Mobile Application for the Management of Covid-19 Health Measures on Public Transport Lines

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Abstract—The pandemic is currently forcing several countries to take certain restrictions on public transportation to prevent the spread of the virus, Peru is in the aforementioned phase, so many users who continue to use public transportation on a daily basis to get to work, home, supermarkets, among other activities, must stay informed to comply with these requirements. In this context, the mobile application was developed to help the proper management of information of the sanitary measures of the Covid-19 in the area of public transport for the city of Lima, and this is compatible with Android and iOS; likewise, the Mobile-D methodology, helped to make such mobile application and to know the phases to proceed with the implementation, which has an impact on time, information management and user satisfaction. The results of the present document show that the level of user satisfaction increased to 67.5% of a sample of 200 people as the experimental group. It was concluded that the application made it possible to automate the management of information on Covid-19 sanitary measures in the field of public transportation.

Keywords—public transport, mobile application, methodology Mobile-D, information management process

1 Introduction

The crisis unleashed by the epidemic caused by SARS-CoV-2 has several edges [1], since the bewilderment and consternation due to its health aspect generates a fertile ground for an avalanche of information that makes it difficult to discern what is authentic from what is false. Currently in times of crisis due to the Covid-19 pandemic, the contribution of science and technology has been essential to address the various problems and give way to the adoption of new digital solutions [2]–[4], which allow the population to keep informed of the various aspects through the use of tools such as mobile applications [5], with functions that help to progressively reduce the contagion, measuring results and mitigating the pandemic.

In the last decade, mobile applications have positioned themselves as one of the most effective tools for companies, especially in the field of information management. And no wonder, because apps make users' lives easier, promote interconnectivity and improve the experience in the acquisition of products and services. The use of apps has changed the dynamics of the market forever [6], so the implementation of these systems in business models is a fundamental pillar for the growth of any startup.

In recent years, work has been done with Mobile-D [7]–[9], demonstrating the effectiveness of this methodology for the development of mobile applications and the importance of applications for data management according to context [10] and logistic processes, which have been used in different fields such as construction, tourism, logistics, etc., with many satisfactory results. These are of high priority especially to cover needs in our day to day life, having updated information on covid-19 health measures which is of vital importance [11].

In the area of public transport, there are still many gaps to be addressed, such as information management with respect to covid-19 health measures and their restrictions. According to reference [12], the information management process requires a level of flexibility for the parties involved and a willingness to adapt the terms of the information to reflect any changes in circumstances. The use of mobile applications would have great effectiveness and efficiency in carrying out all the required processes [13], [14], as it allows streamlining the information, consultation and news processes; making it possible for users to have it available at any time [15]. The immediacy factor is what is needed in today's world [16].

To this end, we proposed the development of a mobile application for the management of information on Covid-19 sanitary measures in public transport lines in the city of Lima, with the aim of managing the information to be provided, complying with the sanitary measures constantly dictated by the state, with the intention of keeping the citizen informed, also allowing to report any incident or complaint of non-compliance with the Covid-19 safety measures and finally allowing to consult the availability of the bus through the plate, if it is going to transit on a day of total immobilization; given the current situation, a preventive measure is necessary to avoid contagion in public transport.

This research is organized as follows. Section 1 Introduction, section 2 contains a literature review of previous research, its limitations and the impact it has had on end users. Section 3 formulates the methodology to be used and describes its different phases, detailing the development of the application that will finally be implemented. Section 4 is the results phase with respect to the indicators studied. In section 5, the discussions are carried out, where the results obtained are analyzed. Finally, in section 6, there are the conclusions that enhance the proposed objective of the mobile application for the management of the information of the Covid-19 health measures in public transport.

2 Bibliographic study

In this section we conducted a review of the most relevant previous research developed which have used digital technologies for multiple aspects, in this case we chose research related to digital readiness linked to Covid-19 and public transportation.

Research [17], [18] conducted a bibliometric analysis of the preparedness of health care educators in relation to Covid-19, highlighting that the advice on health care, teaching and learning helped teachers to move quickly to the virtuality, helping them to give an effective management to the systems.

Also in the research [19], an application to detect Covid-19 using Back Propagation (BP) classification algorithms and the Fuzzy C-Mean (FCM) clustering algorithm was proposed using classification techniques. This application was intended to help users predict and identify Covid-19 infection through the evaluation of symptoms and tests, estimating an accuracy of 89%.

In article [20], we presented the development of a mobile application as a route finder in Cairo with the objective of making it easier for users to choose the most convenient routes in less time. This application considered the database of the minibus network by implementing the Dijkstra algorithm.

The scientific-analytical research [21] proposed the development of a central transportation platform in Metropolitan Lima, with the objective of evaluating a mass transportation network that could be used as the basis of a metropolitan public system, contributing to reduce urban flows, the poor distribution of public transportation and environmental pollution. After the study, it was identified that due to the different actors in the different entities, the proposed integrated transportation system was not able to cover the demand in its entirety. It was concluded that the construction of Line 2 of the Lima Metro is necessary to achieve the complete integration of the proposed network, managing inter-institutional public transport and generating selection and implementation strategies.

In the article [22], user mobility requirements were identified for the development of an application and web page that provides the visualization of routes, planning and booking of a trip in any means of public transport, through a friendly interface, paying great attention to the level of user acceptance of technological tools connected to the Internet, related to transportation. The importance of collecting the users' opinion on the choice of public transport was also highlighted, being evaluated in a pre-experimental scenario. The results showed that the interface design contributed to improve the users' experience, although many of them showed some apathy towards the use of the tools connected to the network.

Currently in use is a free application called "TuRuta" created by a group of young Peruvian entrepreneurs in a startup [23], which is helping citizens by providing information about public transportation in Lima through a selection of travel routes, in addition to providing directions to stops and how to reach the indicated destination in less time, having a great acceptance by citizens with more than 500 thousand downloads [24].

3 Methodology

In this section we proceeded to investigate the development methodologies, opting for the Mobile-D methodology that provides us with an agile methodology for software development, posing as an immediate solution, ensuring the execution of projects in a short time [25], with the aim that software development teams work efficiently and quickly, very directed to the documentation that is generated after each of the activities developed.

Mobile-D is a method that consists of known solutions and ensures the right software at the right time, constant communication between team members; it consists of different phases: exploration, initialization, production, stabilization and testing phase; in each phase there is a set and determined day for the delivery of the assigned tasks, once the phases are completed they are ready to be public and delivered to the customer [26], [27].

The design of this study was pre-experimental with the objective of controlling the inventory process in the pre-test and post-test modes of operation.

3.1 Phase 1 – exploration

In this activity, the parties involved and interested in the project (Public Transportation Management Representative, developers and end users) were defined, and their tasks, roles and responsibilities were identified, in order to achieve the implementation of the application called "APPI-TRANS".

Population: The study population of a phenomenon as a whole includes the units of analysis that are found within the phenomenon and that must be quantified for a given comprehensive study. According to the above, it can be concluded that the population is all the people residing in the different districts of the city of Lima, of which 200 inhabitants will be taken for the population as a whole.

3.2 Phase 2 – initialization

Project configuration, for this initially the development team had to adapt to the programming software, for this the working environment of the team was prepared taking into account the physical resources, internal and external responsibility environments, to establish communication with the client and allow the success of the next stage of the program. The following tools were used: Visual CODE IDE, Android Studio Emulator, Figma and Windows 10.

Application architecture is service oriented, which consists of 2 fields: Mobile Application and Host.

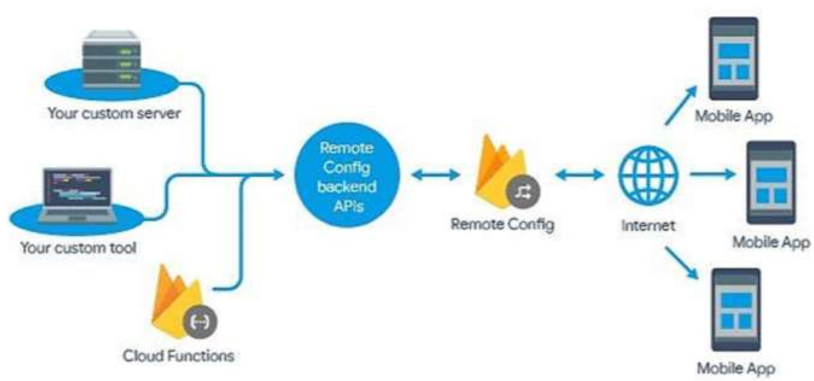


Fig. 1. General architecture of the mobile application

Figure 1 shows the architecture for the APPI-TRANS application, which will be obtained from Google play store, for subsequent installation on a smartphone with Android operating system version 8.0 or higher, in addition the smartphone must be connected to an internet network or mobile data, for subsequent consultation through the app, this will be available for use 24×7.

3.3 Phase 3 – production

The architecture to be used is defined by means of prototypes of the base architecture, and the interaction with the modules presented by the mobile application is also visualized.

Data Model diagram, see Figure 2, which was developed for the query activity following the designed architecture shown in Figure 1.

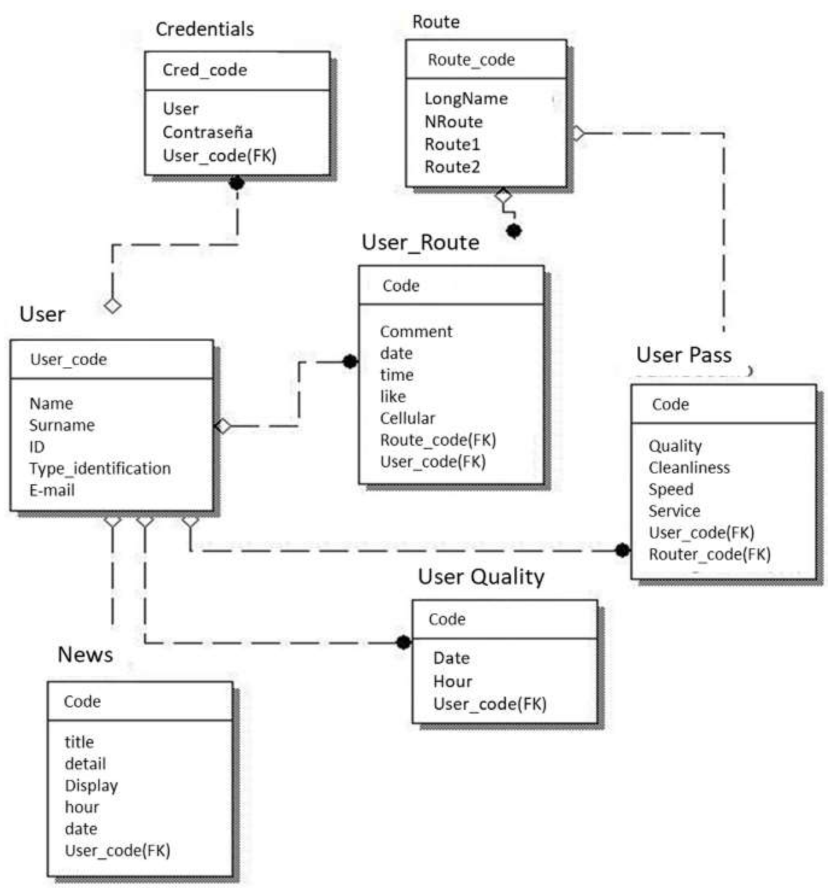
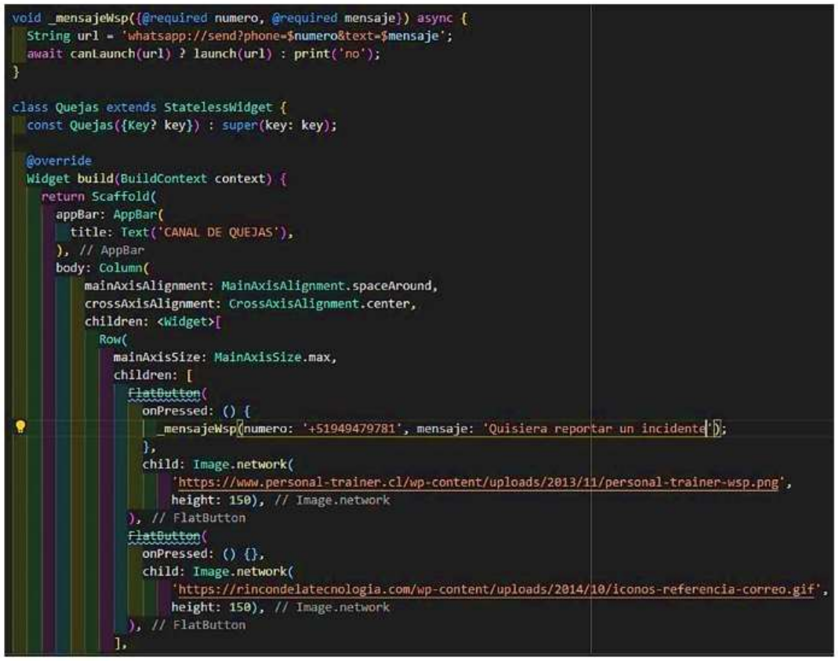


Fig. 2. Database diagram

3.4 Phase 4 – stabilization

This phase details the predecessor tasks of the production phase, integrating the functionalities described above. The system integration is detailed in Figure 3, which was developed in Visual Code to achieve a higher quality for the proposed project.



```
void _mensajeWsp({@required numero, @required mensaje}) async {
  String url = 'whatsapp://send?phone=$numero&text=$mensaje';
  await canLaunch(url) ? launch(url) : print('no');
}

class Quejas extends StatelessWidget {
  const Quejas({Key? key}) : super(key: key);

  @override
  Widget build(BuildContext context) {
    return Scaffold(
      appBar: AppBar(
        title: Text('CANAL DE QUEJAS'),
      ), // AppBar
      body: Column(
          mainAxisAlignment: MainAxisAlignment.spaceAround,
          crossAxisAlignment: CrossAxisAlignment.center,
          children: <Widget>[
            Row(
              mainAxisSize: MainAxisSize.max,
              children: [
                FlatButton(
                  onPressed: () {
                    _mensajeWsp(numero: '+51949479781', mensaje: 'Quisiera reportar un incidente');
                  },
                  child: Image.network(
                      'https://www.personal-trainer.cl/wp-content/uploads/2013/11/personal-trainer-wsp.png',
                      height: 150), // Image.network
                ), // FlatButton
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                  child: Image.network(
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                      height: 150), // Image.network
                ), // FlatButton
              ],
```

Fig. 3. Source code – main menu

Prototype Exploration, Figure 4 shows the prototype of the main page, with four modules, designed from scratch with Figma.

Fig. 4. Application prototype – main interface

Figure 5a shows the service qualification interfaces, including the route information and a review of the stops. In Figures 5b and c, where the information of the Covid-19 sanitary measures is shown, besides consulting if the vehicle is in conditions to transit in a day of total immobilization; which will arrive as a notification each time it is updated, if it is new, accurate and reliable information for the user's evaluation. In Figure 5d, the option to report an incident or event is shown, it allows to enter the license plate number of the vehicle, finally in Figure 5e, the information of what happened by the user is detailed.

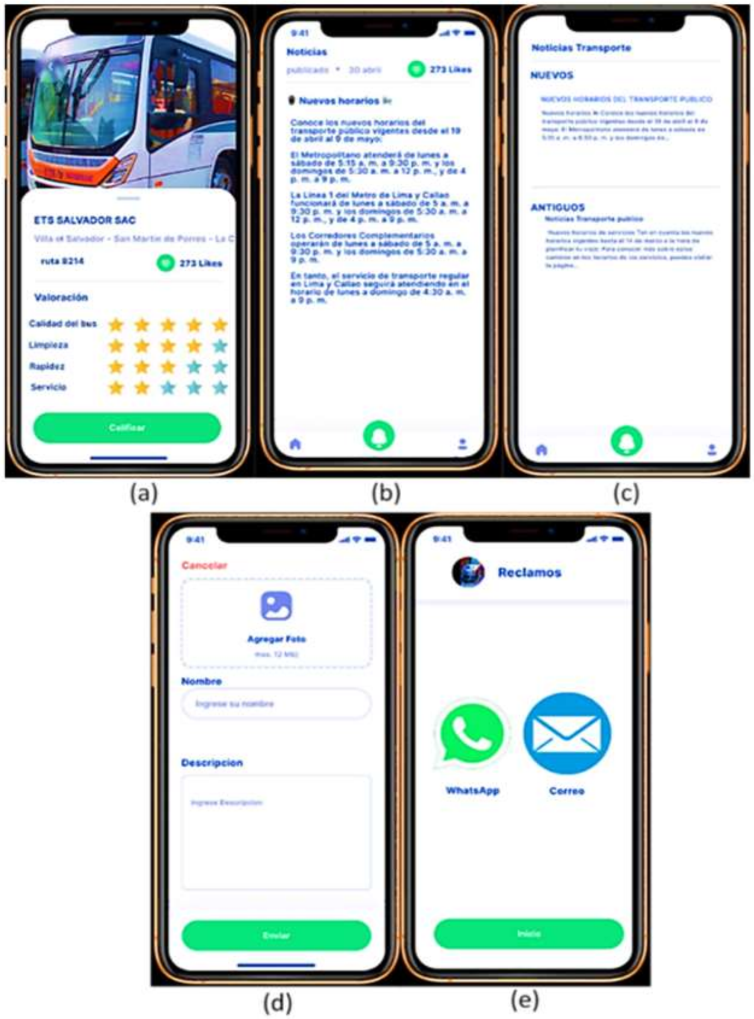


Fig. 5. Application interfaces

3.5 Phase 5 – system testing

In this phase, the validation of the functional requirements of the mobile application was carried out, with the purpose of complying with the functionality for the mobile application in an adequate manner, also it is related to the functional requirements that were raised in the first instance. Once this process was completed, we moved on to the phase of obtaining the results.

4 Results

The purpose of this research was to demonstrate the influence of the mobile application to manage information regarding Covid-19 sanitary measures for public transportation. Two criteria were considered: (1) Efficiency in receiving information, (2) Monthly complaint time, (3) Level of user satisfaction. Surveys collected and results, using the SPSS Version 26 tool.

Table 1. General result of indicator

Indicator	Pre-Test (mean)	Post-Test (mean)
Efficiency in receiving information (KPI 1)	2.26	4.20
Monthly complaint time (KPI 2)	86	5
User satisfaction level (KPI 3)	1.41	3.54

The first criterion measures the level of satisfaction with respect to the receipt of information, the second measures the time in minutes to make a complaint, and finally the third criterion measures the level of general user satisfaction with respect to the use of the Covid-19 mobile application to manage information on health measures.

4.1 Efficiency in receiving information

The first criterion, both in the Pre-test and the Post-test, carried out 4 weeks later, showed a positive difference greater than 50%, validating the importance of managing information.

Figure 6 shows the post-test bar graph of the information reception efficiency indicator.

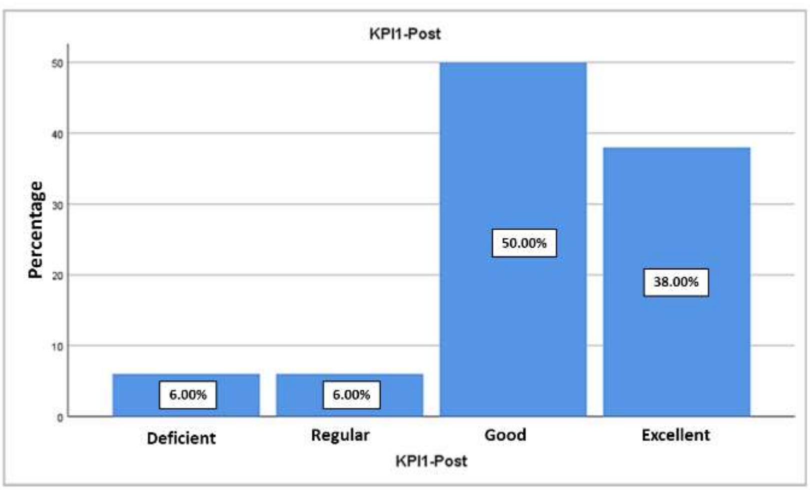
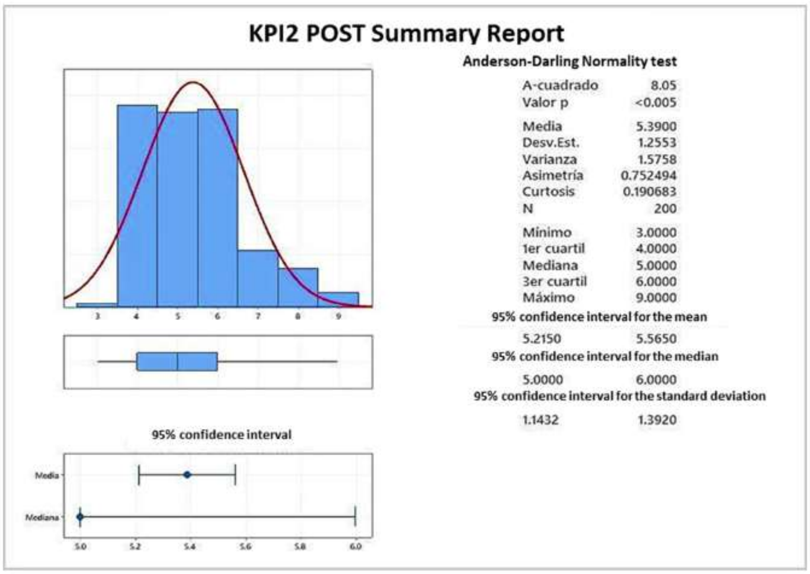


Fig. 6. Bar chart KPI 1 post-test

4.2 Monthly complaint time

The second criterion, with the averages obtained in the data collection for both the Pre-test and the Post-test, can be observed to decrease positively from 86 min to 5 min when making a complaint report. Figure 7 shows the graphical summary report of Torsion KPI 2 Pre-Test.



Descriptive statistics

Muestra	N	Media	Desv.Est.	Error estándar de la media
Time to make complaint KPI2 PRE	200	86.0	17.9	1.3
Time to make complaint KPI2 POST	200	5.39	1.26	0.089

Estimation of the difference Test

Diferencia	IC de 95% para la diferencia
80.66	(78.16; 83.16)

Hipótesis nula	$H_0: \mu_1 - \mu_2 = 0$
Hipótesis alterna	$H_1: \mu_1 - \mu_2 \neq 0$

Valor T	GL	Valor p
63.66	200	0.000

Fig. 7. KPI 2 post-test summary report

4.3 User satisfaction level

The third criterion, both Pre and Post, which were obtained in the data collection, showed a significant difference with a percentage of 67.50% in favor, indicating "Good" influence of the mobile application. Figure 8 shows the Post-Test bar graph of the user satisfaction indicator.

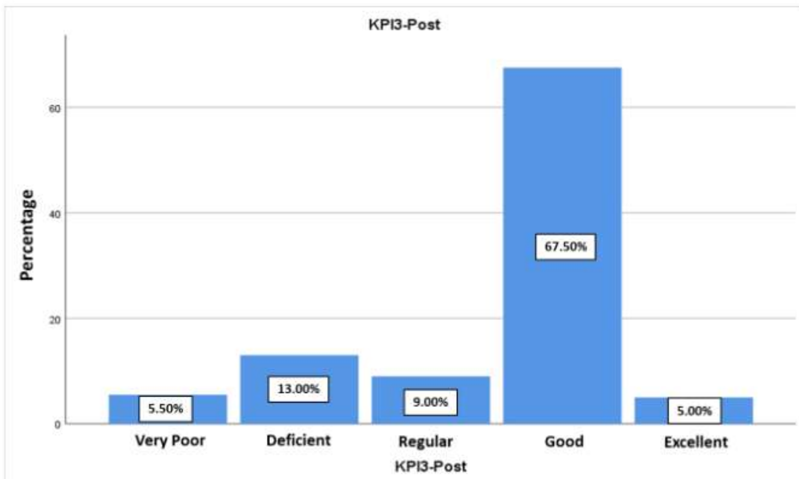


Fig. 8. Bar chart KPI 3 post-test

5 Discussions

The development of this research is based mainly on the requirements and/or needs as a guideline for observation and evaluation in order to obtain the results of each characteristic presented in this project and thus allow its discussion. In turn, there are several works regarding information management, which are carried out in different state and private entities, which are mentioned in the previous works in section 2.

In relation to the indicator: Efficiency in the reception of information, an average of 4.20 was achieved with respect to the influence of using the mobile application, see Figure 6, which represents a percentage higher than 50% that describes as "good" having a mobile application that helps in the reception of information. Evidencing an acceptable reception of information.

Regarding the indicator: Average complaint time in public transportation, it was possible to demonstrate the decrease in time using the mobile application to make a complaint about sanitary measures Covid-19, see Figure 7, which represents 5.39 minutes with respect to the average time to make a complaint report. This shows a significant decrease in the time it takes to register and respond to complaints.

Finally, user satisfaction level, see Figure 8, an average user satisfaction level of 3.54 was obtained, which represents 67.50% of the influence of the mobile application to manage the information of the Covid-19 sanitary measures in public transport.

This shows a higher satisfaction index compared to previous studies (such as Ref. [20]), which goes hand in hand with factors such as time, agility of the system and information provided, allowing to meet the expectations of users.

6 Conclusions

The mobile application for information management on sanitary measures Covid-19 in public transport, allowed to control the flow of information hand in hand with the Manager of ATU (Autoridad de Transporte Urbano), because it allows to know the level of satisfaction regarding the receipt of information, number of monthly complaints regarding the transport lines, in addition, to know the processing time when reporting a complaint, in turn to know the level of user satisfaction. This allowed the automation of the information management of Covid-19's sanitary measures in the public transportation area.

Through the analysis of the indicators, it was found that there was a significant improvement in the reception of information, the time to report an incident or complaint and the level of satisfaction for a user, which was carried out to the inhabitants of the city of Lima belonging to the pre-experimental group, identifying as "good" the influence of the use of the mobile application for the management of information of sanitary measures Covid-19 in the public transport lines of the city of Lima.

It is recommended for future research to increase the process of geolocation of public transport to help to know the arrival time of each public transport line.

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