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Usability of a Mobile Application for Dengue Fever Reporting by Community Health Workers

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ABSTRACTS

Community health workers hold an important role in health promotion and prevention of dengue fever. In the Jumantik program, the community health workers sought to find any mosquito larvae at the houses and report the findings to the community health centers (Puskesmas). Nevertheless, the reporting process is still paper-based and complex. This study aims to develop a mobile application that facilitates the reporting process to be more user-friendly and practical for community health workers. We used a system framework with the input-process-output scheme in developing this application. A review of the Puskesmas program and interviews with Puskesmas officers and community health workers were performed to obtain input. The application was tested among programmers and users (i.e., community health workers) to understand its usability and applicability. The users were able to input the data, upload photos, and produce the report. We invited about fifty users to test this application. They provided positive responses and were satisfied with the final product of this mobile application. However, they also suggest adding some functions related to the data storage and availability of this application in the Apple store.

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Keywords / Kata Kunci — ***Community Health Worker; Dengue Fever; Jumantik; mobile application; Puskesmas***

1. INTRODUCTION

Dengue is a mosquito-borne infectious disease with a high number of cases all over the world. People infected with the dengue virus can have no symptoms at all or mild flu-like syndrome (dengue fever) to a more severe form, like dengue hemorrhagic fever (DHF) or dengue shock syndrome (DSS). In recent decades, the incidence of DHF has increased dramatically worldwide, as reported by The World Health Organization (WHO) [1], [2]. Indonesia is considered one of the most endemic countries in the world and is reported as the second-highest incidence in Asia [3] [1]. It is predicted that by 2085, half of the global population will be at risk of DHF transmission [4].

Indonesia, located on the equator lines, has a tropical climate that is suitable for the Aedes aegypti mosquitoes to breed [5]. These Aedes mosquitoes are the main vector for dengue fever. The warm temperature and humid weather in Indonesia are very favorable for these mosquitos. Particularly, those living in urban areas have a higher risk of being transmitted with dengue virus since the number of Aedes mosquitoes is significantly higher compared with suburban and rural areas [6]. Jakarta, the main urban area in Indonesia, is well-known for its high number of

DHF cases every year. The Health District Office in Jakarta includes DHF as top ten diseases and reminds the community health center (Puskesmas) to be alert for DHF cases, especially during the rainy season [7].

There are numerous strategies to reduce the number of DHF cases and it is primarily dependent on the control of Aedes mosquitoes [8], [9]. The Government of Indonesia has made various efforts to control the disease, for instance by establishing the campaign for mosquito nest eradication (Pemberantasan Sarang Nyamuk), providing mosquito fogging services, and empowering community health workers to monitor and report the presence of mosquito larvae at resident houses. The community health workers who focus on these mosquito larvae monitoring are called "Jumantik" (Gubler, 1998) [12]. All of these strategies have been regulated in the Regulation of the Minister of Health of the Republic of Indonesia Number 374/Menkes/Per/III/2010 on Vector Control [13]. Eradicating mosquito larvae is considered to be highly effective in breaking the chain of DHF transmission [14]. Nevertheless, these strategies are not a stand-alone program. Participation from the community is important to make the strategies successful.

The government has launched a mosquito larva monitoring program more than ten years ago. This program so-called program for larva monitoring or the short "Jumantik" in the Indonesian language, involves community health workers to monitor and report routine inspections of mosquito larvae in residential areas [12]. The community health workers are known as "Jumantik". They visit residents' houses every week to monitor whether there are mosquito larvae in their water containers. These Jumantik will then report the findings to their coordinator, who eventually reports to the community health centers (Puskesmas). However, all processes are still manual and use paper. This is very time-consuming and inefficient. Community health workers require time to keep the record and report to Puskesmas. In addition, the Puskesmas is unable to update the data in real-time, and this will slow down the prevention strategies that might be required in areas with high mosquito larvae rates [15].

To improve the efficiency of DHF reporting, a mobile application for community health workers is developed to allow them to send weekly reports to the community health center without using the manual form. The use of mobile phones is increasing worldwide, and also in Indonesia. About 5.07 billion mobile phone users globally in 2019, increased nearly 10% in two years [16]. In Indonesia, the number of mobile users reached even higher than the total population of Indonesia, i.e. 355.5 million users [17], [18]. Numerous medical apps are available to cater to the needs of healthcare professionals. For instance, apps to remind patients with chronic diseases to control [19]–[21], and applications to help clinic accreditation [22], [23]. Currently, the use of medical apps is commonly used for information management, communication and consultation, patient management and monitoring, medical education, and training [24], [25]. Nevertheless, the use of mobile apps to track breeding places has not been widely used. The existing application has not been widely available to involve community health workers (Suranto, 2017; Idriani et al., 2019). While community health workers have an important role in tracking and reporting DHF cases in the community, therefore, this mobile app is developed to transform the reporting process to be more user-friendly, compared to a manual system.

2. RESEARCH METHODOLOGY

2.1. Study design

The study was carried out in three stages using the input-process-output framework. In the first stage, i.e. data collection, we obtained the data from primary and secondary sources. In-depth interviews with Puskesmas coordinators, jumantik coordinators, and jumantik were conducted. We asked questions about the program implementation, reporting form, and reporting process.

While secondary sources were obtained from a literature review and policies/regulations related to Jumantik programs. This information will be used as a basis to develop the form in the mobile application. In the 2nd stage, i.e. process, we had a discussion with programmers to develop the application and test the applications among them. In the final stage, the output, i.e. mobile application, was tested among community health workers to understand the feasibility and applicability of this application.

2.2. Location and time of research

We began to collect the data in November 2018 and managed to develop the prototype of the application in March 2019. The mobile application was then finalized and tested in August 2019. Testing the application was done at a community health center in Jakarta, Indonesia.

2.3. Study subjects

In the first stage, we interviewed the Puskesmas coordinator who was in charge of the Jumantik program, and the Jumantik coordinator. Additionally, we held a focus group discussion with twelve Jumantik members. The Jakarta city is divided into several municipalities (kotamadya), which are then divided into several districts (kecamatan), and sub-districts (kelurahan). Each sub-district is divided into smaller neighborhood units, namely

"Rukun Warga" or "RW". One RW consists of three to a maximum of ten sub-villages (RT), and one RT usually has about 10-50 families. Each jumantik is usually responsible for monitoring conditions in one RT.

In the second stage, the mobile application was tested among programmers to identify any problems that might hamper the functionality of this application. We asked five programmers who were purposively selected to test this application. These programmers were selected because of their experience in developing health-related mobile applications.

At the final stage, we asked Jumantik members to test the usability and function of this mobile application. We sent an invitation via the Puskesmas coordinator to invite all Jumantik members to the Senen subdistrict, Central Jakarta. We selected this area because previously it had a high number of DHF cases and the jumantik members were considered very eager and active. We disseminated a paper-based survey to obtain their response on the usability of this application.

2.4. Software development

Initially, the prototype of this application was developed based on the reporting format of the "Knock the Door with Heart Service (KPLDH)" program. KPLDH is a health service program initiated by a former governor, i.e., Basuki Tjahaja Purnama, who adopted a door-to-door system to provide closer access to health services to the community. This KPLDH program also involves community health workers doing house inspections in searching for larva mosquitoes and waste management. Oftentimes, the community health workers involved in one activity in Puskesmas will also be involved in other activities. Therefore, those who participated in the KPLDH program also became part of the Jumantik program. After discussing with Jumantik members, we were aware that the KPLDH reporting format was too complicated and not easy to fill. We then revised this prototype as suggested by Jumantik members based on the result of the focus group discussion.

2.5. Evaluation of mobile application

The International Organization for Standardization (IOS) defines usability as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use" [28], [29]. Using this definition as a basis, we developed two questionnaires, one for programmers and the other for the users. The questionnaire for programmers includes the scoring on the application display, functionality, and the system flow. Likert scale (from scale 1 to 4) was applied to measure the usability, scale 1 refers to the lowest and scale 4 to the highest.

For the end-user, i.e., jumantik, we asked about users' experience with using the features and their satisfaction with a mobile application. The usability attributes measured in the evaluation include attractiveness, effectiveness, ease of use, independence, information clarity, and satisfaction. Jumantik was asked to respond with a 4-point Likert scale (1 = poorest; 4 = best). The respondents gave their level of agreement and satisfaction in the survey. Data were analyzed descriptively to measure the mean and standard deviation.

3. RESULTS AND DISCUSSION

3.1. Development of the Prototype Specifications

The Jumantik program is a health service program held regularly every week by community health workers to inspect residents' houses for the existence of mosquito larvae [12]. Interviews were performed with one Puskesmas coordinator and one Jumantik coordinator. In addition, focus group discussions were held among twelve Jumantik. The result showed that Jumantik members experienced various problems related to the reporting form and verification of house visits. Before this application was developed, jumantik needed to fill in the reporting form manually in papers. In addition, no evidence shows that Jumantik has visited the resident's house. There was no control nor monitoring by the Puskesmas to verify this data. To overcome this problem, we incorporated the geographical information system (GIS) into the mobile application. Therefore, jumantik can take a picture of their house visit and report it through this mobile application.

After developing the prototype, we asked for input from Puskesmas staff, especially those who were in charge of the KPLDH program. They mentioned that no mobile application exists to help the community health workers in reporting the Jumantik program and Posyandu activities. To follow up, our team also had interviews with the community health workers. The community health workers complained about the visit verification and report development. They also asked for formal identification as community health workers or Jumantik members since the residents often ask for verification. They suggested an additional feature to be able to take pictures as proof of visiting the resident's house. This is important to verify their visits to the Puskesmas coordinator.

3.2. The flow of the system

The system flowchart was developed for the users, i.e., *jumantik*, and also the program leader. In this case, the program leader is the *Jumantik* coordinator of the subdistrict. The system can also be accessed by the Puskesmas coordinator to monitor the *Jumantik* activities. The system flowchart for *Jumantik* members allows them to input

the data in the application. The system for the program leader enables him/her to monitor the data inputted by *Jumantik* members.

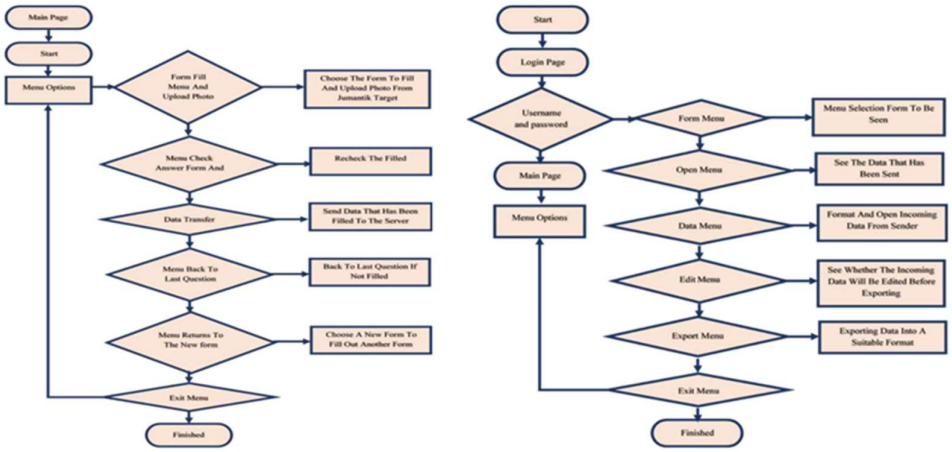

FIG 1. System Flowchart by Jumantik Cadre

3.3 Menu in the mobile application

The mobile application can be accessed in the Google Play Store with the title "healthpoint". The language used in this application is Indonesian because it is intended for jumantik who may not be familiar with English. There are two main features and three features that are being developed. The two main features were features in the mobile application that can be implemented directly. These include the profile of the user and Jumantik. The "Jumantik*"* menu allows Jumantik members to keep a record of their activities when visiting houses. The other features that are being developed in this application, namely 1) data per house; 2) Posyandu; and 3) Kader Super. Data per house allows Jumantik to monitor activities in the families under his/her supervision. The "Posyandu" menu aims to digitally record Jumantik's activities for Posyandu. Meanwhile "Kader Super" menu is a feature that will be developed to improve jumantik members' participation in all Puskesmas activities by providing certain benefits.

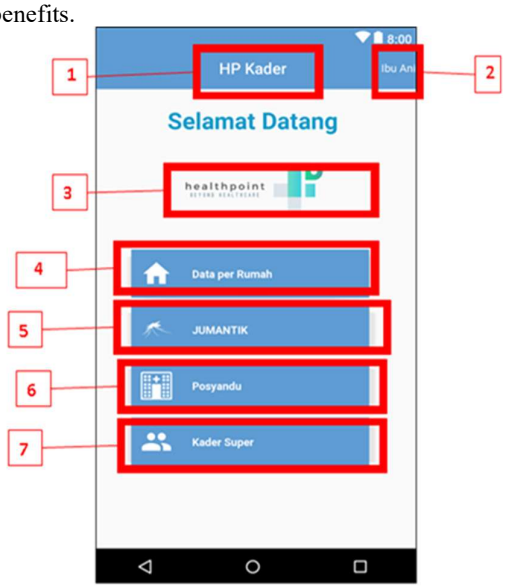

FIG 2. Dashboard of Healthpoint
Dashboard Of Healthpoint
Note: 1) HP Kader: The User Of This HP Application Is "Kader"; 2) Name Of Kader; 3) Name Of Application; 4) Data Per House; 5) Jumantik; 6) Posyandu; 7) Kader Super

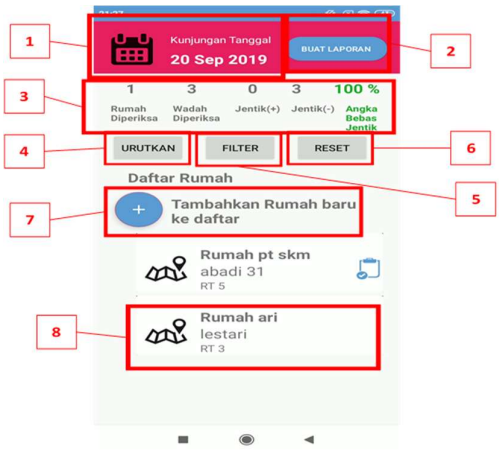

FIG 3. Homepage of Jumantik menu
Dashboard Of Healthpoint
Note: 1) date visit; 2) button to develop report; 3) monitoring report consists of some inspected houses, number of inspected containers, number of water containers inhabited by mosquito larvae, number of water containers without mosquito larvae, and the percentage of mosquito larvae-free containers; 4) button to sort the list of houses; 5) button to filter the list of houses; 6) button to reset; 7) button to add a new house to the list; and 8) the list of inspected houses

To assist Jumantik's activities, jumantik can fill in and report their new visit to the resident's house. They can enter the date of visit, the number of houses inspected, the number of water containers examined, the number of water containers that are inhabited by the mosquito larvae, the number of water containers that do not have mosquito larvae, and the percentage of water containers that free of mosquito larvae. The dashboard will present the results of home visits as indicators of the Jumantik program.

The community health workers can also find the houses that had been registered in the application using the features "sort", "filter", and "reset". The "sort" feature aims to sort the list of houses based on certain criteria. For instance, we can sort the data based on the first name of the head of the family from the letter A to Z. The "filter" feature is used to filter the list of houses to preview houses based on certain criteria. For example, if we filter using criteria for those residing in RT1, then the filter feature will show only houses in RT1. If we would like to reset the appearance, we can use the "reset" button. To add the observation results of houses, the community health workers can click the "add new house" button. The user will then go to the "adding house" page.

After they finish filling out the form, they can click the "developing the reporting form" button. The application would automatically create the reporting form in PDF format. This reporting form can be printed out and sent to the Jumantik coordinator as proof of their weekly report. Jumantik can add their signature to complete this report.

The users, referring to jumantik members, can upload photos under the subtitles "foto pemantauan" (monitoring) and "foto pemberantasan" (eradication). Monitoring photos will be used as evidence of house visits of Jumantik members. The eradication photo is evidence of mosquito larvae eradication activities by Jumantik members. These photos served as important findings to the Puskesmas and can be used as a basis to do interventions in the community.

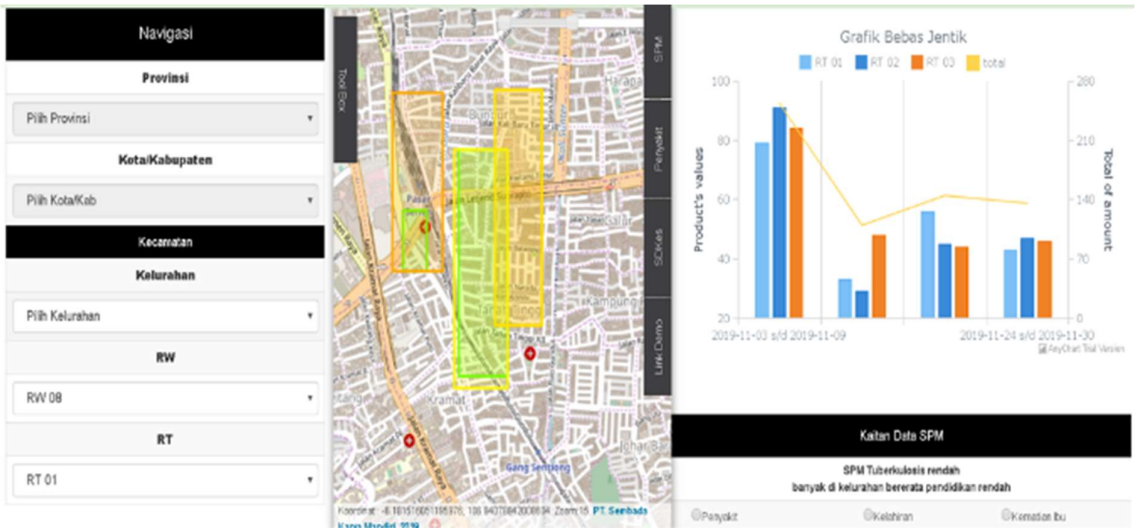

FIG 4. Mapping of mosquito larva-free area

Each Jumantik member can upload the data of mosquito larva-free areas based on the house visits. The application will do the mapping of mosquito larva-free areas. The program leader will be able to access this data using a website application that is connected to this mobile application. Only the program leader (i.e., Jumantik coordinator) and Puskesmas coordinator can obtain these data. They will be used as a basis to develop intervention activities that target the area with a high rate of mosquito larvae. These targeted interventions will improve the effectiveness and efficiency of the public health programs by Puskesmas. Moreover, the Puskesmas coordinator would be able to monitor the activities of Jumantik and check whether they proactively do house inspections or not.

3.4 Evaluation results from programmers

During the evaluation, the programmers tested the flow of mobile applications. In general, they could follow the instructions in the mobile application. The front display is quite attractive, while the main features, i.e., Jumantik and Posyandu function well. All programmers provided good to very good grades in every component. In terms of flow and system content, 3 out of 5 respondents (60%) gave good value and the rest (40%) gave very good grades. As for general functions, 80% (4 out of 5) gave good value and one person provided a very good grade. We also asked for further inputs to improve the function of the application. The programmers suggested adding more capacity to keep the photos, more buttons to upload the photos, and caption columns to provide information on the photos

3.5. Evaluation result from users (Jumantik)

We conducted a workshop to introduce the mobile application to Jumantik. We invited them to the Puskesmas. About fifty Jumantik members participated in the workshop.

The research team explained the function and features of this mobile application. All invited Jumantik members filled in the questionnaire. We asked about the feasibility of this application. The questionnaire used the Likert scale (from 1 to 5) to ask respondents' satisfaction with the functions and features of this mobile application. Zero means strongly disagree and five means strongly agree with the statement.

Additionally, we asked about the technical difficulties in using this mobile application. Some participants were unfamiliar with the terms used in the registration menu and some had difficulties in uploading photos through this application. Participants also had suggestions to add a button if they needed to cancel the uploading process. A few participants requested to have this application available in the Apple store to reach out to those using iPhones. They also asked to add another feature to check the validity of the document and an additional column in which the users can add some information. Although this application has its drawbacks, all respondents agree that this application will help Jumantik programs.

TABLE 1. Result of Respondent's Evaluation

Attribute	Question	Mean score
Attractiveness	Front display of application	3,96
Easy to use	Easy to register for the application	3,76
	Easy to understand definition of each column and button function	3,92
	Easy to upload a document	3,94
	Easy to upload photos	3,94
Effectiveness	This application can improve the performance of *Jumantik*	3,96
	This application can increase the local potential to achieve the target of the *Jumantik* program	3,96
Independence	This application can encourage us to be independent in implementing the *Jumantik* program	3,96
	We could use this application independently (without help from UI)	3,88
Information clarity	Understanding of application manual book	3,90
	UI team provides clear information about this application	3,96
Satisfaction	Satisfaction level for application	4,0

This application is developed specifically to cater to the needs of Jumantik. By using this application, jumantik can report their output to the Jumantik coordinator independently. However, we are also aware that there are some shortcomings in this application. First, the application focuses only on the reporting of mosquito larvae, not yet measuring the success of Jumantik programs. The main activity of Jumantik is inspecting the mosquito larvae in the water containers at residents' houses. Nevertheless, this is not the only parameter to measure the effectiveness of the Jumantik program. The active participation of Jumantik members and the coverage of house inspection have not been included in this application. Second, this application does not have the function to check if the users have uploaded the correct document accordingly. The Jumantik coordinator should be able to monitor the report sent by Jumantik members and check whether the document is in line with the requirement by Puskesmas. Third, this application is still premature and merely available on the Google Play Store. Therefore, it may not reach those with iPhone users.

4. CONCLUSIONS

The Healthpoint mobile application helps the community health workers in developing the report of the Jumantik program. The application has been proven to be used by community health workers in uploading photos and producing reports. Positive responses from Jumantik were obtained, additionally, they recommended this application to their peers.

ETHICAL APPROVAL

The Ethical Committee of Medicine, University of Indonesia approved this study with the ethical approval number KET – 509/ UN2·F1/ETIK/PPM.00.02/2022 and protocol number 22-05-0596

AUTHOR CONTRIBUTION

Agus Sugiharto and Levina Chandra Khoe compile the ideas presented, develop theories, analyze, and write articles. Agus Sugiharto leads the project. Dani Muhamad Trianto, Muhammad Aji Muharrom, and Reza Haryo Yudanto led the design process with the IT team. All authors discuss the results and contribute to the final manuscript.

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