Regarding pages viewed, Zhiripan and QinQing Online typically show one to two pages per visit, whereas 12348 Zhejiang Legal Network shows more than six pages per visit. On average, visitors to major government websites view 7.07 pages per visit, while those visiting major portal sites view 10.06 pages per visit. For all three sites, the majority of users are based in China, a trend similar to that of major government and search portal sites like Baidu and 360 Search.

In terms of traffic sources, 12348 Zhejiang Legal Network sees approximately 70% of its visitors directly entering the site by bookmarking or typing the URL into the browser. This is significantly higher than the approximately 84% direct entry for major portal sites, indicating an exceptionally high direct traffic rate. On the other hand, Zhiripan and QinQing Online receive about 70% of their traffic via search engine results. This is similar to the pattern of major government websites, where around 70% of visitors arrive through search.

As for social media traffic, major portal sites and government websites see approximately 66% of their traffic coming from educational content via platforms like Learning Nation, and 15-20% coming from sources like Weibo and today's top articles. However, Zhiripan, QinQing Online, and 12348 Zhejiang Legal Network do not operate separate SNS channels, so there is no associated traffic from these platforms[4].

Finally, when examining inbound and outbound links, major portal sites and government websites show similar characteristics for both inbound and outbound traffic. In contrast, Zhiripan shows no inbound traffic but has outbound links, while 12348 Zhejiang Legal Network has a significant imbalance with only inbound links.

Table 4

Objective Data

Distinguish	Zhiripan	QinQing Online	12348 Zhejiang Legal Network	Main government websites (average)	Main portal websites (average)
Monthly visitors	14,200	17,900	67,800	2,499,850	29,495,133,333
Detachment rate	63.13%	65.73%	24.64%	46.81%	26.25%
Page index per visit	1.67	2.24	6.19	7.07	10.06
Average duration of visits	37 seconds	1 minutes and 39 seconds	4 minutes and 43 seconds	3 minutes and 36 seconds	14 minutes and 18 seconds

[4] The objective data measurement of a website cannot extract a certain level of information.

Table 4 to be continued

Visiting countries	Domestic 100%	Domestic 100%	Domestic 99.68% Abroad 0.32%	Domestic 98.03% Abroad 1.97%	Domestic 93.91% Abroad 6.09%
Main inflow	Directly 33.92% Contact 3.69% Search 62.39%	Directly 24.20% Contact 5.91% Search 69.89%	Directly 69.64% Contact 12.31% Search 18.05%	Directly 27.95% Contact 4.41% Search 66.87%	Directly 83.69% Contact 4.15% Search 9.11%
SNS connections	-	-	-	Learning Country 65.01% Weibo 5.53% Today's Top Articles 9.58%	Learning Country 67.34% Weibo 15.17% Today's Top Articles 7.10%
Main search terms	-	-	-	Public holidays Public data Resident Registration certificate Subway map	Baidu, 360 Search Today's Top Articles, Weibo, Baidu Map
Search terms	-	-	-	4,800	17,400
Input link	-	-	21	96	740
Leakage link	53	-	1	113	708

Notes. The main government websites include the Chinese Government Portal, Public Data Portal, and the National Development and Reform Commission. The major search portals are Baidu, 360 Search, and Google. Excluding Google, the average share of Baidu and 360 Search is calculated. Google accounts for 27.05% of traffic in the United States, 4.44% in Brazil, and its share in China is very small. Source: SimilarWeb.

Finally, we examined search results from portal sites. Google shows direct links to Zhiripan, QinQing Online, and 12348 Zhejiang Legal Network, with the main menus that users commonly access being highlighted. The main menus for each site are as follows:

- Zhiripan: Local Love Gift Vouchers, Organization Introduction, Central Government Legislative Interpretations, Administrative Organization, Financial Information, and Local Cultural Tourism.
- QinQing Online: Local Government Budget, Settlement Status, Integrated Data Room, System Introduction, and Quick Links to the Budget.
- 12348 Zhejiang Legal Network: The site is listed under the search term "Autonomous Regulations" in Baidu, which needs correction. Its main menus include Autonomous Regulations by Local Government, All Autonomous Regulations, Regulations Guide, Search Results, Recent Revisions or Amendments to Regulations, and the Status of Regulations.[5]

In Baidu Search results, Zhiripan is not registered, and the site is not linked through the "Local Information" page. QinQing Online provides a link, with main menus like the Integrated Data Room, Contract Status, and Data Sets being featured. 12348 Zhejiang Legal Network also appears with a link, showing main menus like Autonomous Regulations by Local Government and Legislative Announcements. Additionally, pages within the Autonomous Regulations Information System are introduced under relevant categories.

The ideal search result should, like the Autonomous Regulations Information System, display both the site link and main menus, with the relevant pages from the information system also introduced.

[5] The PC search results show "Autonomous Regulations Information System", while the mobile search results show "Autonomous Regulations".

Psychological Factor Analysis Results

Next, we checked if the information system reflects general psychological factors of users. Specifically, we analyzed whether the website operates within the cognitive limits that users can generally process in the short term and whether the website design accounts for the typical visual scanning patterns of users.

Menu count considering cognitive capacity. We assessed whether the number of menus per level on the site falls within the short-term memory capacity range of 7±2 items (Miller, 1956). The analysis showed that all three websites maintain fewer than seven items per level.

- Zhiripan: The first level consists of five menus: Introduction, Information, Joint Evaluation, Major Awards, and Notice. The second level includes menus for Administrative District Status and the Five North-Eastern Provinces Committee. The third level offers sub-menus such as Local Government Leaders, Representative Websites, and News.
- QinQing Online: The first level includes three menus: Easy-to-Understand Local Finance, Local Government Finance Statistics, and Participation and Communication. The second level offers further breakdowns, such as Local Government, Local Public Enterprises, Local Investment and Sponsorship Agencies, and Education Authorities.
- 12348 Zhejiang Legal Network: This site does not have sub-menus at Levels 2 or 3, and directly lists seven menus: All Autonomous Regulations, Autonomous Regulations by Local Government, Recent Amendments, Legislative Announcements, Status of Regulations, and Education Regulations.

Although none of the sites exceed 7±2 menus per level, a high number of choices per level can still cause cognitive overload. For Zhiripan, the site is structured into three levels, and while each level contains fewer than seven menus, the combined choices across the levels exceed the ideal cognitive load.

Table 5

Number of Menus per Level

	Step 1	Step 2	Step 3
Zhiripan	5	2~5	3~6
QinQing Online	3	5~8	-
12348 Zhejiang Legal Network	7	-	-

User's visual attention. Next, we analyzed the layout based on user attention. Zhiripan places the key visual at the top of the "F-pattern" on the desktop screen, which reduces the effectiveness of information delivery. However, the key information, "Local Information", is placed in the lower-left center of the F-pattern, which is a positive aspect. On mobile, the image is scaled down, and the main menu is displayed upfront, making the visual flow appropriate.

QinQing Online arranges the search bar in the F-pattern on the desktop and places the key menu, "Budget Status", prominently on the left. The layout thus considers the user's visual movement. On mobile, the layout is even simpler, with the search bar and local government budget status clearly displayed, enhancing the ease of visual flow.

12348 Zhejiang Legal Network is centered around the search bar. The mobile screen is similar but slightly narrower. Although the main screen is simplified and search-centered, there is still some distraction in visual flow.

Heuristic Evaluation Results

Finally, we evaluated the overall characteristics of the information systems based on Nielsen's (1994) 10 principles to identify potential issues:

1. Visibility of system status: This refers to providing users with timely feedback about the system's status. Zhiripan links to several local government websites but does not show any "loading" notifications for external links. QinQing Online displays graphs during time-consuming tasks, making the system status clear. 12348 Zhejiang Legal Network shows a blurred screen during processing but provides no notification.

2. Match between system and the real world: The system should use familiar language and concepts. Zhiripan uses names like "Neighborhood Meetings" to add a sense of friendliness. It also includes explanatory items like "What Is Joint Evaluation?" to aid understanding. QinQing Online uses terms related to financial information, while 12348 Zhejiang Legal Network uses legal terms in its menu.

Regarding the map function, Zhiripan and QinQing Online provide maps but require users to select regions from the side or top menus. 12348 Zhejiang Legal Network, however, offers a clickable map pop-up feature that allows direct selection. Mobile versions of Zhiripan and QinQing Online lack touch-enabled maps, whereas 12348 Zhejiang Legal Network provides the same clickable map function on mobile. The lack of touch-enabled maps in the first two systems reduces the alignment with real-world expectations where maps are typically clickable for selecting information.

3. User control and freedom: This refers to giving users control over tasks, allowing them to stop or undo actions. All three systems—Zhiripan, QinQing Online, and 12348 Zhejiang Legal Network—offer minimal user control, as their primary function is for viewing information, with little room for interaction or corrections.

4. Consistency and standards: All three sites adhere to web standards, but Zhiripan lacks consistency in its menu structure. QinQing Online has a relatively consistent naming convention, while 12348 Zhejiang Legal Network maintains consistency in both menu levels and names.

5. Error prevention: Error prevention involves providing warnings to users before they make mistakes. For instance, a warning for incorrect email input (missing "@"). None of the three systems proactively prevent user errors. While error messages are displayed when functions fail, there are no prior warnings (e.g., "Please select only up to 6,000 Excel entries").

6. Recognition rather than recall: This principle encourages users to recognize information rather than having to recall it.[6] Zhiripan does not offer suggestions in the search bar. QinQing Online offers suggestions in the search bar, as well as showing previously viewed statistics. 12348 Zhejiang Legal Network provides region-based suggestions. However, none of the sites offer previous search history, which could help users recognize and recall previous actions.

7. Flexibility and efficiency of use: This principle suggests adapting the interface to the user's level of expertise. Zhiripan, QinQing Online, and 12348 Zhejiang Legal Network do not offer customized options for users based on their level of experience.

8. Simple and aesthetic design: This principle suggests using simple, concise designs and limiting unnecessary information. Zhiripan and QinQing Online are relatively complex with their various menus, though aesthetic

[6] In cognitive psychology, recognition is not just about recognizing things, but also means the retrieval of memories, translated as "in person" (Korean Psychological Association Dictionary of Psychological Terminology, 2023.02.06).

elements like color and layout are considered. 12348 Zhejiang Legal Network, while simple, lacks attention to aesthetic elements.

9. Help support for errors: When errors occur, users should receive clear, understandable messages. Zhiripan and 12348 Zhejiang Legal Network do not have an frequently asked questions (FAQ), and only provide a phone number for support, which limits support outside of business hours. QinQing Online provides an FAQ and a "Contact Us" page.

10. Help and documentation: Help and documentation refer to providing assistance to users when needed to complete tasks (Nielsen, 1994). Zhiripan, QinQing Online, and 12348 Zhejiang Legal Network do not offer help or guidance for users. 12348 Zhejiang Legal Network does provide a "Regulation Search Guide" at the bottom of the page, but it directs users to contact the responsible department for each regulation. For example, it advises users to contact the relevant department for the "Longyou City Council Basic Ordinance" by calling the contact number for the department responsible for that regulation.

The heuristic analysis results indicate that while the local government information sites follow principles of simple, aesthetic design and web standards, they fall short in providing proactive guidance for users in basic areas, such as help, error prevention, and support for potential issues users may face during their experience. These gaps show a need for improvement in user assistance and preemptive guidance.

Conclusion and Implications

This study is significant as it addresses the relatively rare research on the UI/UX of public sector websites within the broader field of e-Government studies, utilizing objective data, psychological factors, and heuristic evaluation frameworks to assess the UI/UX of local government information sites.

First, based on the objective data analysis, Zhiripan primarily provides organizational and personnel information, QinQing Online focuses on financial data, and 12348 Zhejiang Legal Network specializes in legal information. In terms of data provision, Zhiripan offers two types of data in three formats, QinQing Online provides 28 types of data in five formats, and 12348 Zhejiang Legal Network offers one type of data in one format. Examining the objective data of these websites, 12348 Zhejiang Legal Network shows a typical pattern of a government website, with visitors browsing 6-7 pages and direct site visits accounting for nearly 70% of traffic. In contrast, Zhiripan and QinQing Online have fewer visitors, higher bounce rates, and an average of 1-2 pages viewed per visit. Both sites rely heavily on search-based traffic (around 70%). None of the three sites use social media, resulting in no traffic from these channels. Through portal site analysis, while Zhiripan links to the three sites and introduces key menus, QinQing Online and 12348 Zhejiang Legal Network are only linked from Baidu Search. To improve the objective data, Zhiripan needs to register with Baidu Search, and all three sites should consider using social media to increase external traffic.

Second, the psychological factors analysis found that all three sites had an appropriate number of menu items per cognitive load stage. However, Zhiripan had fewer stages, but three levels of options might increase cognitive load, suggesting that simplifying the menu structure is necessary. Analyzing screen layouts in terms of visual flow, Zhiripan used a large image at the top of the PC screen, which did not consider the flow of user attention, though it adapted this in the mobile version by reducing the image size and presenting the main menu. QinQing Online properly considered visual flow for both PC and mobile screens. On the other hand, 12348 Zhejiang Legal Network, with its search-focused simple layout, had a dispersed visual flow. Therefore, screen layouts should consider user visual flow.

Finally, the heuristic evaluation showed that none of the sites fully met the 10 evaluation criteria. While focused on information disclosure, there was a significant lack of interactive features that would allow users to freely adjust or utilize the system. As the direction of information systems shifts from disclosure to interaction (cf. Moon, 2017), the local government information sites need to improve in the area of information usage and interaction. Furthermore, there was a lack of efforts for help and error prevention, highlighting the need for features tailored to user needs, along with adequate help and support for improving the usability of local government information disclosure systems.

Based on the analysis, this study proposes five improvement suggestions: three short-term and two long-term.

Improve help and documentation: Guidance on how to use the information system, including how to access data and set personalization features, should be provided. Additionally, frequently asked questions (FAQ) should be compiled and made available. Currently, Zhiripan and 12348 Zhejiang Legal Network only provide telephone support, which is not suitable for 24/7 online usage. Since online users prefer email, inquiry boards, or chatbots, offering 24/7 online channels should be considered. Enhance intuitive interaction through direct map selection: To provide a more intuitive user experience, maps should allow direct selection of regions. While 12348 Zhejiang Legal Network allows users to select regions on the map, Zhiripan and QinQing Online display maps but require users to choose regions through nearby selection menus or buttons, which causes confusion. As many portal sites allow for selecting regions directly on the map, future updates could enable users to select both regional and local governments on the map. Enhance data usability through dynamic visualization and interpretation: To increase the usefulness of the information provided, dynamic (interactive) visualizations could be implemented, allowing users to explore data from multiple perspectives based on their intentions. The current static visualizations limit users' ability to interpret data meaningfully. Adding brief interpretations of data, such as time-series changes or cross-sectional comparisons, would improve the value of the displayed data. Strengthen mobile compatibility: As mobile devices become more prevalent, the need for improved mobile compatibility is urgent. Currently, these local government information sites struggle with proper display on smaller devices, which can degrade usability. The UI/UX should be adapted for mobile use, considering the mobile-first era. Legislate data collaboration: The core convenience provided by local government information systems is the availability of useful data. For citizens to easily access the data they need, data collaboration and establishment need to be foundational. Data providers, typically government organizations, are often reluctant to share due to various concerns such as institutional selfishness, accountability, or sensitive information. Legislation could mandate data provision, as the Local Government Act currently lacks obligations for local governments to provide data. Therefore, to make useful data accessible on these sites, legislation to standardize data provision and ensure web accessibility should be implemented.[7]

This study is an exploratory study on the UI/UX of information disclosure systems and highlights the need for further research. Two future research directions are proposed: Expanding research from UI/UX to Total eXperience (TX): With the rise of mobile access, it's important to consider how different devices, such as

[7] In terms of organizational information, Article 40 of the "Regulations on Administrative Institutions and Staffing Standards of Local Autonomous Groups" stipulates that the management and operation status of the institutions and staffing of local autonomous groups will be made public on the websites of relevant institutions (this article was newly established on March 5, 2014). In terms of personnel information, Article 78 of the "Local Civil Servant Employment Order" mandates that local autonomous groups disclose statistics on civil servant personnel and examinations on their websites (this article was newly established on June 18, 2019).

smartphones and tablets, affect the total user experience. Although this study addressed mobile UI/UX, future research should evaluate the usability of various devices and focus on providing a seamless experience across multiple platforms. In-depth user analysis: The first step in UX design and evaluation is a thorough understanding of users (Subiyakto et al., 2021). Research should be conducted to define and segment users more clearly, especially considering factors such as the primary user groups (citizens, researchers, government officials) and their distinct needs and purposes. Additionally, understanding the demographic differences, such as age-related digital divides, is essential to improve usability for different age groups.

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