Servuction Procedures for Waste Collection Management through the use of Information Technologies and the Design Thinking methodology

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Abstract

According to the United Nations and their Human Settlements Program, 7.000 to 10.000 million tons of waste are produced every year in all the world causing a huge air, water and ground pollution. In Cuenca, Ecuador, waste management is carried out by the Cuenca Municipal Public Cleaning Company, which indicates that there is a lack of recycling culture of the citizens due to ignorance about classification and separation of waste. Therefore, it is proposed a user-centered mobile application adoption as an alternative solution to separate waste properly, considering Design Thinking and Technology Acceptance Model. The findings of the study suggest that the app needs to be simple, intuitive, attractive and made up of classification, education and use. Moreover, the study shows that the attitude of users about this app influences the intention to use it and also that the social image within Cuenca influences the perceived ease of use of it.

Keywords
Design thinking, Mobile application, Technology acceptance model and waste.

1. Introduction
In all the world, 7.000 and 10.000 millions tons of waste are produced every year causing a huge air, water and ground pollution (United Nations, 2019) as a consequence of environmental pollution and the efforts to achieve goal 12.5, set by the UN in the Sustainable Development Goals, which indicates that "By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse" (United Nations, n.d) many countries have managed to take measures and in many cases information technologies (IT) have been used as a mean to improve recycling according to the needs of each country, region and community. In Cuenca, Ecuador, since 2010, a recycling system was introduced by the Municipal Public Cleaning Company of Cuenca (EMAC EP). Nevertheless, in 2018, Galo Vasquez, landfill Technician mentioned that, in practice, there is a low performance in waste separation by the citizens (Aguilar, 2018).

The purpose of this research is based on the development of a mobile application as a waste classification tool focus on the citizens' needs. For that reason, Design Thinking (DT) is used, due to it places the developer as another user, allowing to understand the needs, desires, thoughts and dreams of users, and also helps to obtain ideas that catch target market attention (Costa Valentim et al., 2017). In order to complement the results obtained from Design Thinking, the servuction model is used, because it offers a set of steps and tools necessary to create, provide and manage an adequate, successful, quality service.

The demand for the application is not predictable and can be completely random, as it will depend on the knowledge that users have about the classification of waste, regardless of their age, gender, ethnicity, among others. For this reason, the research relies on the Technological Acceptance Model (TAM), proposed by Davis, to understand how users accept and use a certain new technology (Davis et al., 1989).

2. Literature Review
Today, mobile applications serve important functions, Vetterli et al. (2013) mention that users look for mobile applications capable of integrating into their behavior and daily life. For this reason, Apps must be flexible, agile and above all, have a very strong orientation towards what the client wants. Several definitions of Design Thinking have

been developed. Visser (2006) indicates that it is: "creative strategies that designers use during the design process"; Dorst (2012) defines it as: “a process of exploration and creative strategies.” Finally, Serrano and Blázquez (2015) indicate that DT focuses on users and from them finds effective solutions with less risk of rejection, due to, DT allows to generate rapid prototypes that help to understand errors and improve these before launching the product to the market. There are multiple methods for DT development, however, all essentially have the phases of understanding, observing, defining, ideating, prototyping, testing, implementing and learning which is an iterative process. One of the most widely used DT schemes is the method developed by the Hasso Plattner Design Institute, founded at Stanford University in 2005, which consists of a five-phase process: empathize, define, ideate, prototype and evaluate (Pham et al., 2018). It is evident that using the aforementioned method, the final ideas proposed for a mobile application are based on the needs of the potential users (Pham et al., 2018), because it allows them to find the interface preferences and also helps to increase the sensitivity of the programmer to the needs (Hou et al., 2020). Another DT model, commonly used, is that of Brown (2009), who proposes the model in three phases called "innovation spaces", which are inspiration, ideation and implementation. The Brazil +9 application is developed considering all user comments, which has allowed it to be in the store with a maximum evaluation score, and be rated with the best scores in interface, usability, performance and functionality by Tech Tudo (De Paula et al., 2014). For create value for the users, the use of DT is extremely important, however, in the case of medicine, apps do not create trust if it is not done by a professional physician (Petersen et al., 2008).

Silva Siu (2017) mentions that currently, due to the number of competitive markets and the customer-centric approach, service companies are forced to provide high-quality services capable of satisfying consumers and generating a buy-back from customers. Consequently, companies must obtain loyalty from their buyers by understanding their needs; for this reason, servuction is one of the ideal tools adaptable to any business model, capable of achieving better results taking consumers into account.

Servuction is a neologism proposed by Eiglier and Langeard in 1989, which refers to the production process of a service, defining it as: “the systematic and coherent organization of all the physical and human elements of the client-company relationship necessary for the performance of a service provision whose commercial characteristics and quality levels have been determined ”(pp. 12). The service as opposed to production includes the client as part of the process and in this way the user acquires a value through an interactive process of his experience acquired in the use of the service (Ilieska, n.d.). It is important to understand that a service company is divided into: a visible part, which is what clients show during the process, and an invisible part, which is necessary to support the first. The elements that are part of these according to Eiglier and Lageard (1989) are: the client, physical support, personnel in contact, service, the internal organization system and the other clients. In addition, the interaction of all the elements is important, since it is what generates the experience for the client and that experience is what creates the set of benefits for the client (Ullah and Islam, 2011).

Multiple studies about the Technology Acceptance Model (TAM) proposed by Davis (1989), show that the perceived ease of use of a technological tool has a positive impact on its perceived usefulness (Chuang et al., 2020; Reyes and Castañeda, 2020; Muñoz-Leiva et al., 2017; Roy, 2017). Also, the positive attitude is greater towards the technology and therefore the intention to use increases (Reyes and Castañeda, 2020), the ease of use has an impact positive in the attitude of users towards it. However, there is no evidence to confirm that perceived usefulness has a positive effect on the intention to use a proposed application (Muñoz-Leiva et al., 2017). Finally, there are studies that show that the TAM model applied to older adults is not adequate, because the perception of ease of use does not have a major influence on the adoption of a technology; however, the perception of utility does influence the decision (Knowles and Hanson, 2018).

3. Methods

The methodology used in the work consisted of documentary and field research based on collecting primary and secondary information.

3.1 Contextualization of waste classification

Information on solid waste and waste management and the current situation in Cuenca was collected through interviews and research surveys from previous and current years. Surveys were conducted with citizens, and interviews were conducted with the Occupational Health and Safety Coordinator and the Recycling Technician of EMAC EP.

3.2 Application of the DT methodology and TAM model

The DT methodology was applied according the Hasso Plattner Design of Stanford and the TAM model was proposed based on previous works (Muñoz-Leiva et al., 2017; Venkatesh and Davis, 2000). These were developed through the execution of two focus groups; one with university students and the other with workers. Both focus groups were chosen for convenience due to the COVID-19 pandemic and were carried out through the Zoom Video digital platform. Table 1 shows the methodology applied for DT and Table 2 shows the methodology of the TAM model.

Table 1. Methodology applied for Design Thinking (DT)

Stage	Methodology
Empathize	• Knowledge of the classification situation by formulating a scenario: imagine that you are at a party, and you are on the way out, then the host give you a piece of cake on a disposable plate and a personal coke in a plastic container. You eat this at home, so how or where do you dispose these wastes? • Knowledge about the feelings and emotions of the users, asking the questions: how do you feel when you must dispose a product in the trash can and do not know where to deposit it? And how do you feel when you see that there are food residues in the light blue trash can?
Define	• Brainstorm ideas by asking: what aspects should the waste classification App have to improve your garbage separation habits? • Prioritize ideas
Ideate	• Design the App interface, explain how to use and choice the favorite interface design
Prototype	• Design a prototype according to the ideas of the focus group
Test	• Present prototype • Request for recommendations about the prototype presented

The hypotheses of the TAM model are *H1*: perceived ease of use has an impact on attitude of use, *H2*: perceived ease of use has an impact on perceived usefulness, *H3*: perceived usefulness has an impact on attitude of use, *H4*: perceived usefulness has an impact on intention to use, *H5*: attitude of use has an impact on intention to use, *H6*: social image has an impact on perceived ease of use and *H7*: social image it influences perceived usefulness. Once the DT model was completed, a survey of 14 structured questions referring to the TAM model was carried out to all the participants of the focus group, which presented a ranking according to Likert-type scales where 1 strongly disagree and 7 strongly agree.

Table 2. Questions applied for the Technology Acceptance Model (TAM)

Aspects	Questions
Social imagen	• People in my social circle who use applications have more prestige than those who do not use them (S1) • People in my social circle who use Apps have a high profile (S2) • Having the latest apps is a status symbol in my social circle (S3)
Perceived Ease of Use	• My interaction with the app is clear and understandable (EU1) • Interacting with the app does not require a lot of mental effort (EU2) • I find the App easy to use (EU3) • It is easy for me to get the App do what I want (EU4)
Perceived Usefulness	• The use of the App helps me to clear my doubts of waste classification (U1) • Using the App increase my productivity in waste classification (U2) • I find the App is useful to improve my knowledge about a correct waste classification (U3)
Intention to use	• If I have access to the App, I intend to use it (IU1) • Since I had access to the App, I anticipate that I would use it (IU2)
Attitude to use	• It is probably that I use smartphone Apps to find out the correct classification of waste soon (AU1) • It is probably that I use smartphones Apps for various recycling issues soon (AU2)

3.3 Design of the servuction frame

In this stage, the results obtained with the DT were used and a series of steps and tools provided by the "Reference framework for developing effective service marketing strategies" by Lovelock and Wirtz (2009) were followed to successfully establish the service based on waste classification.

3.4 Prototyping of the mobile application

Before defining the final idea of the mobile application, the most common characteristics used when developing a mobile application were investigated and a survey of 11 questions was applied to the target market in order to rectify the needs. Using the stratified random-quota sampling, a sample size of 322 citizens was obtained, with a 95% confidence level, maximum randomness and 5% error.

$$n = \frac{N \times z^2 \times p \times q}{e^2 \times (N-1) + z^2 \times p \times q}$$

The surveys were administered using the Kobo Toolbox for online responses and through paper surveys. The latter were carried out in strategic areas of Cuenca. The total of surveys collected and analyzed were 383.

The final prototype was built with the help of the Figma application, which allows you to create mockups along with your navigation. The device used to demonstrate the idea is an iPhone 11 Pro, which has a 5.8-inch screen.

4. Results

4.1 Contextualization of waste classification

According to the National Institute of Statistics and Censuses (INEC) Cuenca is the city with the highest percentage of classification with 53.37% in Ecuador (INEC, 2017). However, the Occupational Health and Safety Coordinator of the Cuenca Municipal Public Cleaning Company (EMAC EP) indicates, in 2019, that it has found a mix of non-recycling materials like toilet paper and diapers in the light blue trash can. In addition, he mentioned that the biggest problem of recyclers is the organics waste like peels fruits found in the light blue trash can because these contaminated the recycling material. Also, the recycling technician, in 2020, considers that there is no public awareness about the classification of waste and mentioned again the materials found in the light blue trash can.

EMAC EP uses two collection systems, one corresponding to solid waste (black trash can) and recycling waste (light blue trash can), it presents on its website, the way to classify waste. Similarly, in December 2019, a survey was carried out with 277 people in order to know the perception of recycling in the city. It was found that 95.67% of surveyed know what recycling is (Figure 1). In fact, 96.98% of this group selected the correct meaning of recycling as shown in the Figure 2, where 1: corresponds to used materials that can be reused through a transformation process; 2: materials, substances, among others that need to be eliminated because they have no other use and 3: unwanted or unusable materials.

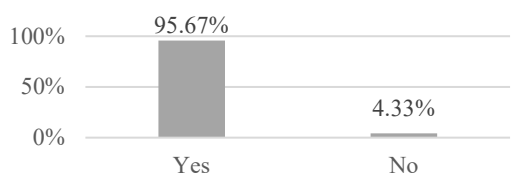

Figure 1. Know of recycling

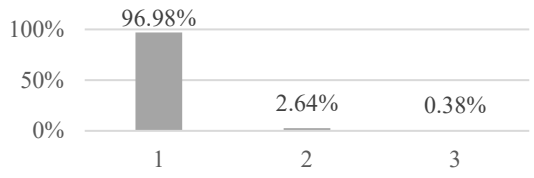

Figure 2. Definition of recycling

The 76.9% of surveyed indicated that they recycle in their homes. To know if the recycling is carried out correctly, two questions was made about which products are discarded in each trash can according to EMAC EP. The first question focused in the products discarded in the black trash can is shown in Figure 3. Between 80-70% of surveyed put correctly some products, a percentage lower than 50% placed candy wrappers, snack covers and toothpaste tubes correctly. Finally, a small number of people (less than 20%) put recyclable materials in the wrong trash can. The second question focused in the products discarded in the light blue trash can is shown in Figure 4. Between 74-65% of surveyed put correctly the products. There is a considerable amount of 61.50% and 56.81% who placed cake

packaging and disposable tableware in the wrong trash can. In addition, a percentage lower than 50% of surveyors placed certain products correctly.

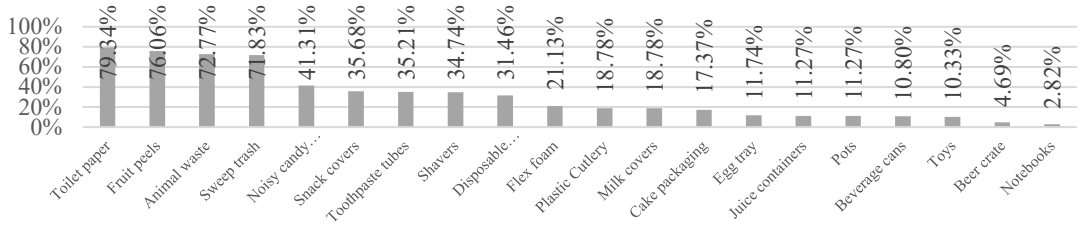

Figure 3. Results of products discarded in the black trash can

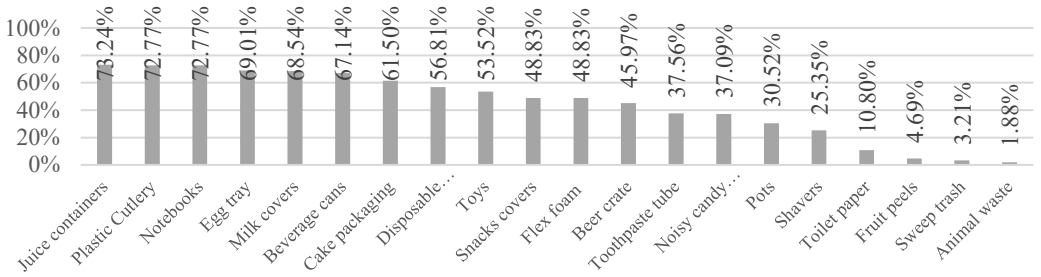

Figure 4. Results of products discarded in the light blue trash can

4.2 DT methodology and TAM model

The focus groups were developed on different days, in the university group assisted 11 participants, meanwhile in the workers group assisted 5, the results of each stage of the Design Thinking methodology are shown below:

- **Stage 1. Empathize:** In both groups, the majority indicated having waste sorting habits in their homes, however, when indicating the way to dispose and the place, they showed insecurity. They also indicated feelings of unease and frustration when they don't know the process, as well as when they see organic waste in the wrong garbage.
- **Stage 2. Define:** Using the Google Jam board, the participants defined aspects and information that the application should have. The first group defined four fundamental aspects: i) informative, within which there is news and developments related to the subject to raise awareness among citizens; ii) educative, which includes videos and didactic material that teach children and adults on the importance of waste classification; iii) classification, which includes information about waste separation according to EMAC EP. Finally, they indicated that there should be an aspect of iv) activism that includes actions that a person or company is carrying out and where they can be part of it.
  The second group defined four similar aspects: i) exploitation, which includes videos and information to transform waste into other artisan products; ii) news, to find out what is happening at the international, national and local level; iii) collection, which indicates how the waste should be separated, the schedules collection and the route of assigned collection truck; and finally, iv) educational, similar to the previous focus group. Within the four aspects mentioned a vote was carried out, in each group, to know the degree of importance of each aspect within the App, according to the needs of potential users. The order from highest to lowest importance in the first group was: education section, classification, informational and finally activism. In the second group, the results were: collection, exploitation, news and educational.
- **Stage 3. Ideate:** In the first group, 2 subgroups of 4 members and 1 subgroup of 3 members were established to design the App interface (Figure 5, Figure 6, Figure 7). While in the second group, 2 subgroups were established, one of 2 members and the other of 3 (Figure 8 and Figure 9). In the first group, the favorite was Figure 6; while in the second group they indicated that the two designs are good options, and those should be complemented.


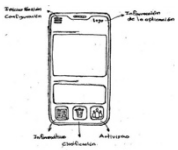

Figure 5. Design 1 Figure 6. Design 2 Figure 7. Design 3 Figure 8. Design 1 Figure 9. Design 2

- **Stage 4. Prototype:** A prototype was designed in WIX, in 30 minutes approximately, for each group considering the mentioned needs as shown in Figure 10 and 11.

Figure 10. Prototype focus group 1 Figure 11. Prototype focus group 2

- **Stage 5. Test:** Those evaluated interacted with the prototype for 10 minutes and issued their recommendations: simpler and more attractive interface; legible buttons, contacts, and images; navigation arrows, incorporate a highlighted section in the interface to attract attention; and the classification section must indicate the classification by trash cans and also by type of waste.
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To accept or reject the hypotheses, the modeling structural equations with partial least squares (PLS-SEM) was applied, and the TAM model was constructed (Figure 12) in Smart PLS version 3.3.2.

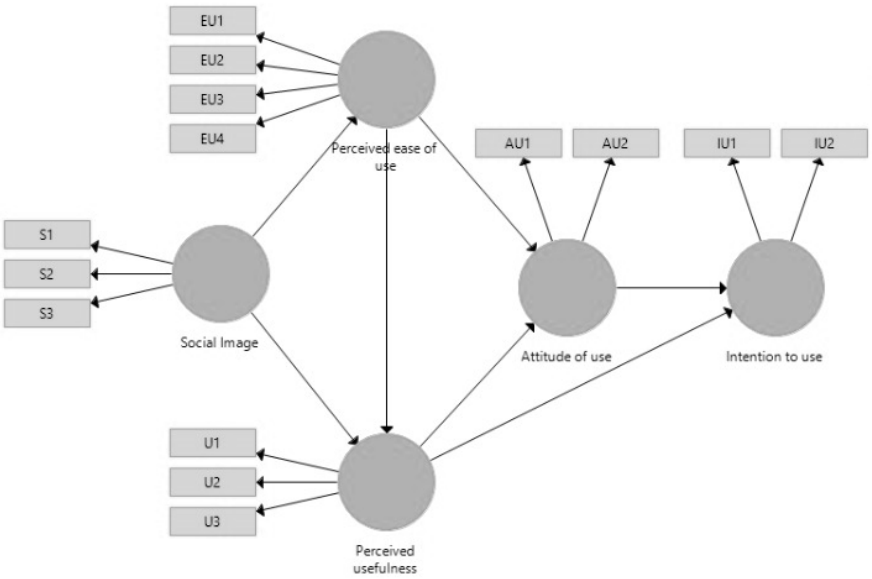

Figure 12. TAM model

Calculating for the first time the PLS algorithm with 500 interactions, three indicators S3, EU2 and U3 were eliminated because their factor loadings were lower than 0.7. Recalculating the model, Cronbach´s Alpha (α), Composite Reliability (CR) and Average Variance Extracted (AVE) values were obtained along with discriminant validity, which showed that the model is valid. Results are shown in Table 3.

Table 3. Model assurance

Latent construct	Attitude of use	Intention to use	Perceived ease of use	Perceived usefulness	Social image
Attitude of use	**0.961**				
Intention to use	0.868	**0.931**			
Perceived ease of use	0.012	-0.037	**0.923**		
Perceived usefulness	0.055	-0.033	0.628	**0.866**	
Social image	0.748	0.640	0.411	0.381	**0.870**
CR > 0.7	0.917	0.845	0.913	0.667	0.681
α > 0.7	0.960	0.928	0.945	0.857	0.862
AVE > 0.5	0.923	0.866	0.851	0.750	0.757

Table 4. Results of the Structural Equations model

Hypotheses	β	t static	p-value	Acceptance
H1: perceived ease of use has an impact on attitude of use	-0.037	0.054	0.957^{ns}	Rejected
H2: perceived ease of use has an impact on perceived of usefulness	0.567	1.887	0.060*	Rejected
H3: perceived usefulness has an impact on attitude of use	0.078	0.109	0.914^{ns}	Rejected
H4: perceived usefulness has an impact on intention to use	-0.081	0.519	0.604^{ns}	Rejected
H5: attitude of use has an impact on intention to use	0.872	9.514	0.000***	Accepted
H6: social image has an impact on perceived ease of use	0.411	2.443	0.015**	Accepted
H7: social image it influences perceived usefulness	0.148	0.547	0.585^{ns}	Rejected

Notes: *** p<0.01, **p<0.05, *p<0.1, ^{ns} Not significant

Table 4 shows the results of the research hypotheses. The column of the p value shows the significant relationships; where the p value less than 0.05 shows significant values and the quasi-significant relationships are values between 0.05 and 0.10. Only two relationships were significant, for which only the following hypotheses are accepted: H5. attitude of use has an impact on intention to use (β = 0.872 t = 9.514 p = 0.000) and H6. social image has an impact on perceived ease of use (β = 0.411 t = 2.227 p = 0.026).

4.3 Servuction model

In order to establish the profile of the client who is willing to use the mobile application on the classification of waste, the target market is defined, taking into account geographic, demographic, psychographic and behavioral variables. In Table 5, the market segment is detailed with its respective variables.

Table 5. Market segment

Type	Variable	Description	Justification
Geographic	Region	Cuenca	The classification of waste is carried out according to each Municipality, in this case EMAC EP is the institution in charge of waste management.
	Population type	Urban	The EMAC EP is responsible for the collection of waste from the entire urban area without exceptions.
Demographic	Gender	Female and male	The mobile application is aimed at all citizens, without distinction of demographic characteristics.
	Age	16-64	Because they are the age groups that have smartphones.
	Socioeconomic level	A, B y C+	Because the application works only on smartphones, which are more expensive.
Psychographic	Value	Concerned about caring for the environment	The majority of the users of the application will be those who are aware of the importance of caring for the environment.

	References groups	Family, friends, neighbours, etc.	The use of mobile applications is influenced by social group.
Behavioral	Use frequency	Random	It is not known exactly when they will need to consult the application to dispose of the garbage.
	Expected benefits	Increased knowledge	The application is used in order to improve knowledge about the classification of waste in the canton.

The proposed service is technology-based. It is a mobile application with detailed information on the correct way to separate waste at the basin level. This mobile application will be compatible with Android and iOS devices, and will allow users to know where the different products should be disposed. The basic characteristics of the proposed service are presented in Table 6. In order to increase the perception of the value of the application, the reduction of non-monetary costs is taken into account, as detailed in Table 7

Table 6. Definition of proposal service

Variable	Description
Service category	Processes towards mental stimulation
Level of contact with the customer	Lower
Purpose of the service	Improve waste sorting
Type of application	Mobile
Mobile App Category	Educational and informative

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Table 7. Value perception proposal for the proposed application

Cost type	Action
Time	In order to avoid the generation of lost time or useless time for the user, it is established to incorporate the search bar to quickly find the required information.
Physical	To avoid forced manipulations within the application, its interface will be designed taking into account ergonomic parameters.
Psychological	To avoid feeling inept when using a new technology, it will be designed with large buttons, basic, simple functions and will have information on the status of the application.
Sensorial	The colors used in the application will be chosen with care, especially the reserved colors that can create annoyance or confusion.

4.4 Prototyping of the mobile application

4.4.1 Mobile Design Features

The success of a mobile application does not only depend on its content, but also on its design, since it also has the ability to convey a perception of quality, increase user satisfaction (Bhandari et al., 2017) and influence strongly in the perception of the mobile application (Nguyen et al., 2018). Several studies indicate that it is essential that mobile applications have a simple design (Kamaruzaman et al., 2016), including only those elements with defined functions that meet the objective of the App (Hoober and Berkman, 2012; Serna and Pardo, n.d.) it is important to maintain a consistent design throughout the entire application (Al-nuiam and AL-Harigy, 2015).The text must be legible (Albornoz, 2018; Moyano et al., 2016) and the use of an excessive number of styles and sizes on the same page must be avoided (Al-nuiam and AL-Harigy, 2015).

Another important aspect for the design of the mobile application is to have texts, buttons or graphics, which indicate the section in which the users are (Jumaat and Tasir, 2013).On the other hand, the use of paging is preferred over the use of scrolling, since the latter can generate user abandonment by showing a large amount of information (Romero et al., 2010); if scrolling is used, it should be minimized and limited to a single direction (Al-nuiam and AL-Harigy, 2015). Likewise, it is important to consider the inclusion of a logo in the introductory screens at the top, a back button to return to higher levels or previously visited sites, a drawer-type menu with no more than five or more seven tabs, an overflow of actions in which are the extra functions and of little frequent use; the tool will search in the upper part with its respective image, and in case of incorporating the cancel button it must be placed on the left side, while the accept button on the right side (Al-nuiam and AL-Harigy, 2015; Hoober and Berkman, 2012; Nguyen et al., 2018; Romero et al., 2010; Stuurman et al., 2014).

4.4.1 Survey Results

The 83.08% of the respondents indicate that they would like to have a mobile application that indicates the bag or trash can where each waste should be (Figure 13). The 80.73% of those surveyed who want the App identified that the classification section must be found within it. With a percentage a little less than 50%, citizens indicated that it should contain the achievement and educational section. Also, 36.73% wanted the activism section, only 28.73% wanted the information section . The remaining 1.45% indicated that within the existing sections the classification of bottles and recycling points within the city should be clearly indicated (Figure 14). On the other hand, the 58.56% indicated that the classification of waste should be indicated both by trash cans and by products (Figure 15).

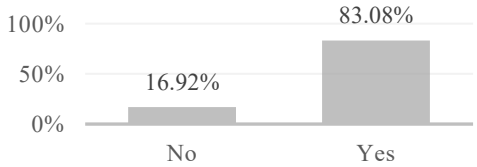


Figure 13. Desire to have the App

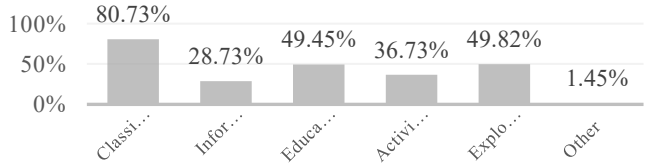


Figure 14. Desire sections for the App

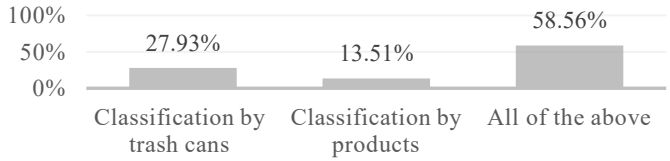


Figure 15. How to organize classification information

4.4.2 Final result

Considering the different aspects mentioned in the development of Design Thinking, the results of the surveys and the characteristics of the mobile applications, the final proposal is established. The interface navigation scheme is presented in Figure 16.

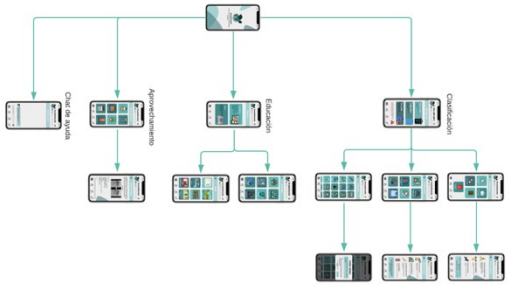
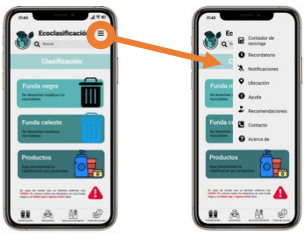


Figure 16. Final proposal interface diagram

At the top, next to the search tool, you will find the actions overflow icon, where there will be extra functions:

- Recycling counter: option so that the user can record the number of recyclable materials and show progress over time.
- Reminder: in which an alarm can be set every time it is time to take out the garbage.
- Notifications: tool that will allow you to configure the status of notifications.
- Location: function that will show the user's location.
- Help: Help center with frequently asked questions and options to contact an assistant.
- Recommendations: space to indicate any suggestions and complaints.
- Contact: contact numbers and location of the physical center.
- About: space in which the purpose of the application is described.

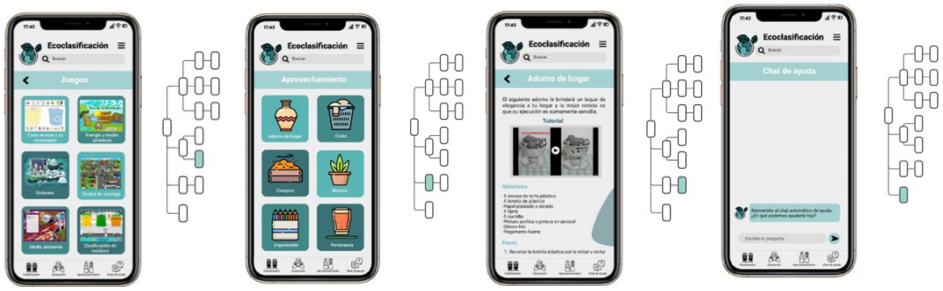


On the first screen, the application logo is displayed along with its name and a motivating phrase. In addition, the typography and chromaticity to be used within the entire application is observed. In the classification section, there

are buttons for the classification of waste by black trash can, light blue trash can and products. When entering the different main classification buttons, the user will go to a new screen with the waste classified according to the EMAC EP, which in turn, when clicking, will show the corresponding description.

In the education section, the user can find two ways to educate themselves regarding waste sorting and environment issues. The first option is called activities, in which readings with trivia will be presented within each topic. In the games option, the user can access any game of interest.

The game images belong to ecoembes, monte deva, the National Oceanic and Atmospheric Administration (NOAA), United States Environmental Protection Agency (EPA), Didactalia and pipo educational games.



In the exploitation section, the user will learn to create homemade products with waste. The explanation will be through videos and written instructions. Both screens scroll vertically through the large number of products and information. Finally, the "help chat" function has been incorporated into the drawer menu, to help the user to answer any questions immediately. This chat will be mixed, since it will have an automatic chat (chatbot) and the option to chat with an advisor.

5. Discussion

Citizens proposed the fundamental elements and the design of the mobile application, applying DT. The methodology helped to understand the needs of citizens, the aspects and interactions that the application should have and consequently clearly define the target market, the functions and navigation with the different service tools. It is important to recognize that only two focus groups were used due to the pandemic, which is a small number; however, it helped to better understand the situation in Cuenca and the real needs.

Results of the TAM model applied to the prototypes obtained in the DT to the 16 participants of the focus groups confirmed that the attitude of use has a positive impact on intention to use, as previous studies showed (Reyes and Castañeda, 2020). Also, social image has a positive impact on perceived ease of use as indicates in (Muñoz-Leiva et al., 2017), while the rest of the hypotheses were rejected alongside the hypothesis most mentioned (Chuang et al., 2020; Reyes and Castañeda, 2020; Muñoz-Leiva et al., 2017; Roy, 2017), indicating that perceived ease of use in this case has no impact on perceived usefulness. It is important to recognize that the original simple size was exceedingly small (n=16), which could influence in the hypothesis results. Some previous works suggest that the minimum sample size depends on the number of relationships that are specified in the model (Marcoulides and Saunders, 2006) or use a minimum of 100 to 200 to reach acceptable levels of statistics power (Martínez Ávila and Fierro Moreno, 2018). Thus, it is recommended to create a single prototype in which the aspects mentioned in the results are covered and show it at a more significant sample size of citizens, to validate the results of the hypotheses obtained in this study.
Since 2008 (Fernández Quijada and Ramos-Serrano, 2014), the use of mobile apps has been increased due to the flexibility, versatility, easy handling and the free rate but the real success of these are based on the interaction with users, for that reason, we dare to say that a mobile waste classification app with the characteristics mentioned previously in the results could be a successful tool to improve waste classification. Also, according to the census of

2010 (INEC, 2010), the 62,9% of citizens in Azuay use a cellphone, which show us that the implementation of a mobile application is worthwhile, due to mass use of information technologies.

6. Conclusion

The results obtained in the servuction framework and the Design Thinking methodology made it possible to clearly define that the mobile application must resolve doubts about waste classification, contain environmental information, include advice on how to reuse materials, educate users and have a section on activism. Similarly, it is recognized that the main characteristics that citizens want in the mobile application are clarity, simplicity and quality. There are significant statistical values that indicate that the social image in the target market influences the perception of ease of use of the mobile application; and that the attitude of use with which users use the application influences the intention to use it. Therefore, it is important to establish promotion strategies emphasizing the importance of contributing to the care of the environment and its benefits. The mobile application initially proposed will have only three main functions (answering classification doubts, educating and advice on reuse of materials), which have been the most requested by the respondents, in order to avoid information overload. In addition, the design will include the most common characteristics of mobile applications, the recommendations and suggestions provided in the DT; thus, generating a mobile application focused on users.

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Biography

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