JURNAL BINA PRAJA
Journal of Home Affairs Governance

ARTICLE

Development of Geographic Information System for Government With Extreme Programming and User-Centered Design Methods

Subhan [1], **I Gusti Ayu Suciningsih** [2]

[1, 2]Computer Science Department, Universitas Negeri Semarang, Semarang, Indonesia

subhan@mail.unnes.ac.id

OPEN ACCESS

Citation: Subhan, & Suciningsih, I. G. A. (2024). Development of Geographic Information System for Government With Extreme Programming and User-Centered Design Methods. *Jurnal Bina Praja, 16*(1), 111–126. https://doi.org/10.21787/jbp.16.2024.111-126

Submitted: 19 February 2024

Accepted: 25 April 2024

Published: April 2024

Abstract: Software development is among the most powerful needs in every organization and industry in the current generation. It is used to help the functionality of their system by using the software development guide named Software Development Life Cycle (SDLC). Various system developments have been conducted, including developing a public complaint service system. This research applies extreme programming (XP) and User-Centered Design (UCD) development methods to develop the geographic information system for the Badan Narkotika Nasional (BNN) Kediri City complaint service. These development methods are expected to meet user expectations. Also, it can reduce the time required to develop products with results that will be shown by conducting usability testing and validity tests. This research applied extreme programming and user-centered design development methods, both quantitative and qualitative for user testing. The application was successfully developed using XP and UCD development methods. The Kediri City BNN complaint service application was successfully developed in several stages: planning, implementing the design, and program code, followed by the evaluation stage. In the evaluation stage, usability testing results on the geotagging mobile application of the Kediri City BNN complaint service obtained a total score of 92.75% with a very good interpretation, and the validation testing results obtained a value of 100%. Applying extreme programming and user-centered design as a development method produces high usability testing and user experience because, in the development stage, it prioritizes interactions and user opinions.

Keywords: Extreme Programming; User-Centered Design; Geographic Information System; Geotagging.

1. Introduction

Innovation technology is crucial in government today, as it significantly impacts public administration and services (Bannister & Grönlund, 2017; Ouerghi, 2014; Sudrajat & Andhika, 2021). Government agencies reinvent themselves to meet citizens' needs and provide efficient, transparent services. Technology has the potential to simplify tasks, automate processes, and improve productivity, ultimately enhancing people's quality (Méndez-Sánchez, 2023). Technology-driven disruption is reshaping professional lives, necessitating the development of new skills and rethinking government structures to better serve constituents (Agarwal, 2018). Governments should consider specific technological characteristics when formulating innovation policies, considering the discrete or cumulative nature of technological development and network effects in the market (Dolfsma & Seo, 2013). Software development plays a crucial role in the modernization and efficiency of government operations. It enables government agencies to meet the needs and aspirations of citizens by providing better and more efficient services, as well as being more open and transparent (Ouerghi, 2014).

In the current generation, software development is one of the most powerful needs in every organization and industry; it is used to help the functionality of their system by using the software development guide named Software Development Life Cycle (SDLC). SDLC is a guide to developing software with several stages: planning, analysis, design, and implementation. SDLC is a formalized software system development process through successive phases, from requirements gathering and analysis to design, coding, testing, deployment, and monitoring (Zorzetti et al., 2022). There are several popular SDLC models, namely the waterfall and agile models. However, the waterfall method itself is classified as a traditional method to be used in the current era, such as other traditional methods, namely, prototype method, iterative, spiral, v-model, and others, where many literature studies confirm the discovery of difficulties that arise in traditional methods so that Agile methods appear which are considered better than traditional methods. Agile methods, such as Scrum, Kanban, Extreme Programming (XP), and others, can reduce the time required to develop products available in the market (Serrador & Pinto, 2015). Agile is one of the popular SDLC models, where the Extreme Programming (XP) method is one of the branches of the Agile development method, which has the advantage that the stages in the software development process are simpler so that they become more adaptive and flexible and provide alignment to changes in terms of design and features with flexible handling (Carolina & Supriyatna, 2019).

Agile innovation in government is important because it allows governments to adapt to changes, improve operational flexibility, and enhance customer service (Sandoval-Almazán et al., 2017; Stephens et al., 2022; Ylinen, 2021). Governments must provide efficient and effective communication facilities to support transparency in government performance (Budiantoro et al., 2023). The benefits of agile innovation in government include (1) Adaptiveness and responsiveness: Agile government enables governments to transform and adapt to changes in the world around them, making them more responsive to the needs of their constituents (Fitriati & Marsanty, 2023; Stephens et al., 2022). (2) Improved operational flexibility: Agile IT management in public sector IT departments can help improve operational flexibility, collaboration, and customer service despite barriers such as traditional operational structures and resistance to change (Ylinen, 2021). (3) Enhanced customer service: Agile development methods can help governments develop digital services more effectively and efficiently, leading to improved customer service (Sandoval-Almazán et al., 2017).

However, implementing agile innovation in government also comes with challenges: (1) Traditional operational structures: Traditional bureaucratic structures in government can hinder the adoption of agile methods, as governments often value stability over agility. (2) Resistance to change: Resistance to change is a common challenge in implementing agile innovation in government, as it requires a shift in mindset and practices (Ylinen, 2021). (3) Organizational, methodological, end-user-related, technological, and regulatory challenges: Implementing agile methods for governmental digital service development can face challenges in various categories, including organizational, methodological, end-user-related, technological, and regulatory challenges (Kupi & McBride, 2021).

Agile innovation improves government services by enabling governments to provide faster and more automated services to the public, facilitating collaboration with stakeholders, and increasing responsiveness to changing requirements (Bjørnson et al., 2017; Simonofski et al., 2018) . It allows governments to learn from past projects and apply those lessons in the future, leading to faster development and implementation cycles (Sandoval-Almazán et al., 2017).

Extreme Programming (XP) is an agile software development method that can be used for government app development. XP ensures customer satisfaction, better software quality, and efficient project management. It is a dynamic model emphasizing continuous discussion and integration of new features and ideas (Shrivastava et al., 2021). However, implementing agile methods in e-government services can face challenges due to the intrinsic characteristics of governments. Agile methods can increase responsiveness and collaboration, but practitioners face challenges in tailoring them to the specificities of e-government (Simonofski et al., 2018). To address the shortage of software engineers, citizen developers with little or no programming skills are being encouraged to use no-code platforms for app development. However, these platforms lack the flexibility of general-purpose programming languages. A multi-paradigm minimalist approach that includes intuitive abstractions could bridge the gap between simplicity and expressiveness for citizen developers (Avishahar-Zeira & Lorenz, 2023).

System development is not only focused on application goals, diverse features, and capabilities in software and hardware, but user involvement should be a top priority in system development (Saputri et al., 2017). Agile methods are described as iterative and incremental, avoiding standard approaches that emphasize freezing initial designs and specifications, fixed project scope, and low customer interaction (Boehm & Turner, 2003). In designing this application, a method is needed that utilizes user opinions, as well as user patterns and behavior, by applying the User Centered Design (UCD) method, the most popular method for user interface design (Saffer, 2010). UCD is an approach that represents techniques, processes, methods, and procedures for designing usable products and systems, considering the user as the center of the process, which has the goal of achieving a greater level of usability in software (Aguilar & Zapata, 2017; Llema & Vilela-Malabanan, 2019). Usability is one of the factors that determine the quality of a system. Usability refers to learnability, efficiency, memorability, error prevention ability, and the ability to provide pleasant interaction from a system (Lund, 2001). This describes the quality of the User Interface (UI) from the user's point of view. Various studies have adopted many different methods to develop UIs with excellent usability. UCD is the most popular method for UI design (Hasani et al., 2020; Sukarsa et al., 2021).

The integration of XP and UCD system development methods was applied in this study to develop a drug complaint service system. Drug abuse affects not only the

survival of the abuser but also the future of the nation and state, regardless of social, economic, or educational strata. Drug abuse can be caused by many things, such as the lack of socialization among the public about drugs and the lack of understanding and awareness of the dangers of drug abuse (Kumalasari et al., 2022). Drug abuse can be caused by many things, such as the lack of socialization among the public about drugs and the lack of understanding and awareness of the dangers of drug abuse (Amanda et al., 2017). Community participation in reporting drug abuse information is needed. Public complaints are an important element in the successful performance of institutions (Sabeni & Setiamandani, 2020). Public complaints in reporting drug abuse information are needed to involve the role of the community to record drug abuse acts to the relevant agencies for immediate follow-up to reduce drug abuse in an area.

The urgency and relevance of developing technology to handle drug trafficking is evident from the increasing use of the dark web and internet-based platforms for illicit drug trade (Chawki, 2022; Salouros, 2018). The surge in drug trafficking is facilitated by the anonymity of offenders and the diversity of internet-based trading platforms, leading to global concerns. Law enforcement agencies are constantly undertaking surveillance operations to track and disrupt mass criminals and prevent crime on the dark web. However, the closure of major online drug trafficking platforms has minimal long-term impact, highlighting the importance of a technologically robust intergovernmental regulatory framework (Chawki, 2022). Additionally, remote sensing and machine learning technologies have become crucial for detecting and identifying drug trafficking operations in remote and rural areas, emphasizing the need for technological tools and infrastructure in affected regions (Valles & Romero-Alva, 2023). Furthermore, the development of an app for anonymous reporting of drug trafficking incidents can aid in curbing drug trafficking and supporting the recovery of drug-addicted individuals. This proactive approach addresses the root causes of drug addiction and helps break the cycle of substance abuse, particularly among vulnerable populations (Thamizhselvi et al., 2023). Therefore, the urgency and relevance of developing technology to handle drug trafficking can be inferred from the increasing sophistication of illicit drug trade and the need for robust technological solutions to address this global issue.

Public complaints against drug abuse in Kediri City are currently carried out by visiting the BNN Kediri office directly, this is considered inefficient because the community cannot make reports directly and requires more time for the reporting process. In Zulfa & Pramono (2019), it is said that BNN Kediri's efforts in tackling drug abuse are by conducting socialization in the community, educational institutions, and government institutions. In addition, BNN Kediri City also conducts prevention programs by holding counseling programs for people who need guidance so as not to fall deeper into drug abuse.

Geographic Information Systems (GIS) have become an essential tool in government development, impacting decision-making and policy development. Key applications of GIS in government development: (1) Acquiring and communicating geographic knowledge: GIS is used in social and behavioral sciences as a tool for acquiring and communicating geographic knowledge (Goodchild, 2015). (2) Managing, integrating, and visualizing spatial datasets: GIS is widely used in local and regional planning for managing, integrating, and visualizing spatial datasets (Man, 2020; Maulana & Maulana, 2023). (3) Supporting comprehensive study of specific geographic objects: GIS applications are developed for the comprehensive study of specific geographic objects, such as regions and territories (Yudina et al., 2022).

Impacts of GIS on government decision-making and policy development include (1) Improved efficiency of storing, retrieving, and updating data: GIS improves the efficiency of storing, retrieving, and updating natural resource data, benefiting land-use management agencies (Shultz & MacArthur, 2019). (2) Enhanced decision support: GIS facilitates decision support by combining different spatial themes, studying trends and patterns, and analyzing spatial data (van Kreveld, 2017). (3) Increased value and benefits: Increasing actual GIS usage leads to an increase in GIS value, with efficiency and effectiveness benefits being realized (Alrwais et al., 2016).

Nowadays, Global Positioning System (GPS) technology has become a standard feature on smartphone devices. One of the implementations of GPS and camera technology is geotagging, which is a technology that provides location-based information on digital media taken using a smartphone (Supriyanto et al., 2021). The combination of camera features that can synergize directly with GPS, commonly called geotagging, can add and store GPS data position information, such as latitude and longitude, distance, altitude, data accuracy, and place names in the form of metadata to various media. Location information can be automatically added to the photo metadata, also known as EXIF, so the location can be displayed on a map (Buladaco & Ubay, 2020; Varadan & Kumar, 2015). Geotagging is a geographic information system widely used in the community (Joshi et al., 2010). By this definition, geotagging can be utilized to assist the public in reporting information where the results of the report will contain location information related to the report provided, this feature will later be provided in the application that will be designed in this study.

Research in government application development is extensive, with a study by Murtadho et al. (2018) entering on a road damage reporting app. Achieving an 88.24% user satisfaction rate, there's room for improvement by integrating XP and UCD Methods. These methodologies promise to elevate user satisfaction and enhance the application's effectiveness.

Based on the explanation above, this research focuses on developing a mobile geographic information system geotagging complaint services BNN Kediri based on Android with Extreme Programming and User-Centered Design development method. Thus, this study aims to develop and test the BNN Kediri City complaint service application with XP and UCD system development methods.

2. Methods

This research focuses on developing a mobile geographic information system geotagging complaint services BNN Kediri based on Android with Extreme Programming and User-Centered Design development methods, and several stages must be passed. In the XP method, there are stages of planning, development iteration, acceptance testing, and release (Revdiwala & Mittal, 2021; Supriyatna, 2018), in the UCD method, there are stages: understand the context of use, specify user requirements, design solutions, and evaluate against requirements (Risald et al., 2018; Zimmermann & Grötzbach, 2007). The implementation of XP and UCD methods is shown in Figure 1.

At the planning stage, there are three steps in analyzing needs: understanding the context of use, specifying user requirements, and designing solutions. The stage of understanding the context of use is carried out by observing five expert respondents, which aims to determine the user's specific needs for the system to be developed. Furthermore, the specifying user requirements stage by analyzing system requirements, which include an overview of the application, identification of actors, system functional requirements, and system non-functional requirements.

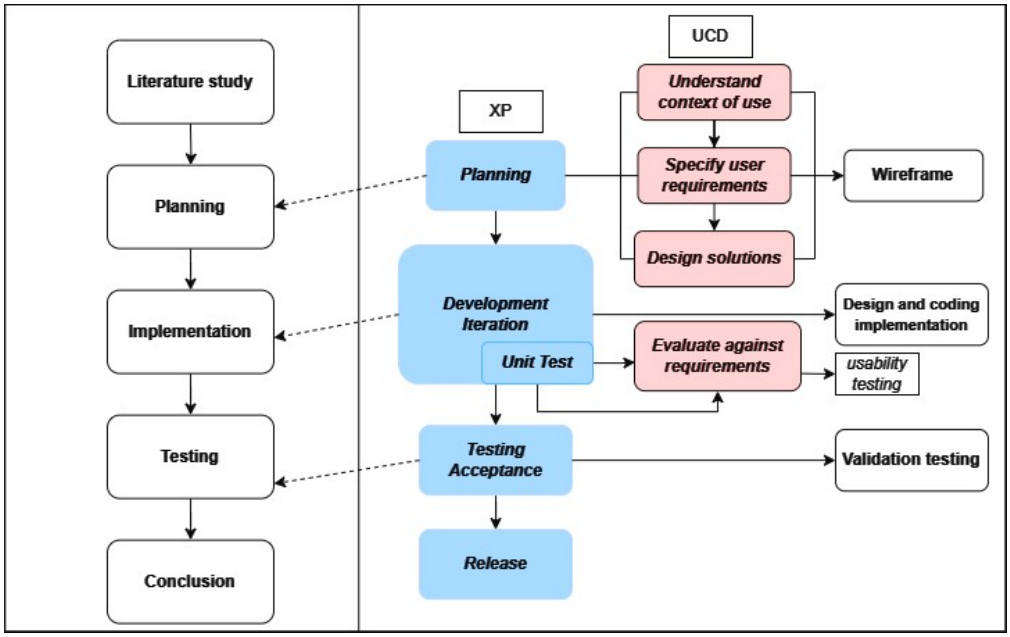

Figure 1. Implementation Stages of XP and UCD

Overview of the application: the geotagging mobile application of the Kediri City BNN complaint service "Halo BNN" aims to facilitate the community in reporting drug abuse and other services such as socialization requests, counseling requests, and rehabilitation assistance. This application system will be divided into two parts: a mobile application that can be used by the public as a reporting party and used by the admin to manage report data. The back-end server uses SQLite. Non-functional needs in the mobile application geotagging complaint services BNN Kediri City is usability, where the application can be operated by users easily and has an interface designed as simply as possible so that users can easily understand the flow of using the application without requiring guidance.

In the design solutions stage, we implement the ScreenFlow design, as illustrated in Figure 2. This design method is used to depict the flow of the Kediri City BNN complaint service application interface on a smartphone mobile device. Our application system's wireframe and ScreenFlow are intentionally designed to be user-friendly, aligning with the main objectives of this research. Most of the navigation menus are strategically placed in the main view, ensuring that accessing specific features of the app does not require lengthy or complex steps.

At the development iterations stage, program code implementation and unit tests are carried out. Implementation is a stage where the system design is converted into a programming language to produce a form of system that can be used by users. The implementation of this application uses Android Studio software and uses SQLite to store user data. At this stage, prospective users will carry out unit testing. When the program and interface have been implemented, they will be shared with prospective users for evaluation by conducting a survey. Evaluation is carried out by applying usability testing and user experience testing, which is carried out to measure aspects of effectiveness, efficiency, user satisfaction, and user experience of the Kediri City BNN complaint service application (Laugwitz et al., 2008; Murdiono et al., 2018). The application has been usability tested on five expert respondents who can represent application users based on the criteria set (Aniesiyah et al., 2018). As for user experience testing, it has been carried out by 30 respondents (Schrepp et al., 2014).

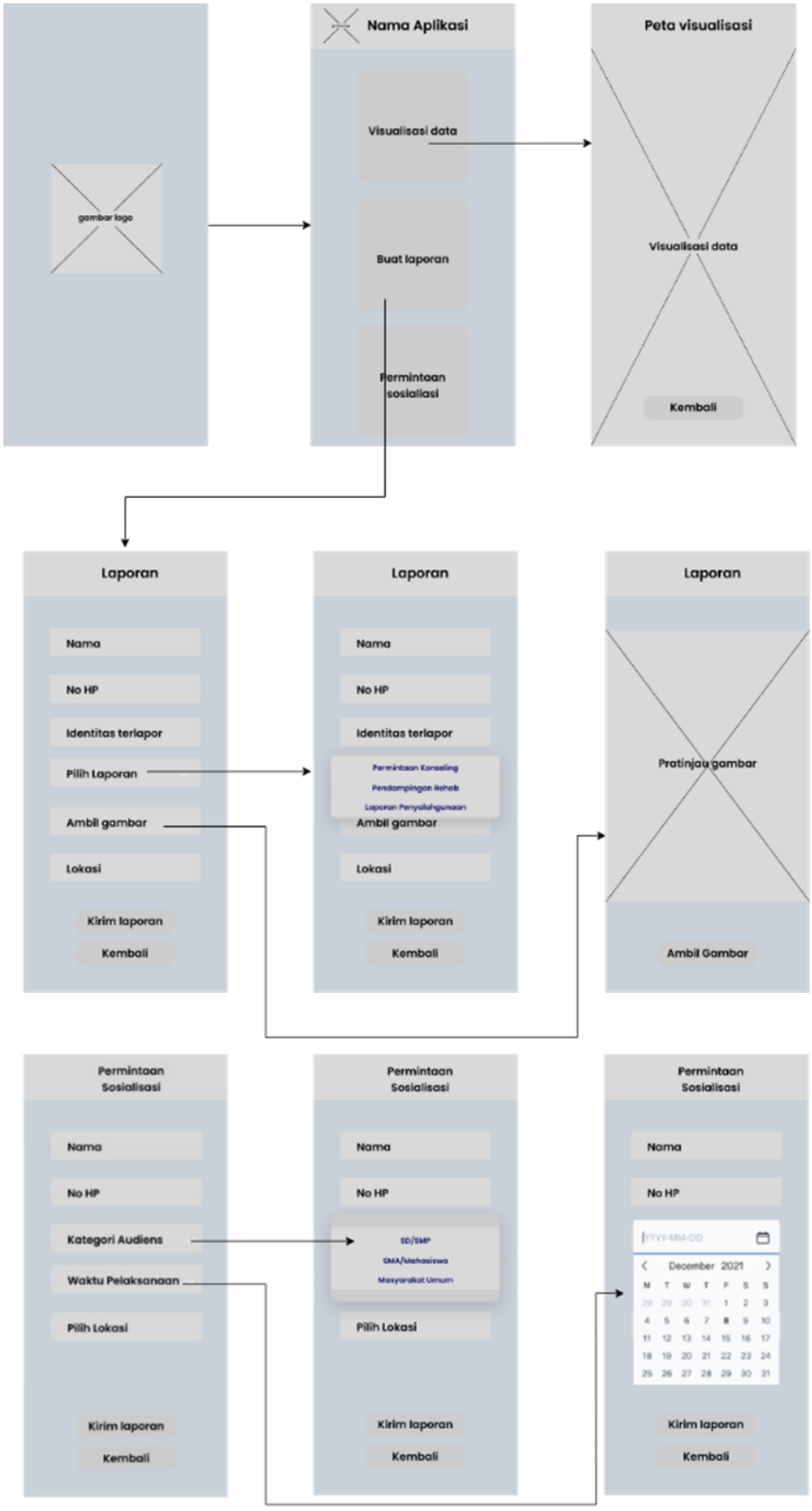

Figure 2. ScreenFlow Application

Testing acceptance has been carried out with validation testing using black-box testing. Validation testing aims to test all functional requirements of the system by the design requirements obtained previously (Suryn, 2014). The test results will show the functional suitability of the system in the tested application with the initial design of the application.

In this study, a mixed methods research approach is applied to test statements in terms of outcomes and processes (Sugiyono, 2017). The application development process utilizes the XP Method, which constitutes the qualitative research phase, followed by quantitative research in the UCD Method.

3. Results and Discussion

This research was conducted to develop a geographic information system for BNN Kediri City complaint services by implementing XP and UCD methods in its development. In the XP method, the planning stage implements the stages of understanding the context of use, specifying user requirements, and designing solutions, which are included in the UCD method with the final result of wireframes. Furthermore, the development iterations stage, namely the stages carried out in the design, are implemented into a mobile-based system. System implementation is done by creating a mobile application using Java language with Android Studio and SQLite for the database. For the testing stage, implement usability testing, user experience testing, and black-box testing for the validation.

3.1. Implementation System

The implementation of this system is composed of two parts, namely guests and admins, where the guest section is composed of several menus, including visualization maps, new reports, and socialization requests. The admin section shows a list of reports created by guests, which the admin can then manage. The implementation results can be seen below.

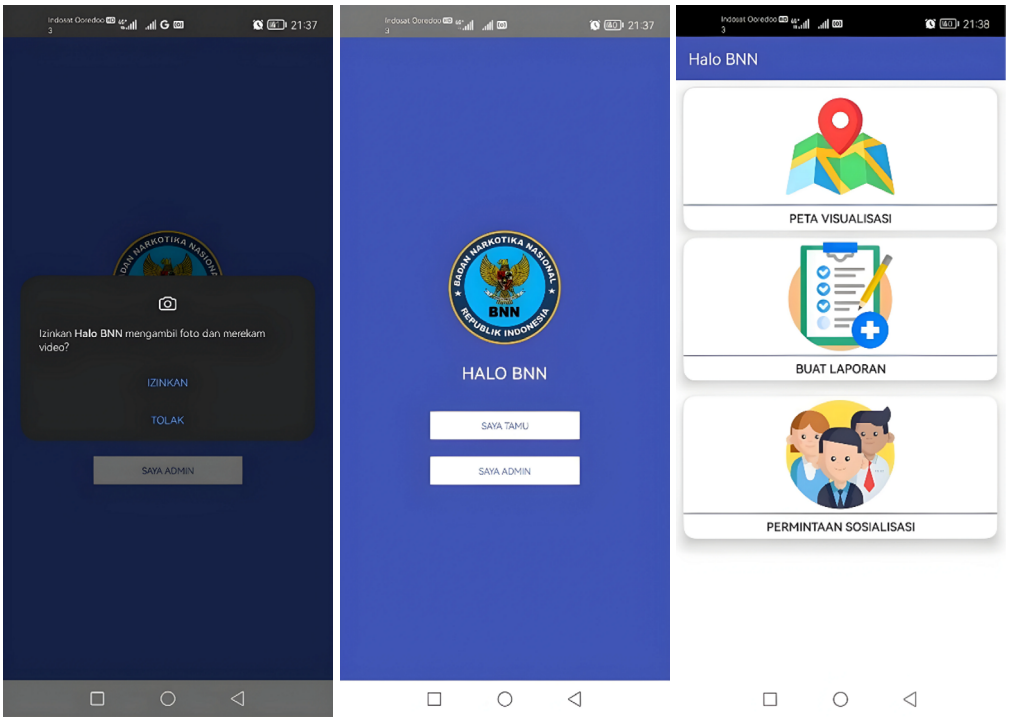

Figure 3. The First Page and Home Page of the Application

Figure 3 shows the initial display of the Halo BNN application, which displays location and camera access permissions on the device used, the display of user options in the Halo BNN application, which, if using the application as a guest, will be directly redirected to the home page, if using the application as an admin it will be redirected to the login page, and the home page display in the Halo BNN application which displays the three main menus contained in this application, namely the distribution map menu, new reports, and requests for socialization in the Halo BNN application.

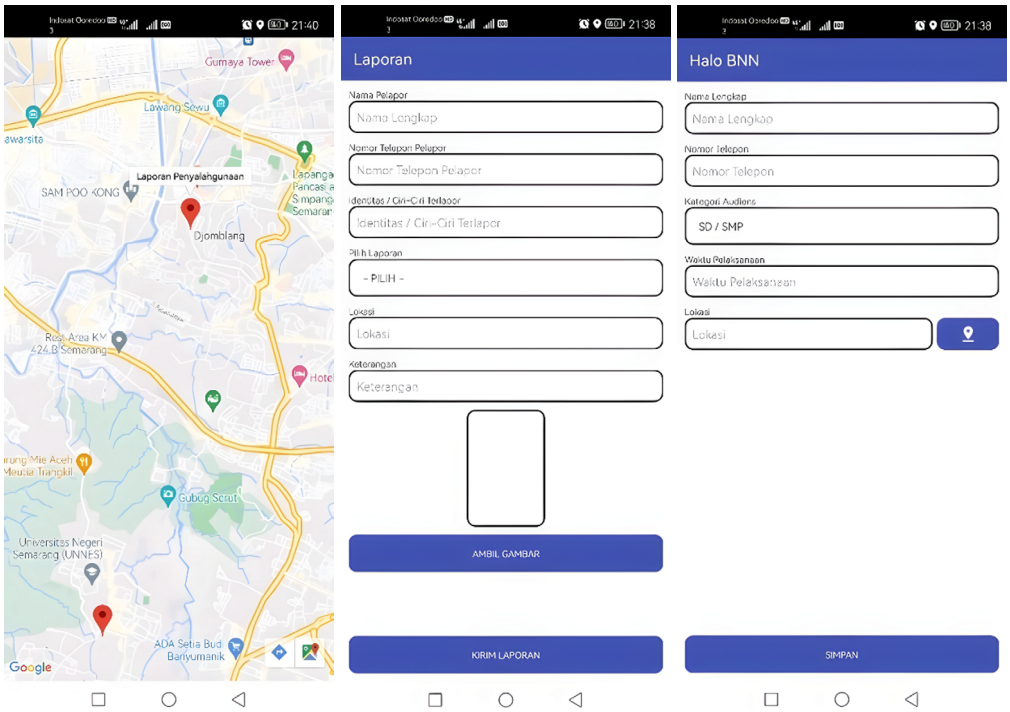

Figure 4. Visualization Map Page and New Report Pages

Figure 4 shows a display of the distribution map page in the Halo BNN application, which displays the distribution of markers and a description of the type of report that has been uploaded. This page implements program code that functions to display maps and visualization data in the form of markers according to the reports that have been uploaded. There is also a new report page in the Halo BNN application that displays a report form containing the required data. On this page, geotagging with geocoding is implemented using the Google API when taking pictures using a smartphone camera. When taking pictures using a camera, the image data is reduced in size, and image rotation is carried out according to the orientation of the smartphone. Furthermore, the location data in the EXIF image will be read, and location data will be displayed in the form of latitude and longitude. Users can directly take pictures and upload reports. Furthermore, there is a socialization request page on the Halo BNN application which displays the required data form, such as the name and telephone number of the socialization request maker, and then there is a choice of socialization audience categories, implementation time using a date picker, and implementation location.

Figure 5 shows the admin login page in the Halo BNN application. To see the list of reports and manage reports, the admin is required to log in first. Furthermore, there is a page that shows the admin can view and manage reports.

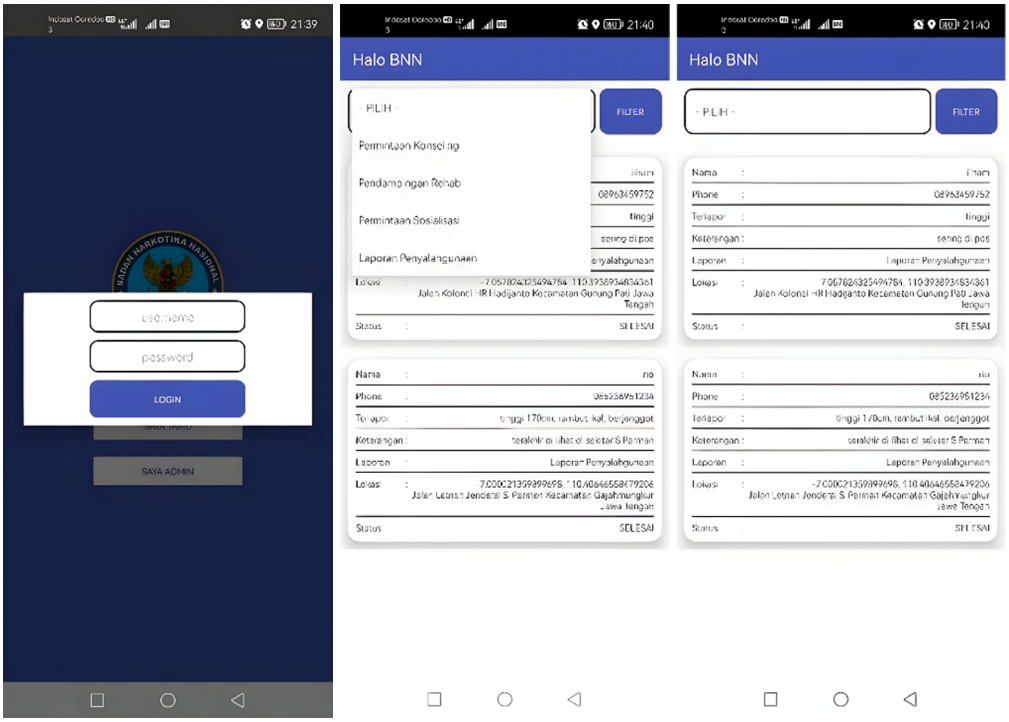

Figure 5. Admin Pages

3.2. Usability Testing

After implementing the system, the next step is to test the system with usability testing using the USE and UEQ questionnaires. The USE questionnaire was distributed to five expert respondents with the same expertise as the application needs in this study, such as Mobile Application Lecturers, UI designers, UX Researchers, Kediri City BNN Staff, and students who participate in anti-narcotics organizations. The USE questionnaire measured effectiveness, efficiency, and user satisfaction with the application. The effectiveness and efficiency assessment was carried out by observing five expert respondents who aimed to determine the success of the tasks given to respondents and determine the time required by users to complete the assigned tasks.

Based on the results of the success rate calculation, the level of effectiveness in usability assessment reached 97.5%. Out of 20 total tasks, 19 were successfully carried out by expert respondents. Only 1 task was declared partially successful by one of the respondents, namely, making a misuse report. The respondent did not get an accurate location due to an unstable signal.

Furthermore, the satisfaction aspect assessment is carried out using the USE questionnaire, where the USE questionnaire testing index can be declared fulfilled if the value of each testing aspect exceeds 60%. Table 1 shows the results of the calculation of each parameter in the USE questionnaire.

Table 1. The Result of the USE Questionnaire

Parameter	Usefulness	Ease of Use	Ease of Learning	Satisfaction
Value	93%	94%	96%	88%

After calculating the total usability testing on the geotagging mobile application of the Kediri City BNN complaint service, 92.75% was obtained with a very good interpretation. Since one respondent failed to complete one of the tasks due to an unstable signal, no iteration was required at the development stage. So, it can be stated

that the mobile application geotagging complaint service BNN Kota Kediri has met the criteria of usability testing, is acceptable, and facilitates users in making complaints addressed to the agency BNN Kota Kediri.

In addition to using the USE questionnaire for usability testing, user experience testing was also carried out using the UEQ questionnaire, which was distributed to 30 respondents. The UEQ questionnaire aims to assess the user experience of the mobile geotagging geographic information system of the BNN Kediri complaint services. The UEQ questionnaire consists of 26 statement items representing six scales namely Attractiveness, Clarity, Efficiency, Dependability, Stimulation, and Novelty.

Table 2. The Result of UEQ

UEQ Quality	UEQ Scale	Variables	UEQ Scale
Attractiveness	1.76	Attractiveness	1.76
Pragmatic Quality	1.73	Perspicuity	1.90
		Efficiency	1.70
		Dependability	1.55
Hedonic Quality	1.25	Stimulate	1.54
		Novelty	0.95

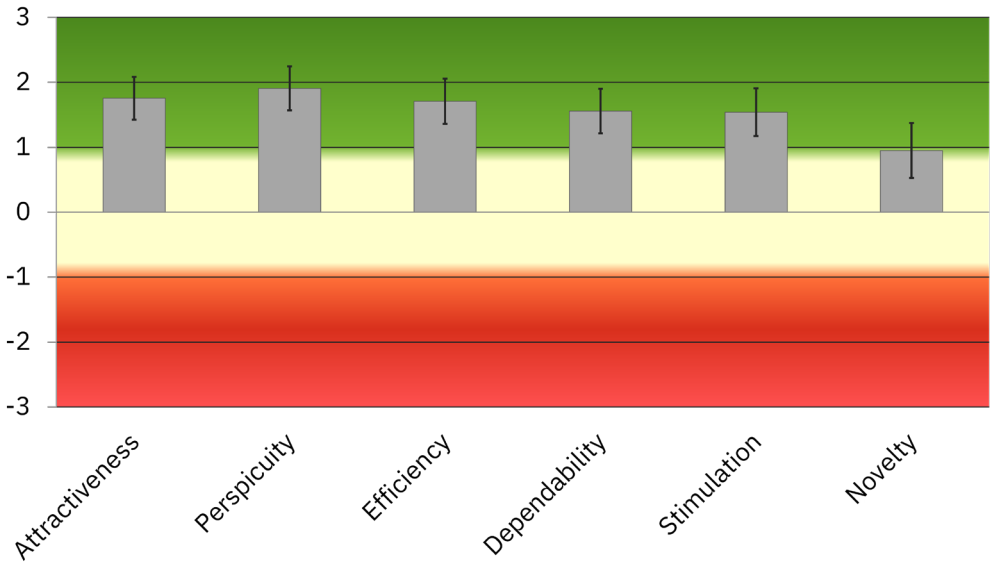

Figure 6. UEQ Parameter Calculation Results

Table 2 and Figure 6 show the average value of each scale of the UEQ questionnaire. It is found that the results of the highest average value are on the clarity scale with an average value of 1.90, which shows how easy. The users use the application attractiveness scale with an average value of 1.76, which indicates that the application has a good level of attractiveness so that users feel happy to use it. This assessment is influenced by a sense of comfort and a sense of fun when using the application. The ease of users when using the application, then the efficiency scale with a value of 1.70 which implies that the application structure has met the needs of users in completing their activities, users feel the practicality and organization of the application. Furthermore, the factors of the level of security, the level of conformity to expectations, the level of predictability, and the level of reliability in supporting user work are indicated by the accuracy scale with an average value of 1.55, followed by the stimulation scale with

an average value of 1.54 which defines the experience that motivates users to access and operate the application. Lastly, the attractiveness scale with a value of 0.95 shows that users think the application is quite innovative. The evaluation results using UEQ show that the evaluation for all aspects has a positive value, with all aspects of user experience scoring above 0.8. This is consistent with previous research that has been conducted, which indicates that an average value between -0.8 and 0.8 is considered a normal evaluation. In contrast, values > 0.8 are considered a positive evaluation, and values < -0.8 are considered a negative evaluation (Rauschenberger et al., 2013). It can be concluded that the Kediri City BNN complaint service application has a high value in the user experience assessment.

3.3. Black-Box Testing

The final test on this system uses validation testing black-box testing techniques. Validation testing aims to determine that the application can function as designed at the system requirements analysis stage. From the test results obtained, it will be compared with the expected results. If the expected results match the results obtained during validation testing, then the status of the test results in the test case can be declared valid. Based on the results of validation testing, the functional needs of the application system are met and have a validity level of 100%, so it can be concluded that the implementation of the geotagging mobile application development of the Kediri City BNN complaint service has been fulfilled.

3.4. Discussion

The implementation of the Geographical Information System for the BNN Kediri complaint service using XP and UCD methodologies was successfully executed in this study. The study encompassed several phases: initial planning involved identifying stakeholders to understand the context of use, gathering user data to determine system requirements, and creating scenarios such as UML diagrams to reinforce customer-oriented software development. Subsequently, application wireframes were generated to propose design solutions. The development phase encompassed iterative implementation of design and code. Evaluation ensued, involving usability and user experience testing via the USE and UEQ questionnaires. This stage aimed to validate that the system aligned with user expectations through user feedback review.

In usability testing involving five expert respondents, a commendable 92.75% result was achieved. User experience assessments conducted with 30 respondents revealed notably high average scores across different scales: clarity (1.90), attractiveness (1.76), efficiency (1.70), accuracy (1.55), stimulation (1.54), and innovation (0.95). Evaluation using the UEQ also yielded positive scores, with all aspects scoring above 0.8, aligning with Rauschenberger et al. (2013) criteria for positive evaluations. Notably, the application underwent a single evaluation stage without iteration, reflecting its successful development and smooth testing process. The validation phase concluded with black-box testing.

In contrast to the research of Murtadho et al. (2018), this study shares similarities, including mobile geotagging development and system evaluation using a USE questionnaire. However, while Murtadho's study achieved an 88.24% rating, this study attained a 92.75% rating and employed the XP Method for development, diverging from the traditional prototyping approach devoid of user-involved design stages.

Iqbal et al. (2020) conducted research utilizing the Waterfall and UCD development methods for Android-based emergency applications. However, their study lacked

user evaluation, with user involvement limited to the design stage. Consequently, no conclusive results regarding user satisfaction were obtained. In contrast, this study emphasizes the crucial role of user involvement throughout the development process.

This study comprehensively evaluates all stages of the XP method, a departure from Llema and Vilela-Malabanan's (2019) approach to developing English learning mobile applications, which relied on prototyping and UCD. While Llema and Vilela-Malabanan's research iterated design solutions using Five-Design Sheets (FDS) until meeting user expectations, it solely assessed the design, lacking evaluation of the application's alignment with user needs and expectations. Consequently, there was no definitive measurement of usability assessment and user experience.

The advantage of this research is that it applies the XP development method, which is included in the Agile method and is considered better than traditional methods such as prototyping, waterfall, and others. This research also applies the UCD method, which in the design and testing stages involves users, so that it can be ensured that the needs of users in the development of this application can be met, as evidenced by the results of usability testing and user experience testing assessments which get Very Good and Positive results for each assessment, and by applying usability assessment using the USE questionnaire and user experience assessment using the UEQ questionnaire, the measurement results are obtained according to the usability and user experience assessment standards.

While the disadvantage of this research is the user experience assessment, the attractiveness assessment scale gets the lowest results this can occur due to the lack of other innovations that can be applied to the Kediri City BNN complaint service application. On the flip side, this research could benefit from further optimization, particularly concerning the privacy of whistleblowers. Privacy-related vulnerabilities and risks are frequently built into applications during their development, either intentionally or due to negligence (Jorgensen et al., 2015).

4. Conclusion

The development of government information system applications, particularly for BNN Kediri, has been successfully executed through the utilization of XP and UCD methodologies. The development process initiates with an examination of the application's business processes, followed by the analysis of involved actors such as users and administrators. Use case diagrams are then crafted to depict the necessary actions for each actor, further refined into UML diagrams and application wireframes. Implementation ensues with the translation of designs into program code, culminating in user testing. Testing procedures facilitated by the USE and UEQ questionnaires yield commendable results, indicating a high level of usability and user experience. Subsequent black-box testing confirms the application's alignment with user expectations. Based on the results obtained from this research, it can be seen that applying the XP and UCD development methods can increase the level of satisfaction and user experience more than previous research, which can be seen through the results of usability testing and user experience testing using the USE and UEQ questionnaires. Therefore, this research can be considered in the development of government applications, supplementing traditional approaches. The research could be improved, especially regarding whistleblower privacy, as privacy vulnerabilities are often present in applications during development due to either malicious intent or negligence.

Acknowledgment

We would like to express our gratitude to the many parties who have supported and participated in discussing this study, especially those at Universitas Negeri Semarang.

References

Agarwal, P. K. (2018). Public Administration Challenges in the World of AI and Bots. *Public Administration Review, 78*(6), 917–921. https://doi.org/10.1111/puar.12979

Aguilar, M., & Zapata, C. (2017). *Integrating UCD and an Agile Methodology in the Development of a Mobile Catalog of Plants* (pp. 75–87). https://doi.org/10.1007/978-3-319-41685-4_8

Alrwais, O., Hilton, B., Horan, T., & Bechor, T. (2016, August 11). An Organizational Perspective on GIS Payoffs for the Public Sector: Is Usage the Missing Link? *AMCIS 2016 Proceedings*. https://aisel.aisnet.org/amcis2016/Decision/Presentations/9

Amanda, M. P., Humaedi, S., & Santoso, M. B. (2017). Penyalahgunaan Narkoba di Kalangan Remaja (Adolescent Substance Abuse). *Prosiding Penelitian Dan Pengabdian Kepada Masyarakat, 4*(2). https://doi.org/10.24198/jppm.v4i2.14392

Aniesiyah, A. N., Tolle, H., & Az-Zahra, H. M. (2018). Perancangan User Experience Aplikasi Pelaporan Keluhan Masyarakat Menggunakan Metode Human-Centered Design. *JPTIIK (Jurnal Pengembangan Teknologi Informasi Dan Ilmu Komputer), 2*(11), 5503–5511. https://j-ptiik.ub.ac.id/index.php/j-ptiik/article/view/3327

Avishahar-Zeira, A., & Lorenz, D. H. (2023). Could No-Code Be Code? Toward a No-Code Programming Language for Citizen Developers. *Proceedings of the 2023 ACM SIGPLAN International Symposium on New Ideas, New Paradigms, and Reflections on Programming and Software*, 103–119. https://doi.org/10.1145/3622758.3622893

Bannister, F., & Grönlund, Å. (2017). Information Technology and Government Research: A Brief History. *Proceedings of the Annual Hawaii International Conference on System Sciences, 2017-January*, 2943–2952. https://doi.org/10.24251/HICSS.2017.356

Bjørnson, F. O., Vestues, K., & Rolland, K. H. (2017). Coordination in the Large: A Research Design. *Proceedings of the XP2017 Scientific Workshops*, 1–5. https://doi.org/10.1145/3120459.3120477

Boehm, B., & Turner, R. (2003). Using Risk to Balance Agile and Plan-Driven Methods. Computer, 36(6), 57–66. https://doi.org/10.1109/MC.2003.1204376

Budiantoro, R. A., Aji, M. R. W., Prayogi, J., & Susanti, A. (2023). SI Desa (Sistem Informasi Desa): Initiation of an Integrated Village Economic Information System and Data Management by the Provincial Government of East Java. *Jurnal Bina Praja, 15*(2), 233–247. https://doi.org/10.21787/jbp.15.2023.233-247

Buladaco, M. V. M., & Ubay, F. Lou. (2020). GETMOSYS: A Plant Pathologists' Geotagging and Monitoring System for Infected Banana Plant. *International Journal of Scientific and Technology Research, 9*(4), 980–985.

Carolina, I., & Supriyatna, A. (2019). Penerapan Metode Extreme Programming dalam Perancangan Aplikasi Perhitungan Kuota SKS Mengajar Dosen. *IKRA-ITH Informatika: Jurnal Komputer Dan Informatika, 3*(1), 106–113. https://journals.upi-yai.ac.id/index.php/ikraith-informatika/article/view/306

Chawki, M. (2022). The Dark Web and the Future of Illicit Drug Markets. *Journal of Transportation Security, 15*(3–4), 173–191. https://doi.org/10.1007/s12198-022-00252-y

Dolfsma, W., & Seo, D. (2013). Government Policy and Technological Innovation—A Suggested Typology. *Technovation, 33*(6–7), 173–179. https://doi.org/10.1016/j.technovation.2013.03.011

Fitriati, R., & Marsanty, D. A. (2023). Transformational Leadership in Times of Crisis: Study of Handling COVID-19 in Bumi Raja-Raja. *Jurnal Bina Praja, 15*(2), 289–308. https://doi.org/10.21787/jbp.15.2023.289-308

Goodchild, M. F. (2015). Geographic Information Systems. In *International Encyclopedia of the Social & Behavioral Sciences* (pp. 58–63). Elsevier. https://doi.org/10.1016/B978-0-08-097086-8.72018-6

Hasani, L. M., Sensuse, D. I., Kautsarina, & Suryono, R. R. (2020). User-Centered Design of e-Learning User Interfaces: A Survey of the Practices. *2020 3rd International Conference on Computer and Informatics Engineering (IC2IE)*, 1–7. https://doi.org/10.1109/IC2IE50715.2020.9274623

Iqbal, M., Marthasari, G. I., & Nuryasin, I. (2020). Penerapan Metode UCD (User Centered Design) pada Perancangan Aplikasi Darurat Berbasis Android. *Jurnal Repositor, 2*(2), 201–214. https://doi.org/10.22219/REPOSITOR.V2I2.30470

Jorgensen, Z., Chen, J., Gates, C. S., Li, N., Proctor, R. W., & Yu, T. (2015). Dimensions of Risk in Mobile Applications. *Proceedings of the 5th ACM Conference on Data and Application Security and Privacy*, 49–60. https://doi.org/10.1145/2699026.2699108

Joshi, D., Gallagher, A., Yu, J., & Luo, J. (2010). Exploring User Image Tags for Geo-Location Inference. *2010 IEEE International Conference on Acoustics, Speech and Signal Processing*, 5598–5601. https://doi.org/10.1109/ICASSP.2010.5495247

Kumalasari, K., Rahmah, L., & Hastuti, Y. D. (2022). Edukasi Bahaya Narkoba pada Remaja. *Jurnal Inovasi, Pemberdayaan Dan Pengabdian Masyarakat, 2*(1), 18–22. https://doi.org/10.36990/jippm.v2i1.484

Kupi, M., & McBride, K. (2021). *Agile Development for Digital Government Services: Challenges and Success Factors* (pp. 139–150). https://doi.org/10.1007/978-3-030-82824-0_11

Laugwitz, B., Held, T., & Schrepp, M. (2008). *Construction and Evaluation of a User Experience Questionnaire* (pp. 63–76). https://doi.org/10.1007/978-3-540-89350-9_6

Llema, C. F., & Vilela-Malabanan, C. M. (2019). Design and Development of MLERWS: A User-Centered Mobile Application for English Reading and Writing Skills. *Procedia Computer Science*, 161, 1002–1010. https://doi.org/10.1016/j.procs.2019.11.210

Lund, A. M. (2001). Measuring Usability with the USE Questionnaire. *Usability Interface, 8*(2), 3–6. https://www.researchgate.net/publication/230786746

Man, Q. H. (2020). Overview of GIS Application. In *TORUS 2 – Toward an Open Resource Using Services* (pp. 229–245). Wiley. https://doi.org/10.1002/9781119720553.ch8

Maulana, M. I., & Maulana, M. I. (2023). Analysis of Agricultural Economic Development in East Java Province. *Jurnal Bina Praja, 15*(3), 593–604. https://doi.org/10.21787/jbp.15.2023.593-604

Méndez-Sánchez, S. I. (2023). *The Work of the Committees in the Business Chambers to Promote the Development of Emerging Technologies* (pp. 213–223). https://doi.org/10.4018/978-1-6684-8088-5.ch013

Murdiono, R. A., Tolle, H., & Kharisma, A. P. (2018). Evaluasi User Experience pada Aplikasi Mobile Penjualan Tiket Online. *JPTIIK (Jurnal Pengembangan Teknologi Informasi Dan Ilmu Komputer), 2*(5), 2078–2085. https://j-ptiik.ub.ac.id/index.php/j-ptiik/article/view/1544

Murtadho, M., Tolle, H., & Kharisma, A. P. (2018). Rancang Bangun Aplikasi Mobile Geotagging Kerusakan Jalan Berbasis Laporan Sosial pada Platform Android. *JPTIIK (Jurnal Pengembangan Teknologi Informasi Dan Ilmu Komputer), 2*(12), 7538–7544. https://j-ptiik.ub.ac.id/index.php/j-ptiik/article/view/4006

Ouerghi, M. S. (2014). ICT Strategy in Tunisia: The Case of E-tunisia and Tunisan2.Open Movement. *2014 World Congress on Computer Applications and Information Systems (WCCAIS)*, 1–8. https://doi.org/10.1109/WCCAIS.2014.6916543

Rauschenberger, M., Schrepp, M., Perez-Cota, M., Olschner, S., & Thomaschewski, J. (2013). Efficient Measurement of the User Experience of Interactive Products. How to use the User Experience Questionnaire (UEQ).Example: Spanish Language Version. *International Journal of Interactive Multimedia and Artificial Intelligence, 2*(1), 39. https://doi.org/10.9781/ijimai.2013.215

Revdiwala, R., & Mittal, R. (2021). *Analytical Study of Agile Methodology with Cloud Computing*. https://doi.org/10.13140/RG.2.2.11801.34404

Risald, R., Suyoto, S., & Santoso, A. J. (2018). Mobile Application Design Emergency Medical Call for the Deaf using UCD Method. *International Journal of Interactive Mobile Technologies (IJIM), 12*(3), 168–177. https://doi.org/10.3991/ijim.v12i3.8754

Sabeni, H., & Setiamandani, E. D. (2020). Pengelolaan Pengaduan Masyarakat dalam Upaya Meningkatkan Kualitas Pelayanan Publik. *Jurnal Ilmu Sosial Dan Ilmu Politik, 9*(1), 43–52. https://doi.org/10.33366/JISIP.V9I1.2214

Saffer, D. (2010). Designing for Interaction: Creating Innovative Applications and Devices. New Riders.

Salouros, H. (2018). Illicit Drug Chemical Profiling: Current and Future State. *Australian Journal of Forensic Sciences*, 1–8. https://doi.org/10.1080/00450618.2018.1424244

Sandoval-Almazán, R., Luna-Reyes, L. F., Luna-Reyes, D. E., Gil-Garcia, J. R., Puron-Cid, G., & Picazo-Vela, S. (2017). *Managing Information Technology Development Projects* (pp. 65–77). https://doi.org/10.1007/978-3-319-60348-3_6

Saputri, I. S. Y., Fadhli, M., & Surya, I. (2017). Penerapan Metode UCD (User Centered Design) pada E-Commerce Putri Intan Shop Berbasis Web. *Jurnal Nasional Teknologi Dan Sistem Informasi (TEKNOSI), 3*(2), 269–278. https://doi.org/10.25077/TEKNOSI.V3I2.2017.269-278

Schrepp, M., Hinderks, A., & Thomaschewski, J. (2014). *Applying the User Experience Questionnaire (UEQ) in Different Evaluation Scenarios* (pp. 383–392). https://doi.org/10.1007/978-3-319-07668-3_37

Serrador, P., & Pinto, J. K. (2015). Does Agile Work? — A Quantitative Analysis of Agile Project Success. *International Journal of Project Management, 33*(5), 1040–1051. https://doi.org/10.1016/j.ijproman.2015.01.006

Shrivastava, A., Jaggi, I., Katoch, N., Gupta, D., & Gupta, S. (2021). A Systematic Review on Extreme Programming. *Journal of Physics: Conference Series, 1969*(1), 012046. https://doi.org/10.1088/1742-6596/1969/1/012046

Shultz, S. D., & MacArthur, R. (2019). Geographic Information Systems and Rural Data. In *Rural Data, People, and Policy* (pp. 189–204). Routledge. https://doi.org/10.4324/9780429305016-14

Simonofski, A., Ayed, H., Vanderose, B., & Snoeck, M. (2018, August 16). From Traditional to Agile E-Government Service Development: Starting from Practitioners' Challenges. *AMCIS 2018 Proceedings*. https://aisel.aisnet.org/amcis2018/eGovernment/Presentations/6

Stephens, M., Awamleh, R., & Salem, F. (2022). *Agile Government: Emerging Perspectives in Public Management*. World Scientific. https://doi.org/10.1142/12354

Sudrajat, A., & Andhika, L. (2021). Empirical Evidence Governance Innovation in Public Service. *Jurnal Bina Praja, 13*(3), 407–417. https://doi.org/10.21787/jbp.13.2021.407-417

Sugiyono. (2017). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Alfabeta.

Sukarsa, I. M., Piarsa, I. N., & Linggar Sukarta, E. B. (2021). Goal Directed Design Method Application on UI/UX of Dua Mata Mobile Apps. *Scientific Journal of Informatics, 8*(2), 183–193. https://doi.org/10.15294/sji.v8i2.30216

Supriyanto, E. E., Rachmawati, M., & Nugroho, F. J. (2021). Transformative Policies and Infrastructure Strengthening Towards the Police Era 4.0. *Jurnal Bina Praja, 13*(2), 231–243. https://doi.org/10.21787/jbp.13.2021.231-243

Supriyatna, A. (2018). Metode Extreme Programming pada Pembangunan Web Aplikasi Seleksi Peserta Pelatihan Kerja. *Jurnal Teknik Informatika, 11*(1), 1–18. https://doi.org/10.15408/JTI.V11I1.6628

Suryn, W. (Ed.). (2014). Software Quality Engineering: A Practitioner's Approach. Wiley. https://doi.org/10.1002/9781118830208

Thamizhselvi, D., M, M. I. H., Amrith, R. V., & Avudainayaki, R. (2023). Drugex: The Drug Extinctor App. *2023 Intelligent Computing and Control for Engineering and Business Systems (ICCEBS)*, 1–6. https://doi.org/10.1109/ICCEBS58601.2023.10449288

Valles, A. E., & Romero-Alva, V. (2023). Proposal of an Integrated Remote Sensing System for Detection of Drug Trafficking Organizations Operations in Latin America. *74th International Astronautical Congress 2023*.

van Kreveld, M. (2017). Geographic Information Systems. In C. D. Toth, J. O'Rourke, & J. E. Goodman (Eds.), *Handbook of Discrete and Computational Geometry* (3rd ed.). Chapman and Hall/CRC. https://doi.org/10.1201/9781315119601

Varadan, R. J., & Kumar, P. (2015). Mapping Agricultural Vulnerability of Tamil Nadu, India to Climate Change: A Dynamic Approach to Take Forward the Vulnerability Assessment Methodology. *Climatic Change, 129*(1–2), 159–181. https://doi.org/10.1007/s10584-015-1327-0

Ylinen, M. (2021). Incorporating Agile Practices in Public Sector IT Management: A Nudge Toward Adaptive Governance. *Information Polity, 26*(3), 251–271. https://doi.org/10.3233/IP-200269

Yudina, T. N., Bogomolova, A. V., Petuhova, O. V., & Vainshtok, A. P. (2022). GIS-Technologies for Social Investigations. *Lomonosov Geography Journal, 4*. https://vestnik5.geogr.msu.ru/jour/article/view/1042

Zimmermann, D., & Grötzbach, L. (2007). *A Requirement Engineering Approach to User Centered Design* (pp. 360–369). https://doi.org/10.1007/978-3-540-73105-4_40

Zorzetti, M., Signoretti, I., Salerno, L., Marczak, S., & Bastos, R. (2022). Improving Agile Software Development using User-Centered Design and Lean Startup. *Information and Software Technology, 141*, 106718. https://doi.org/10.1016/j.infsof.2021.106718

Zulfa, A., & Pramono, T. (2019). Upaya Badan Narkotika Nasional (BNN) Kota Kediri dalam Menanggulangi Penyalahgunaan Narkoba. *Jurnal Mediasosian: Jurnal Ilmu Sosial Dan Administrasi Negara, 3*(2). https://doi.org/10.30737/mediasosian.v3i2.1359