mHealth-UC CW-Rev3

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Assessing User Experience of Indonesian m-Health PeduliLindungi Mobile-Apps with the User-Centered Cognitive Walkthrough Approach

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***Abstract*— In April 2020, KOMINFO announced the mobile-based e-Health app PeduliLindungi Mobile-Apps (PLMA). The Indonesian government uses this app to track and stop COVID-19. PLMA monitors, warns and stops Covid-19. Residents must use PLMA, downloaded over 10,000,000 times, according to KOMINFO. However, users criticized PLMA for application failures, data breaches, and incorrect user data. On September 29, 2021, 470,521 Play Store users gave it 3.8. The app's PLMA score suggests revision. PLMA addresses navigation, functionality, connectivity and performance challenges, data security, and accessibility. User Experience and User Interface studies of PLMA have yielded disappointing results. This study evaluates the PLMA user experience. User-Centered Cognitive Walkthrough (UC-CW) is a cognitive walkthrough development strategy. To identify learning issues, the evaluator gives mobile app users scenario-based assignments and various questions. This method can study users' cognitive processes when utilizing new systems. Ten PLMA users were studied. Participants completed most tasks, indicating a satisfactory user experience. However, particular difficulties and recommendations have identified possibilities for development, such as adding notification features, updating the start page, enhancing user data security, introducing customizable vaccination timings, and strengthening HP number validation. This study contributes by recommending measuring user experience and encourages application developers and policymakers to focus on the issues that affect the Mobile-Apps m-Health PeduliLindungi application in Indonesia. PLMA can support public health initiatives, especially during the COVID-19 epidemic, by making its health-related platform more user-friendly, efficient, and secure.**

Keywords—user experience, m-health, user-centered cognitive walkthrough, PeduliLindungi apps

I. INTRODUCTION

The Ministry of Communication and Information (KOMINFO) of the Republic of Indonesia launched the e-Health app PeduliLindungi Mobile-Apps (PLMA) in April 2020[1]. The application was made with mobile technology in mind. Its goal is to help the Indonesian government keep an eye on the Covid-19 Pandemic and stop the disease from spreading further. PLMA is used to find Covid-19, keep track of it, let people know about it, and stop it from spreading around the world[2],[3]. The PLMA, which is a digital change, was made by the Indonesian government to stop COVID-19 from spreading in Indonesia. It is set up so that everyone in Indonesia can use it, and it is up to the government to get people to use it. The app is also used to get around in shops, tourist spots, airplanes, and other public places. It is also used to move people by land, sea, and air. Certificates of immunization are also given out to people who want to download the program. The government has several rules or policies about how to use PeduliLindungi, and all government departments in Indonesia are expected to follow them. The application has to be made because a lot of community tracking needs to be done.

PLMA has been downloaded more than ten million times, and KOMINFO has told all people to use it. The sources say that more than ten million people have downloaded it[4]. Based on what you can see above, PeduliLindungi is user-driven. The queue has grown over the past year. Between 4 and 5 million period users (July to December 2020) and 32.85 million period users (July to September 2021) there is room for growth. This line shows that people's faith in PeduliLindungi is growing quickly. These numbers show that people trust the PeduliLindungi app. People know that PeduliLindungi is important during the COVID-19 spread.

But people who used PLMA's apps had problems like application failures, data leaks, and wrong user data. Also, as of September 29, 2021, 470,521 reviews on the Google Play Store gave it a score of 3.8 stars out of 5. The score from the PLMA review shows that the program could use some changes. PLMA also gets comments about the site's bad usability, unclear features, connection and speed problems,

unsafe storage of private information, and inaccessibility[2]. The PLMA sees a number of problems, such as people not trusting the app, the app not being useful in everyday life, and the government not being able to come up with a plan to get people to use the app[1]. In Indonesia, users have given the most comments about the PeduliLindungi app, which has application errors at 52%, data errors at 28%, and data leakage at 20%. The most common topics of conversation are data mistakes, application failures, and data leaks. These errors are caused by user data, which can lead to things like vaccine license data that didn't come out, wrong data on people who might get a vaccine, and mistakes that cause users to miss the train or wait in long lines. The app can't be used because of the mistake[1].

Research investigations on PLMA user experience and user interface are limited. Previous related studies include PeduliLindungi's COVID-19 Treatment Success (Indonesian Case Study)[1], User Satisfaction Analysis of PeduliLindungi App Using EUCS Method[[5], and PeduliLindungi App Users Multinomial Naive Bayes-SMOTE Fine-Grained Sentiment Analysis[6]. Google Play PeduliLindungi sentiment analysis utilizing the Random Forest Algorithm and SMOTE.PeduliLindungi, an Indonesian tracking app, casts light on an integrated model of tracking apps[7], Case Study of Jakarta University Students' Use of the PeduliLindungi App to Prevent COVID-19[8],[9], Factors Influencing Indonesians' Intentions to Use the PeduliLindungi App During COVID-19[10], Sentiment Analysis Machine Learning Comparison PeduliLindungi Applications[11], Binary Sentiment Reviews: Support Vector Machine vs. Naive Bayes Classifier for the PeduliLindungi App[12], Support Vector Machine and Naive Bayes Algorithm-Based Particle Swarm Optimisation Analysis of Google.

The study evaluates PLMA's UX/UI for app users. PLMA I/UX studies are scarce. PLMA user interface and user experience studies include Bianca et al., 2023[13], During the COVID-19 epidemic, the research examined users' perceptions of a program's E-Service Quality. This PLS-SEM study involved 198 Java-Bali PLMA users. Quantitative cross-sectional design. Users liked PeduliLindungi's service quality. User experience (EXP) and faith (TRU) affect PeduliLindungi (ESQ) quality. The PeduliLindungi (ESQ) application's user ratings are unaffected by REL, RES, EOU, PRI, SA, WD, and IQ. Victoria, et al. (2022)[14] studied PeduliLindungi Application User Interface Layout, Control, and Colour Design Components for User Experience. This study explored how PeduliLindungi's interface design affects user experience. Respondents completed Heuristic Evaluation questionnaires on 10 factors to calculate the Severity Rate. Severity Rate measures application damage. The average Severity Rate is 1,298, suggesting a minor issue or design error that does not require application enhancements. Based on UX Honeycomb, Kusuma, et al. (2022)[2] examined PeduliLindungi User Experience Factors. This study uses UX Honeycomb. UX Honeycomb explains UX design with 7 signals and 3 variables: Think, feel, and use (helpful, significant, trustworthy). This study combines raw data from 404 online questionnaires with 15 statements covering all UX Honeycomb variables and five possible answers: strongly disagree, disagree, neutral, agree, or strongly agree. All factors and indicators affect user experience, with Think having the greatest impact at 0.418, Use at 0.219, and Feel at 0.151.

This research aims to evaluate the User Experience of PLMA. User-Centered Cognitive Walkthrough (UC-CW), a development method of Cognitive Walkthrough (CW) is employed. In this method of evaluating user experience, the evaluator provides scenario-based assignments and multiple queries to mobile application users in order to identify issues that impede the learning process. This method is appropriate for newly released systems because it can investigate the cognitive processes of the user when using the system. Ten PLMA users participated in this investigation.

This research contributes to the development of guidelines for evaluating user experience and informs application developers and policymakers to pay greater attention to the factors that influence the user experience of the Mobile-Apps m-Health PeduliLindungi application in Indonesia. By implementing these enhancements, PLMA will be able to provide a more user-friendly, efficient, and secure platform for managing health-related requirements, thereby enhancing its ability to support public health initiatives, particularly in light of the ongoing and ongoing Covid-19 pandemic.

II. Literature Review

A. PeduliLindungi: An Indonesian M-Health Apps for Covid-19 Monitoring System

Indonesia's Ministry of Communication and Information (Kominfo) released PeduliLindungi in April 2020 for the fight against COVID-19. The Indonesian Ministry of Communication and Information (Kominfo) recommends the PeduliLindungi app to everyone[15]. Indonesia's government tracks COVID-19 dissemination through the Google Play Store's Android app. A government-made software that enables tourists to reveal their locations so Indonesian COVID-19 patients may immediately find their contact history. This app facilitates community engagement. The Google Play Cares Protect app is where users discuss this software[16].

Among the previously published research on PLMA is PeduliLindungi's COVID-19 Treatment Success (Indonesian Case Study)[1], EUCS Method User Satisfaction Analysis of the PeduliLindungi App[5], Multinomial Naive Bayes-SMOTE Fine-Grained Sentiment Analysis of the PeduliLindungi App Users[6], PeduliLindungi Data and Software Architecture The process of re Integration and Interoperability Issues[17], Considerations for the PeduliLindungi App User's Purposes, Methods, Resources, and Environment[18], Analysis of pleased Users on PeduliLindungi[19], Analysis of user opinions on Google Play's PeduliLindungi performed with the use of the Random Forest Algorithm and SMOTE[7], The PeduliLindungi App: A Case Study of Its Use by Jakarta University Students to Fight COVID-19[8], Indonesian tracking app PeduliLindungi shows an integrated tracking app model[9], Predictors of PeduliLindungi App Use in Indonesia During COVID-19[10], PeduliLindungi Applications Sentiment Analysis Machine Learning[11], The PeduliLindungi App's Support Vector Machine Classifier vs. Naive Bayes[12], SVM and Naive Bayes Algorithm-Based Particle Swarm Optimisation Analysis of PeduliLindungi Google Play User Reviews[16], and Pedulilindungi's Popularity Increases Due to COVID-19[15].

B. User-Centered Cognitive Walkthrough (UC-CW)

Cognitive Walkthrough (CW) was created by Polson and Lewis as a collaborative approach predicated on cognitive exploratory learning theories or user capacities[20][21]. Scientists have been utilizing CW to simulate the skills required to address user issues and identify system flaws. This is especially crucial for systems and applications that lack extensive background information or enough cognitive support and reaction time.

Experts first analyze the problem at hand to establish the steps a user must take and the system's expected responses before the implementation phase can begin. The group of software architects and coders then performs the processes together and provides an evaluation based on four criteria. We can pinpoint usability issues with each subtask action by answering these targeted questions. Data is collected using standard forms, and attendees receive a report detailing potential session takeaways[20]–[22].

The CW is valuable since it can generate findings more quickly and cheaply than other usability methodologies. Even inexperienced users can use modern CW systems. One more benefit is that the procedure can be used right away, throughout product development[23]. One major drawback is that it takes too long to evaluate the product and that small interface design issues aren't always user-related[25,30,31]. Current CW issues are addressed in this study.

TABLE I. CW APPROACH IMPROVEMENTS IN A SNAP[24]

Components	Description
User input	Targeted users (preferably 5 to 8 per session) have the disease and vary in severity, gender, and computer proficiency.
Supporter of Cross-Domain Cooperation	have a moderator/patient coach throughout the assessment.
Procedure for Creating Work	Validate with a suitable word count. Hold self-specific (including usability) tasks for the disease/disorder while using HLI/Health care panelists to generate long-specific guidelines.
Focus on more challenging tasks	Assess individually and collaboratively. Individual solutions are followed by group discussions.
Evaluation Queries	Two Spencer-adapted step-by-step test questions Add these "call to action" items to the strategy.
Digitally Recorded Information	All CW portions capture data digitally, including the evaluation session.
Coding, sorting, and assessing problems in the same way every time	With Digital Domain Experts and Quality Data Analysis Software, analyze, code, classify, and evaluate digital data collection/recording materials. QDAS data control sheets.

III. METHODOLOGY

The research approach of this study consists of multiple steps: cognitive navigation testing, analysis of test results, and suggestions for enhancing the Android-based mobile application interface.

A. Assessment Technique with Cognitive Walkthrough

The cognitive walkthrough approach for conducting a usability test has two phases: the planning phase and the actual testing phase. Literature review, system analysis, user recruitment, and scenario development are all part of the testing process's preliminary stage of preparation. The implementation phase entails recording problems and walking through solutions (Jacobsen & John, 2000)[25].

B. Respondents

Ten PeduliLindungi Mobile Apps (PLMA) users—general public, academics and students, and businesspeople—participated in this study. Stratified random sampling is utilized. This method samples population strata. The respondents are Play store app users. Android-based mobile app users' knowledge, skills, and frequency are also considered. Nielsen (2012) requires at least five participants in a usability research[26]. This lets researchers identify nearly as many usability issues with more testers. Usability testing with five participants usually approximates the maximum benefit-cost ratio.

C. Task Scenario Designing

The task scenario is a list of things that respondents did when they used the PeduliLindungi Mobile Apps (PLMA) app. Tullis and Albert (2008) say that there should be anywhere from five to sixteen job scenarios[27]. This study uses 15 (fifteen) tasks that are related to the PLMA options. Table 2 shows what the respondent's jobs will be and how they will be done.

TABLE II. TAK SCENARIO DESIGNING FOR USABILITY TESTS

Task Code	Purposes
ST1	Visit the ease of accessing the application
ST2	Sign in to the app account
ST3	Carry out the registration process and complete the completeness of user administration
ST4	Select the type of vaccine and the location of the available vaccinations
ST5	See available vaccination schedules
ST6	Make a booking for vaccinations to be carried out
ST7	Validate the accuracy and completeness of the information in the notifications received
ST8	Validate the user's vaccination history
ST9	Validate vaccination status
ST10	Validate the availability of easily accessible contact information
ST11	Validate the availability of application service information
ST12	Validate the availability of information regarding application policies
ST13	Validate the availability of information regarding application privacy
ST14	Validate availability of app accessibility
ST15	Exit the application

D. Analysis of Usability Test Results

The success of the user is evaluated at this point by looking at metrics like the respondent's accuracy rate, how long it took them to do the task, and how many times they made a mistake. Users' ability to accomplish their intended tasks while navigating the website is directly correlated with its efficiency. Respondents' efficiency is proportional to the effort required to complete tasks and the number of errors they make. This error rate can rank issues in order of severity and assess the difficulty of various work scenarios (George, 2008)[28]. Users of PeduliLindungi Mobile Apps (PLMA) may be able to learn from these findings about the difficulties they have encountered.

E. Identifying the problem and making suggestions for how to fix it

After looking at the findings of the usability test, the PLMA application was used to find out what the interviewees' problems were. For each task scenario,

problems that come up will be given an importance rating and suggestions for how to fix them right away.

IV. Result and Discussion

A. Success Rate in a Few Cases of Taskste

A respondent's task completion level indicates how far along they are in completing that activity[28]. Participants' task scenario completion scores show their success. Scores above 100% imply achievement, while scores below 100% indicate difficulty or failure. Task scenario completion scores show how well participants completed activities using the Indonesian m-Health PeduliLindungi mobile app. Most task scenarios score between 80% and 100%. Overall, participants completed activities and navigated the app. Some task situations scored lower, suggesting possibilities for development. These lower scores may reflect participant difficulty during certain tasks. By analysing various task scenarios and finding prevalent faults, the PeduliLindungi mobile app may be improved to improve user experience and usability.

Percentages of respondents who completed each task scenario are shown. A percentage of 100% suggests all respondents completed the job, while a smaller proportion means some respondents struggled or failed. The Indonesian m-Health PeduliLindungi mobile app's task scenario completion percentages show respondents' success rates. Most responses complete between 90% and 100%. This shows that most participants completed the activities. However, other work situations had slightly lower completion percentages, indicating some respondents had difficulties. These scenarios and responders' challenges can be examined to improve the PeduliLindungi mobile app's user experience.

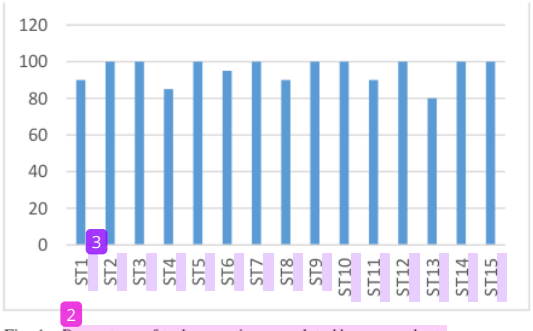

Fig. 1. Percentage of task scenarios completed by respondents

B. How Much Time It Will Take to Finish a Task

Respondent job scenario completion time. Task scenarios are recorded and their completion times are successful or unsuccessful[28]. The task scenario completion time recap shows each respondent's time, the total time, and the average time. Data-driven observations:

1) Respondents' task scenario completion times vary, indicating performance and task difficulty.
2) All work situations have an average completion time of 61.2 seconds, ranging from 25 seconds to 90 seconds.
3) Respondent 1's overall completion time is 834 seconds, whereas Respondent 10's is 1022 seconds.
4) Task complexity and proficiency vary, as task scenario mean completion durations range from 57.6 to 73.8 seconds.

The completion time data can reveal how well respondents use the PeduliLindungi mobile app. It can show where participants struggled or took longer than expected. Examining task situations with lengthier completion times allows you to focus on enhancing the user experience and reducing the app's functionality to minimise completion times and increase efficiency.

The Indonesian m-Health PeduliLindungi mobile app's task scenario completion time recap shows each respondent's time. Task conditions vary, but responders' average completion time is 61.2 seconds. As shown by the 25-to-90-second completion times, respondents performed the tasks differently. The findings also show that some respondents complete tasks faster or slower than others. Analysing completion time data can help improve the PeduliLindungi mobile app's efficiency and user experience by identifying locations where respondents had trouble or took longer.

Fig. 2. Percentage of respondents who completed task scenarios

TABLE III. Recap of Task Scenario Completion Time

	ST1	ST2	ST3	ST4	ST5	ST6	ST7	ST8	ST9	ST10	ST11	ST12	ST13	ST14	ST15	Total (Second)	Average (Second)
R1	75	34	25	75	34	25	75	76	90	25	75	34	76	90	25	834	55.6
R2	78	54	45	78	54	45	78	43	64	45	78	54	43	64	45	868	57.86
R3	67	43	65	67	43	65	67	43	76	65	67	43	43	76	65	895	59.66
R4	56	43	78	56	43	78	56	56	65	78	56	43	56	65	78	907	60.46
R5	35	56	89	35	56	89	35	43	67	89	35	56	43	67	89	884	58.93
R6	39	87	54	39	87	54	39	56	89	54	39	87	56	89	54	923	61.53
R7	36	59	82	36	59	82	36	60	67	82	36	59	60	67	82	903	60.2
R8	89	67	45	89	67	45	89	67	43	45	89	67	67	43	45	957	63.8
R9	45	78	54	45	78	54	45	89	90	54	45	78	89	90	54	988	65.86
R10	56	78	75	56	78	75	56	45	87	75	56	78	45	87	75	1022	55.6
Mean	57.6	59.9	61.2	57.6	59.9	61.2	57.6	57.8	73.8	61.2	57.6	59.9	57.8	73.8	61.2		

Min	35	34	25	35	34	25	35	43	43	25	35	34	43	43	25		
Max	89	87	89	89	87	89	89	89	90	89	89	87	89	90	89		

C. Repair Concerns and Suggestions

Users of PeduliLindungi Mobile Apps (PLMA) have problems when they try to use PeduliLindungi Mobile Apps (PLMA) because of how the completion rate of tasks and error cases are explained. It needs to be fixed because it has so many problems. Table 4 shows the problems and what should be done to fix them. The provided results outline several issues identified in the user interface of the Indonesian m-Health PeduliLindungi mobile app (PLMA) along with corresponding recommendations for enhancement. Here is a summary of the issues and recommendations:

Absence of a contact notification feature for Covid-19 patients. Add a notification function to alert users if they have come into contact with a Covid-19 patient. Integration with current Covid-19 tracking systems would be advantageous. Integrate the PLMA with existing Covid-19 tracking systems in order to access contact tracing data and enable real-time notifications. Priority: Crucial

For Issue: The appearance of the start page hinders access to key features.Recommendation: Redesign the look of the home page to enhance the user experience and optimize navigation so that key features are more accessible. Method of implementation: redesign the home page with user-friendly layouts and intuitive navigation elements. Priority: Center

TABLE IV. ISSUE AND RECOMMENDATION FOR ENHANCING PLMA'S USER INTERFACE

No	Enhancing Recommendations	Implementation Method	Priority
1	Added a notification feature if contact is detected with a Covid-19 patient	Integrate with existing Covid-19 tracking systems	High
2	Improvements to the appearance of the start page for easier access to key features	Redesigned the appearance of the start page and optimized navigation	Middle
3	Improved user data security by using a better encryption system	Perform security audits and redesign encryption systems	High
4	Added a more flexible vaccination time selection feature	Updated the vaccination registration system and added more flexible time options	Middle
5	Improvements to the HP number validation system for account registration	Changing the HP number validation process becomes easier and faster	Low

Insufficient protection of user data due to a deficient encryption system. Recommendation: Increase the security of user data by implementing a more robust encryption system. Conduct security audits to identify vulnerabilities, then redesign the encryption system with more robust protocols and algorithms. Priority: Crucial

Lack of flexibility in selecting vaccination timing. To accommodate user preferences, it is suggested to add a more versatile vaccination time selection feature. Method of Implementation: Modify the vaccination registration system to offer additional options for choosing vaccination time intervals, allowing users to select a time that is convenient for them. Priority: Medium

For Issue: The HP number validation system during account registration is inefficient. Recommendation: Enhance the HP number validation procedure to make it more efficient and user-friendly. Method of Implementation: Simplify and optimize the HP number validation system in order to accelerate the registration procedure. Importance: Low

By addressing these identified issues and implementing the corresponding recommendations, the PeduliLindungi mobile app's user interface can be improved to provide a more comprehensive and user-friendly experience for its users.

V. CONCLUSION

This study aims to assess the User Experience aspect of PeduliLindungi Mobile-Apps (PLMA) using a User-Centered Cognitive Walkthrough (UC-CW) approach. In conclusion, task completion ratings, completion percentages, and issue identification help improve the Indonesian m-Health PeduliLindungi mobile app's user interface. Most participants completed activities, indicating a satisfactory user experience. However, lower task scenario completion scores and percentages show places for development. Notification features, start page design, user data security, vaccination time selection, and HP number validation are among the difficulties and suggestions. These proposals, from high to low priority, emphasise integrating with existing systems, revamping UI elements, completing security audits, and optimising user processes to improve the PeduliLindungi mobile app's usability, efficiency, and security.

The suggested improvements should make the health management mobile app easier to use. A notification feature for Covid-19 contact, improved start page look, and stronger encryption will greatly improve user experience and security. More vaccination timing flexibility and HP number validation simplification would improve user experience. The Indonesian m-Health PeduliLindungi mobile app can empower users to monitor their health and prevent themselves from the COVID-19 epidemic by solving these challenges.

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