Enhancing Official Statistics Data Dissemination using Google Firebase Platform on Mobile Application: A User-Centered Design Approach

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Abstract. The dissemination of official statistics as publicly available information has been mandated in the United Nations Fundamental Principles of Official Statistics (UNFPOS) to be highly accessible to all users. Recently, with an increasing volume of data and public demand, National Statistical Offices (NSO) including Statistics Indonesia (BPS) are being challenged to provide accurate, excellent-quality, and user-friendly information. In this paper, we introduce our attempts to enhance the official statistics data dissemination by developing an Android-based mobile application using a User-Centered Design (UCD) approach to meet the requirement of specifically targeted users. Google Firebase platform is utilized to improve the administrator-level usability in updating the disseminated information. The proposed mobile application is launched at BPS-Statistics Madiun Municipality, East Java Province called Batu Cadas (an acronym for BAca TUjuh CAtatan DAta Statistik). Further evaluations using Black-Box functionality testing, System Usability Scale, and specific needs comparison conclude that the proposed mobile application is sufficient to cover the gap between user needs and the currently existing applications.

1. Introduction

Providing comprehensive data of official statistics via multiple online platforms has been a primary concern in the statistical processing life cycle. The dissemination platforms are also expected to address the priority needs at different levels of national and regional requirements to reduce the reporting burden. Statistics Indonesia (BPS) has been providing two major online statistical data dissemination platforms, namely the BPS official website and an android application called Allstats-BPS which contains millions of statistical data. However, at the regional level, such as provinces, regencies, and municipalities, customized dissemination platforms are needed to serve the specific needs of targeted users in their respective regions.

Despite the high-quality information architecture of the official BPS website and Allstats-BPS, both are not specifically designed to satisfy the diverse user segment in each particular region. It is because the initial objective is intended for the benefit of national data users. The interests of data users in each region may vary. For instance, contrary to the national-level applications that are mostly accessed by public citizens, the main user of disseminated information of BPS-Statistics Madiun Municipality, East Java Province are local government agencies. Hence, it is important to build a specific data dissemination platform with a design method that involves users to increase user satisfaction towards official statistics information.

In this study, we aim to develop an Android mobile application using the User-Centered Design approach by taking the BPS-Statistics Madiun Municipality as a case study to improve user satisfaction in the region. The User-Centered Design approach has been widely known in recent literature for its ability to guide the development of mobile applications with respect to the user's need. For instance, to build a portal system for a digital campus, the information architecture designed using the UCD approach provides us with a more reasonable information classification and clearer information structure [1]. The UCD approach focuses on the user as the center of application development, hence it can produce a user-friendly system with a high level of usability [2], [3]. The UCD also prioritizes user needs when creating a design hence it will produce a better design with respect to the user needs [4], [5]. Another investigation has been conducted by Fanani and Kusumaningrum, in which they found that the usability of the application build using this UCD approach is at an acceptable level [6], [7]. UCD approach can also be used in geospatial applications to enhance performance and also user satisfaction as introduced by Soleman and Sasmito[8], [9].

Additionally, we utilize the Google Firebase platform into Android to increase the usability and easiness of administrators to update the disseminated data. With the Google Firebase platform, the data updating process can be performed directly through the application interface without having to go back and forth to Android Studio. To this end, there is no updating burden in creating new Android Package (APK) updates and upload them to the Google Playstore, which were commonly found in standard Android development platforms.

Google Firebase has also been widely used for developing Android-based applications. Android application MCCApp is able to utilize the features provided by Firebase to show its usage as the best Mobile Backend-as-a-service [10]. Firebase technology is also commonly utilized to support the features contained in a digitalized jersey design ordering application system [11]. Google Firebase can handle the backend of the communication operation, highlighting the various features of both the operating system and the service, hence it is very powerful to support real-time applications [12]–[14]. Another advantage offered by Google Firebase is that the database stores data locally when a device is not connected to the internet [15]. Such an advantage is in line with government regulations that require government agencies to provide cheap, affordable, and easily accessible services [16]. Firebase also supports geospatial apps [17] and monitoring [18]. Some existing studies have been using Firebase technology to provide push notification [19] and to support preventing traffic accidents [20].

The development process of the proposed mobile application, called Batu Cadas (an acronym for BAca TUjuh CAtatan DAta Statistik), provides the potential benefit for other local and regional levels of BPS Statistics Indonesia to enhance the official statistics data dissemination quality which is easily updated at any time and improve the user satisfaction of their respective user needs.

2. Research Framework

The research framework in this study can be briefly described in **Figure 1**. With the existing issues in current data dissemination applications and the available opportunities, we develop a new online statistical data dissemination application using the UCD approach.
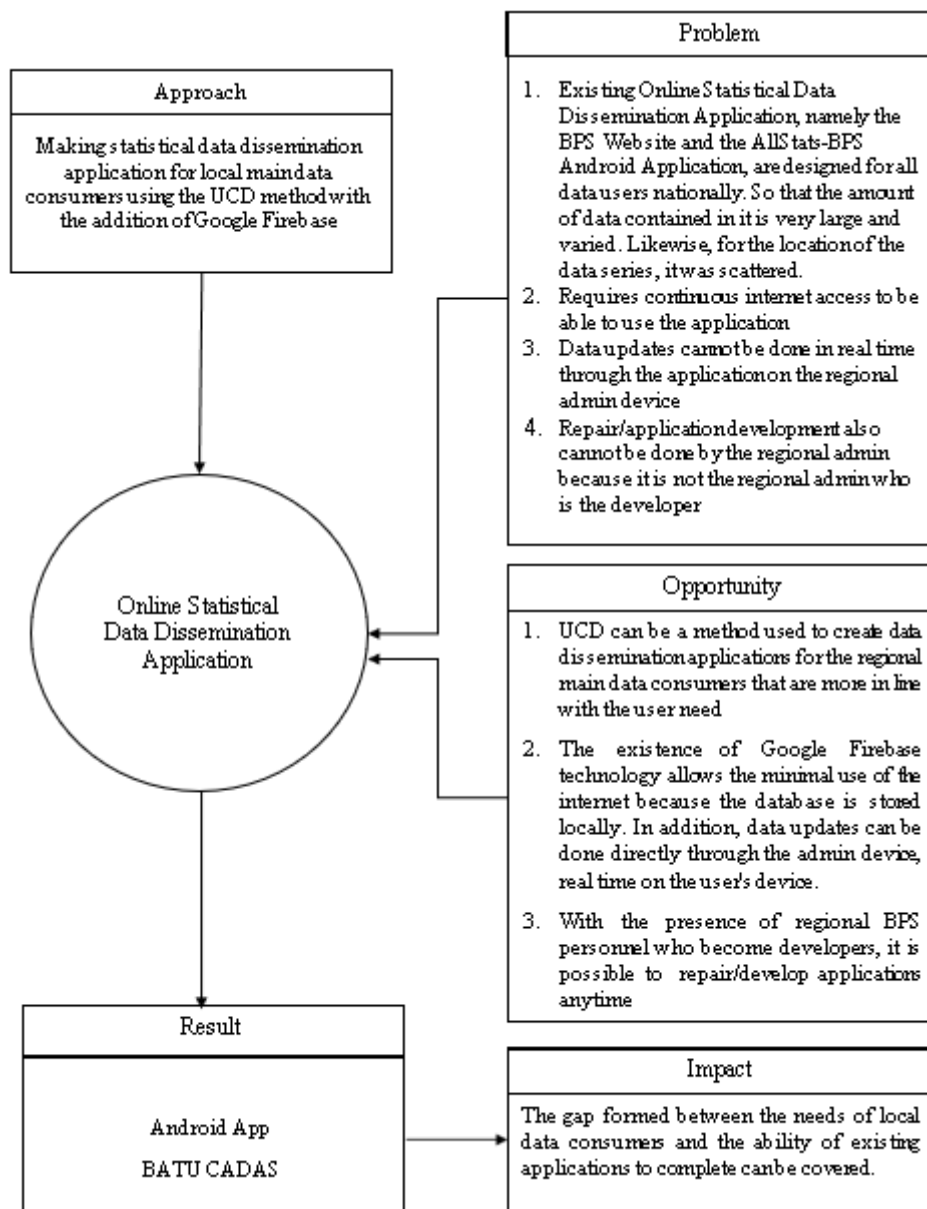
Figure 1. Research Framework

3. Methodology

Application design is carried out using the User-Centered Design (UCD) approach [5] as illustrated in **Figure 2**, where we build an application not only because we want to create, but indeed based on the requirements and needs of the user for the application. Besides UCD, there is also a design method with the Human-Centered Design (HCD) approach. For ordinary people, the two are often considered the same. The significant difference between the two is that HCD is a design method with an approach that tends to be open to all users while UCD has a focus on specific users. Because the purpose of making this application is to meet the specific needs of users, we use the UCD approach.
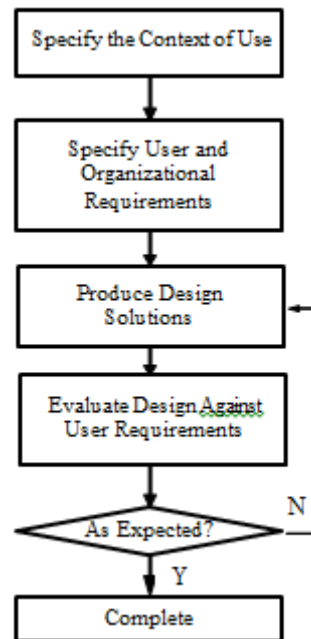
Figure 2. User Centered Design Method

Step-by-step processes:

1. The first step, Specify the Context of Use, explains what this application is made for. It can be obtained from interview with the Subject Matter, to make sure the specific target user for the application.

2. The second step, Specify User and Organizational Requirements, analyzes application requirements from the user side. Looking for gaps between user requirements and existing applications. Tools which can be used is questionnaire in form of hardcopy or online document like Google Form.

3. The third step, Produce Design Solutions, builds a design as a solution to the user needs identified in the previous two steps, which have not been met by existing applications. The design will be build using Android Studio with the addition of Google Firebase.

4. The fourth step, Evaluate Design Against User Requirements, sees whether the application created has been able to cover the gap formed from existing applications versus user needs. The process involved some of potential users. If the results is not as expected then return to step three. If it is, then complete.

3.1. Android Studio

Android Studio is an IDE (Integrated Development Environment) for android application development, this application was published by Google on 16 May 2013 and is available for free under the Apache 2.0 license, this Android studio replaces the previous android development software, Eclipse [21].

3.2. Google Firebase

Firebase is a BaaS (Backend as a Service) currently owned by Google. Firebase was first founded in 2011 by Andrew Lee and James Tamplin. The product that was first developed was the Realtime Database, where developers can store and synchronize data to multiple users. Then developed into an application development service provider. In October 2014, the company was acquired by Google [11].

4. Result

We will describe step by step processes from the methodology and it's implementation as follows:

4.1. Specify the Context of Use

According to the interview with the Subject Matter, the main common users of this application are the local government agencies. The admin should be from BPS-Statistics of Madiun Municipality personal.

4.2. Specify User and Organizational Requirements

Respondents who were interviewed and given a questionnaire in this Specify User and Organizational Requirements process were selected from representatives of local government ranks. The questionnaire were given used Google Form. From the results of the interviews and the distribution of the questionnaire, seven main data were identified that were of the most interest, namely: Population, Open Unemployment Rate, Human Development Index, Poverty Percentage, Economic Growth, Literacy Rate and Life Expectancy Rate. Their demand is that the data should be available in series, up to date, and easily searchable.

Admin from BPS-Statistics of Madiun Municipality demand that the admin should be easy in update either adding, changing or deleting data. Straight from the application user interface.

4.3. Produce Design Solutions

Based on the result of the previous two processes above, this simple application design was made. An android application that contains the seven data series, plus a feature called OLAH DATA which is specifically made for admin to update either adding, changing or deleting data.

In this application, the data is displayed in the form of tables and series from several years back until now. This application has gone through a series of tests on each of its features and all of these features work well. This application has been uploaded to the Google Playstore under the name Batu Cadas (an acronym for BAca TUjuh CAtatan DAta Statistik) and socialization of its use to data users has been carried out both through media coverage and during meetings with local government officials.

The Android-Firebase application system architecture in this Batu Cadas Application can be described in **Figure 3** as follows:

Figure 3. Application System Architecture

One of the advantages of Google Firebase is that it stores its database locally when not connected to the internet, so users don't have to always be connected to the internet to be able to use the application. Contrary to the BPS Website and BPS Allstat. Both of these statistical data dissemination facilities require internet access before users can use their features.

Users of this application are divided into general users and admins. The main menu structure of the Batu Cadas application is described in **Figure 4**, as follows:
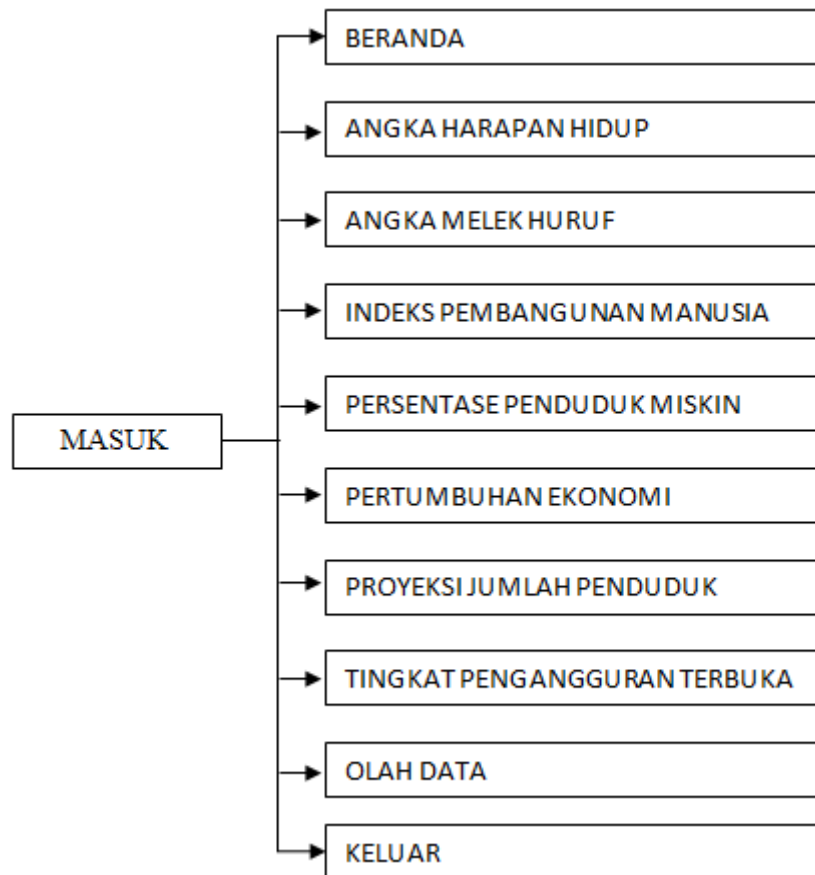
Figure 4. Main Menu Structure of BATU CADAS

The login page with the obligation to enter a username and password, is only displayed when general users access the OLAH DATA menu. To access menus other than OLAH DATA, users do not need to log in with a specific username and password. The goal is to streamline the user's process of obtaining the desired data.

The OLAH DATA menu is used to update data, be it adding, changing or deleting data. Data updates made by the admin will be immediately visible on the user's device after synchronize process through internet (one time only).

The followings are some screenshots of the Batu Cadas application:
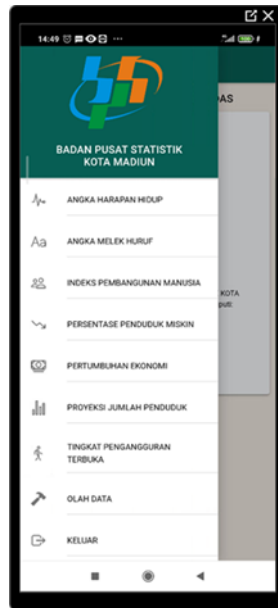
Figure 5. Home Page View

Figure 6. Slider Left View

Figure 7. Example of Statistical Data Series

Figure 5 illustrates the Home Page View when we open Batu Cadas application in first time. If the user clicks on the icon on the top left, a slider left will appear as shown in **Figure 6**, which contains 10 menus like the structure in **Figure 4**.

Users can directly choose what data they want to get. With one click, the application will display the selected data series starting in 2010, except for statistical data that are only produced after 2010. **Figure 7** illustrates an example of statistical data series. To return to the Home Page View, simply click the icon on the top left, then the slider left will reappear to provide another menu options, as in **Figure 6**.
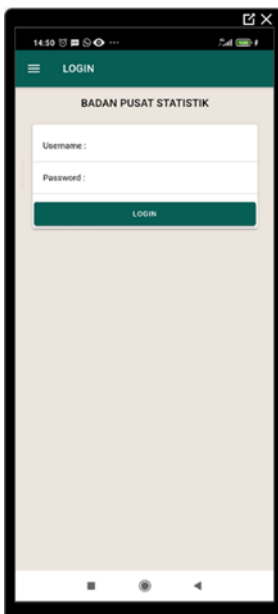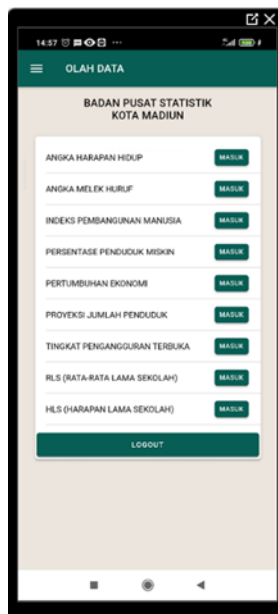

Figure 8. Olah Data Login Page View
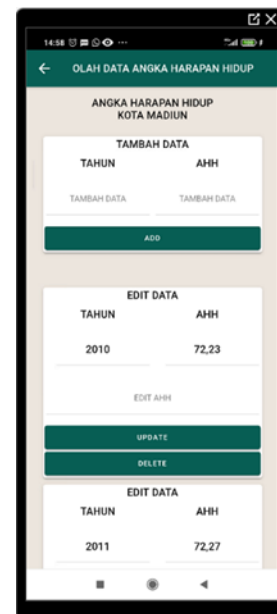
Figure 9. Olah Data Page View

Figure 10. Example of Updating Page View

If the user selects the Olah Data menu, Login Page View of Olah Data Menu will appear as shown in **Figure 8**. When user enters the correct username and password succesfully, it will be considered as an admin-level user, and can enter the interface page to update data as shown in **Figure 9**. Admin-level user can add, update and delete the data as shown in **Figure 10**.

4.4. Evaluate Design Against User Requirements

We perform functional Black-Box testing and System Usability Scale (SUS) testing. The Black-Box testing in this application was performed by evaluating 13 scenarios of events carried out by researchers. The test results showed that all the scenarios tested were as expected. The SUS test was conducted on 20 participants from local government agencies as the main ordinary users and 2 participants from BPS-Statistics Madiun Municipality as the administrator users. Based on the test results, an average score of 100 % was obtained, which means all menu in the application has been well functioned as shown in **Table 1**.

Table 1. The results of Functionality Testing using Black-Box Testing

Test Scenario	User Role	Result
Show series table from Menu ANGKA HARAPAN HIDUP	Common and Admin User	Success
Show series table from Menu ANGKA MELEK HURUF	Common and Admin User	Success
Show series table from Menu INDEKS PEMBANGUNAN MANUSIA	Common and Admin User	Success
Show series table from Menu PERSENTASE PENDUDUK MISKIN	Common and Admin User	Success
Show series table from Menu PERTUMBUHAN EKONOMI	Common and Admin User	Success
Show series table from Menu PROYEKSI JUMLAH PENDUDUK	Common and Admin User	Success
Show series table from Menu TINGKAT PENGANGGURAN TERBUKA	Common and Admin User	Success
Show the Login Page from Menu OLAH DATA	Admin User	Success
Validate the correct username and password	Admin User	Success
Adding Data	Admin User	Success
Delete Data	Admin User	Success
Edit Data	Admin User	Success
Exit Button Function	Common and Admin User	Success

The issue of specific user needs that have not been met by the BPS Website and the Allstats-BPS mobile application, which was extracted from interviews with users in the early stages of development of this application, was finally resolved through the Batu Cadas application, as described in the **Table 2.**

Table 2. Comparison between Allstats-BPS Mobile Application, Website and Batu Cadas Android Application in Answering the Issue of Specific Needs of Data Users in Madiun Municipality.

No	Issues	Allstats BPS	Website	Batu Cadas Android Apps
1	Number of Data	Many and vary	Many and vary	Specific, only show what is needed by user
2	Location of Data Series	Scattered	Scattered	It's been sorted into series and grouped in a certain menu
3	Internet Access	Always	Always	Not Always
4	Update Data by Admin	Performed by central admin	Can be done by regional admins, must use a PC or Laptop	Can be done by regional admins, directly through the OLAH DATA menu in the application on the Android device
5	Application Update Requests from users	It took a long time to accommodate because we had to contact the central admin	It took a long time to accommodate because we had to contact the central admin	It can be fulfilled soon because the developer is regional office

5. Conclusion

A specific data dissemination platform to increase user satisfaction towards official statistics information using Google Firebase on Mobile App by User Centered Design Approach at BPS-Statistics of Madiun Municipality has been succesfully built.

Despite the simplicity of the Batu Cadas application, it is currently sufficient to cover the gap between user needs and existing applications.

Batu Cadas has been widely used by Madiun Municipality local government in their daily activity, especially in meetings which need statistical data. They prefer to use Batu Cadas than BPS Website and Allstats BPS, because the data they need most has been sorted into series and grouped in a certain menu. So it can be easier to obtained, even without internet signal. This application also makes it easy for admins to make changes to the data, either adding, editing or deleting.

However, this application still has a limitation as it is not equipped with a magnifier (zoom) feature to adjust to the user's device settings. In addition, there are many chance for improvements to further develop of this application. Future enhancements that can be done include the integration with the BPS website so that updates made to this application are also simultaneously synchronized with the data on the website, or vice versa. Another future improvement is to integrate this application with speech-to-text technology and or machine learning models. We believe that our application is potentially beneficial to support the quality of data dissemination at BPS-Statistics Indonesia in general.

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