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Article

# Dynamic web application for dissemination of blood donations and registration of donor candidates implementing e-advertising

# Aplicación web dinámica para divulgación de donaciones sanguíneas y registro de candidatos a donador implementando e-publicidad

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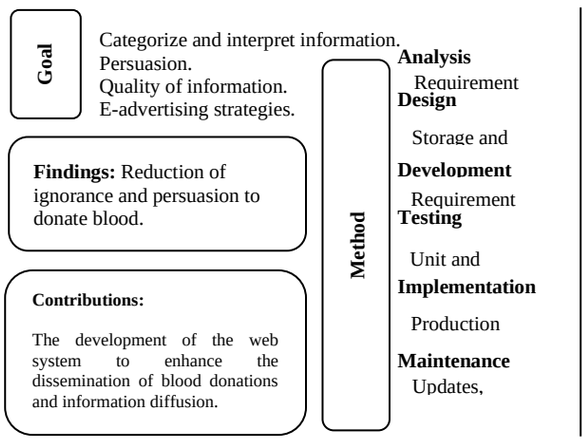
## Abstract

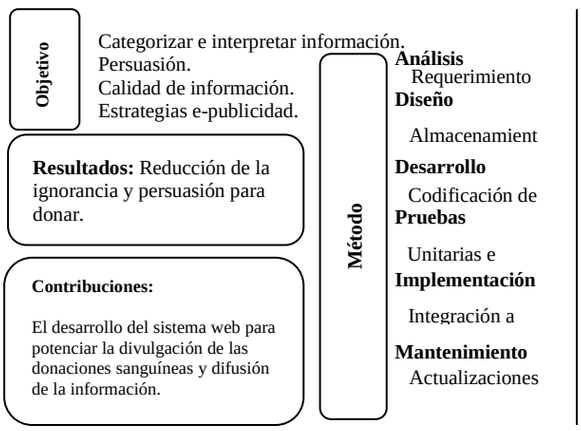
Blood donation, ideally altruistic and voluntary, is uncommon in today's society, where most donations are driven by personal needs. A quantitative experimental investigation was initiated to study how uncertainty influences the willingness of the population in Lázaro Cárdenas, Michoacán, Mexico, to donate blood altruistically and voluntarily. Using descriptive statistical techniques, it was identified that lack of information is a decisive factor in this choice. To address this information gap, a dynamic web application with E-Advertising strategies was developed. This tool has shown to significantly reduce uncertainty and increase willingness to donate blood altruistically and voluntarily among the studied population.




**Uncertainty Blood Donations (UBD), Web application, Strategies E.Advertising**.

## Resumen

La donación de sangre, idealmente altruista y voluntaria, es poco común en la sociedad actual, donde la mayoría de las donaciones responden a necesidades personales. Se inició una investigación experimental cuantitativa para estudiar cómo la incertidumbre influye en la disposición de la población de Lázaro Cárdenas, Michoacán, México, a donar sangre de manera altruista y voluntaria. Utilizando técnicas estadísticas descriptivas, se identificó que la falta de información es un factor decisivo en esta elección. Para abordar esta falta de información, se desarrolló una aplicación web dinámica con estrategias de E-Publicidad. Esta herramienta ha demostrado reducir significativamente la incertidumbre y aumentar la disposición a donar sangre de manera altruista y voluntaria en la población estudiada.




**Incertidumbre Donaciones Sanguíneas (IDS), Aplicación web, E. Publicidad estratégica**

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## Introduction

Blood donation is an essential process for transfusion medicine, crucial for saving millions of lives annually. However, insufficient clear and accessible information about this procedure generates uncertainty among the population, reducing the number of voluntary donors. This study focuses on addressing the lack of accurate data on blood donation and how this lack of knowledge affects people's willingness to participate.

The main issue to be investigated is the limited information available to the public about blood donation, the lack of which, due to unfounded fears and myths, deters potential donors from contributing. Addressing this gap is vital, as better understanding and dissemination of adequate information can significantly increase the number of donors.

The importance of this issue lies in its direct impact on public health. Improving the accessibility and quality of information on blood donation can mitigate uncertainty and increase the confidence of potential donors. In addition, the adoption of new technologies and communication strategies, such as web applications and E-advertising, which according to (Canales, 2020), can be referred to as 'presented on various platforms called digital media, defined as those through which information can be created, observed, transformed and preserved on a variety of digital electronic devices'.

The aforementioned manifest themselves as an innovative opportunity to address this challenge.

According to research by (Ahmed Saad, 2019), many people want to donate blood to help others, but this willingness may face many obstacles due to lack of information, such as people do not know how to find information, schedules and activities of existing blood donors.

In Khartoum-Sudan, despite the increasing number of donations, the blood donation process still struggles to provide enough blood to meet the high demand.

On the other hand, at the University of Icesi, Colombia, two professors and the director of the Blood Bank of the Valle del Lili Foundation (FVL), undertook as a university project an awareness-raising campaign among the enrolled students of the university by incorporating traditional advertising to persuade students to support the blood bank's blood supply (Manfredi et al., 2023). Furthermore, a clear example of the level of influence of uncertainty in the area of health, according to research by (Valdez-Martínez & Bedolla, 2021), mentions: 'Illnesses cause distress, threat and uncertainty to those who suffer from them, their families and, in general, to society.

This distress and uncertainty generates the need for valid knowledge that allows the doctor to explain the disease and, at the same time, to implement a successful treatment'.

Taking as variables; 'Information', analysed in its 'knowledge' dimension, and 'uncertainty' in its 'ignorance' dimension, being these independent and dependent, respectively, allow the following central hypothesis to be put forward: 'From the implementation of a dynamic web application that includes a digital information analytics metrics module, supported by E-advertising strategies, a reduction in the ignorance resulting from the uncertainty surrounding blood donations is anticipated'.

The context of this research is primarily cultural and social, as perception and behaviour towards blood donation is deeply influenced by societal values and beliefs. To address these challenges, in general, this study proposes to develop a dynamic web application whose design and development are based on the implementation of e-advertising strategies, in order to enhance the dissemination of blood donations and related information.

In order to verify the proposed postulate, we have opted for the application of descriptive statistics, developing two analytical models, the first allows us to obtain quantitative data on the initial state of the case study, while the second allows us to corroborate the level of impact of the technological tool implemented, both including methods such as Cronbach's alpha, frequency analysis, measures of dispersion, correlation coefficients, as well as the respective graphs of each method.

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## Methodology

The present research has been carried out according to the stages of development of quantitative methodology mentioned in (Morejòn Labrada, 2020), respecting and integrating in detail each one of them, such as; conceptual phase, planning and design phase, empirical phase, analytical phase.

Due to the fact that the type of research is applied, it begins with the conceptual phase, defining that the main problem lies in the lack of information associated with blood donations, so that ignorance regarding this issue leads to a shortage of donors, so from the formulation of the object of study, the following specific objectives have been set out:

1. To categorise and interpret information related to the process of blood donations in a subtle way for the general public, in order to positively persuade the population regarding the context of donations.
2. Maximise the quality of information regarding blood donations by implementing e-advertising and developing a web application to reduce uncertainty about the issue.

In general terms, the objective is to create a dynamic web application whose design and development are based on the implementation of e-advertising strategies, with the aim of promoting the dissemination of blood donations and information related to them.

The following is a historical background that supports the need for an innovative approach to blood donations. (Arias Guzmán, 2020) Implementation of the SIGEHO WEB for campaigns. This system is interconnected with RENIEC, allowing the applicant to register and obtain accurate data for filling out the EG05 - FR 01 'APPLICANT SELECTION FORM' and thus carry out the appropriate interview, as well as optimising the blood bank's processes.

In the blood bank of Cienfuegos, Cuba, a web application was implemented that interacts with the existing database for the purpose of generating reports, the Galen application of the Cienfuegos Blood Bank allows its users to access, aggregate and generate information on all donors (Sánchez-Rivero et al., 2023).

Meanwhile in Palestine, based on the same problem, a model was developed to predict whether a person is likely to become a blood donor or not, according to different input factors (Barhoom et al., 2019).

Some factors that negatively impact and condition donations are: (a) fear of needles; (b) fear of blood; (c) discomfort; (d) fear of contracting a disease; (e) ignorance; (f) 'no one ever asked me'; and (g) 'I never thought about it' (Matos et al., 2024).

Advances in technology facilitate quality data collection, data mining and analysis of large volumes of information, which can drive informed decisions in healthcare (Gammon et al., 2024).

After having investigated the degree of influence of the problem on the population, the hypothesis has been designed and projected to be fulfilled according to the formulated methods and technological strategies. Primarily, two research variables, dependent and independent, which according to the previous enquiry have been defined as 'uncertainty' and 'information', respectively, have been set out. Consequently, the statement of the concluding hypothesis is presented as follows:

*'From the implementation of a dynamic web application that includes a digital information analytics metrics module, supported by e-advertising strategies, a reduction in ignorance resulting from uncertainty around blood donations is anticipated'.*

As a technological tool to address the problem, the design and implementation of e-advertising strategies in conjunction with the development of a web software has been proposed, which allows the verification of the hypothesis formulated, i.e. the reduction of uncertainty, which results in the increase of information (knowledge), the above referring to blood donations.

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## Population and sample

**Box 1**

**Table 1**

Variables with their Items, Dimensions, Indicators, Instruments and Source

| Variables | Dimensiones | Indications | Ítems | Scale | Instrument | Source |
|---|---|---|---|---|---|---|
| Information (VX) (Chiavenato et al., 2019, p.281). | Knowledge "Systematisation of information and its correct application for human benefit" (Hernández L., 2021). | Social | 1,2,3,4 ,5,6,7, 8,9,10 | Likert Strongly Disagree (MD)=1 point Disagree (ED)=2 points Undecided (ID)=3 points Agree (DA)=4 points Strongly Agree (MA)=5 points | Survey | The Likert scale in assessing the knowledge and attitudes of nursing professionals in health care.. |
| Incertidumbre (VY) (Alfaro García, 2019). | Ignorance "Absence of knowledge" (Jones et al., 2023). | Lack of knowledge | 1,2,3,4 ,5,6,7, 8,9,10 | Likert Strongly Disagree (MD)=1 point Disagree (ED)=2 points Undecided (ID)=3 points Agree (DA)=4 points Strongly Agree (MA)=5 points | Survey | Attitudes: definition and measurement of attitude components. Model of reasoned action and planned action. |

*Source: Own elaboration*

The population or universe to be studied is made up of men and women in an age range of 18 to 65 years from the city of Lázaro Cárdenas, Michoacán, Mexico, which is estimated at a total of approximately 4462 (four thousand four hundred and sixty-two) according to data from (Instituto Nacional de Estadística y Geografía [INEGI], (2020) being a relatively high number of individuals, it was decided to collect a representative sample of this population according to the non-probabilistic method of convenience sampling, consequently a total sample of 50 (fifty) people was deducted.

## Research Design

**Box 2**

| Type of research | | | Applied research | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Study Variables/ Types | Independent | Dependent | Cualitativa | Cuantitative | Continued | Discreet | Strange | Order | Appointment 1 |
| (X) Information | ✓ | | | ✓ | | | | | ✓ |
| (Y) Uncertainty | | ✓ | | ✓ | | | | ✓ | |
| E- Advertising | | | | ✓ | ✓ | | | | |
| Application web | | | | ✓ | ✓ | | | | |
| Donation Blood | | | ✓ | | | | | | ✓ |
| Type of study: | | | | Analytical and Empirical | | | | | |
| Non-experimental research Longitudinal research | | | Finite study population of 100 people from the town of Lázaro Cárdenas with a sample of 50 selected people. | | | | | | |
| Forward-looking research | | | | Data collection: prospective | | | | | |
| Statistical test: Pearson's correlation | | | | | | | | | |
| Quantitative approach | | | | | | | | | |
| Method to be used: cuantitative | | | | | | | | | |

Formula for sample calculation: $n = \frac{z^2 * N\rho q}{e^2(N-1) + z^2\rho q}$

**Figure 1**

It shows the type of research applied, variables, the method to be used, the formula for the calculation of the sample.

*Source: Own elaboration*

## Selection, design and testing of the data Collection instrument

For its part, as an auxiliary means for the collection and recording of data, it has been decided to use a survey, according to (Sánchez Huarcaya et al, 2020), it can be defined as 'Systematic method for the collection of information from [a sample of] entities, in order to construct quantitative descriptors of the attributes of the general population of which the entities are members', whose structure is designed in a way that is congruent with the operationalisation of the variables and their respective dimensions, an instrument has been designed for each variable (dependent and independent), i.e. a survey was designed for the information variable and a second one in the same way for the uncertainty variable, both with a content of 10 items based on the research of (ARONI VASQUEZ et al. , 2022) in which a Likert-type scale has been used as a measurement method according to (Suárez Lindao & Maggi Garcés, 2020), since as mentioned in (Gamboa Graus, 2022), 'there is a growing need to use statistical measurement scales in the educational research process to solve, more effectively, problems of a research nature in professional practice'.

The instruments used for data collection, which were used for the analysis of their corresponding variables, are shown below.

Scale: Likert

1. Strongly disagree.
2. Disagree.
3. Undecided.
4. Agree.
5. Strongly agree.

Independent variable (Information):

1. It is possible to donate blood if you have tattoos older than one year.
2. The name of the process where blood is checked for suitability to donate is called screening.
3. The age range required to be a donor is 18-65 years of age.
4. Blood group O- is the so-called universal donor (can donate to all blood groups).
5. Blood group AB+ is the so-called universal recipient (can receive blood from all blood groups).

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6. It is possible for people with diabetes to donate blood as long as the diabetes is not controlled by insulin.
7. It is possible to donate blood during menstruation.
8. It is possible to donate blood if you are taking antidepressants.
9. The minimum weight to be a donor is 50Kg.
10. By donating blood, up to 3 people can benefit.

Dependent variable (Uncertainty):

1. Pregnant women can donate blood.
2. Fasting is required to donate blood.
3. Donating blood causes pain.
4. People who have had any type of hepatitis are not allowed to donate blood.
5. People with piercings cannot donate blood.
6. Donating blood can make people fat/ fattening.
7. The needle lasts a long time inside the patient's arm during the donation process.
8. It is not possible to donate blood after having been vaccinated against influenza.
9. It is possible to donate blood if alcohol has been consumed within the last 48 hours.
10. It is possible to donate blood if you have had dengue fever in a period of less than 30 days.

All data collected during the study have been treated with the utmost confidentiality and will only be used for research purposes, guaranteeing its transparency and honesty, in addition to being able to exercise ARCO rights at any time (Arellano López, 2020).

### Development of the Web System

Regarding the development of the aforementioned software, the cascade methodology was used (Gonzalez Perez & Soto Galindo, 2023). See figure 2.

## Box 3

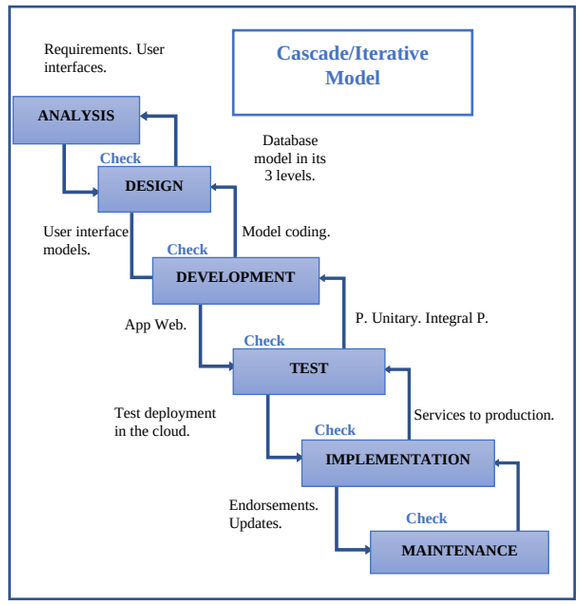


**Figure 2**

It shows the phases of the key activities that were carried out

The development of the software product is based on the research previously analysed and carried out following the phases of the waterfall methodology, which will be described in detail below, according to the system model designed, the requirements consist of having a database management system. Understanding the characteristics contained in the web application, based on the research of (Morejòn Labrada, 2020) a suitable model of the application is designed where the operation of the application is detailed in a general way, see figure 3.

## Box 4

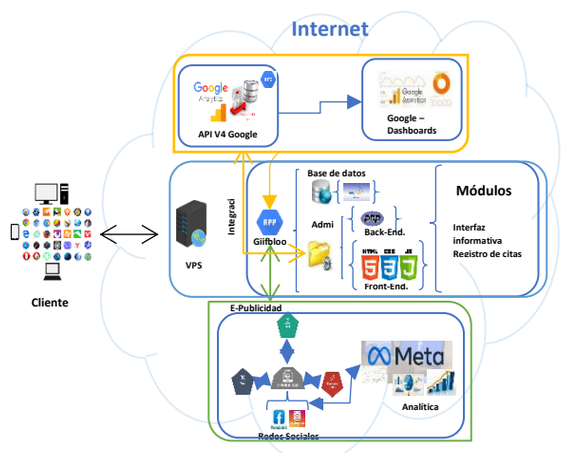


**Figure 3**

Web System Architecture: analytics, integration and E-advertising

*Source: Own elaboration*

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So, for a better understanding, it is relevant to mention web analytics, as a "tool, skill, action that collects digital user data, interprets data on web behaviour with the aim of building, extracting insights to improve the web and better understand users". (López Fernández, 2019). Main interfaces of the system The main interfaces of the web system are presented below, see figure 4,5,6,7.

## Box 5

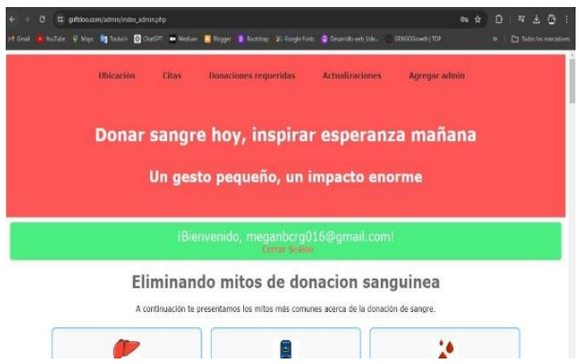


**Figure 4**

Login to the application as administrator

*Source: Own elaboration*

## Box 6


**Figure 5**

Blood myths

*Source: Own elaboration*

E-Advertising consists of the design, planning and implementation of advertisements, which aim to raise awareness of the population through information disseminated by digital media, such as Facebook and Instagram connected to the web system via APIs. See figure 6,7.

## Box 7


**Figure 6**

Campaign on the most frequent doubts about donations

*Source: Own elaboration*

It aims to educate, motivate and raise public awareness of the importance of donating blood regularly and safely. It usually includes activities such as educational talks, media awareness campaigns, organisation of donation days, and promotion of donation among different demographic groups. The ultimate goal is to ensure a constant and adequate supply of blood for patients in need in hospitals and health centres. See figure 7.

## Box 8


**Figure 7**

Campaign on blood donation standards

*Source: Own elaboration*

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## Results

The following is a description of the results related to the study variables, which were obtained by means of data collection instruments designed for the analysis of the research, and which, through descriptive statistics, allow for the confirmation of the hypothesis initially put forward.

In the data processing stage, statistical concepts were applied with the purpose of confirming the viability of the data collection tools, as well as their variability both before and after the deployment of the approach technique to the problem, among these parameters are: dispersion measures, multiple correlation coefficients, frequency analysis, as well as histograms that allow us to observe the results illustratively.

Therefore, the analytical evaluation of the data allows us to satisfactorily accept the hypothesis, demonstrating that through E-advertising strategies and a web software as a whole, the uncertainty associated with blood donations can be reduced, as can be seen in figures 11 and 12, in which we can appreciate the behaviour of the mean according to the items of the collection instruments designed, representing the trend lines ‘statistical model 1’, the original situation and ‘statistical model 2’ the situation after the implementation of the technological tactics postulated in the hypothesis; in the case of figure 12, after the second data collection, the answers of the sample oscillate between 1 and 2 according to the Likert scale, these being the desired values, representing a low index of ignorance. See figure 8,9.

**Box 9**

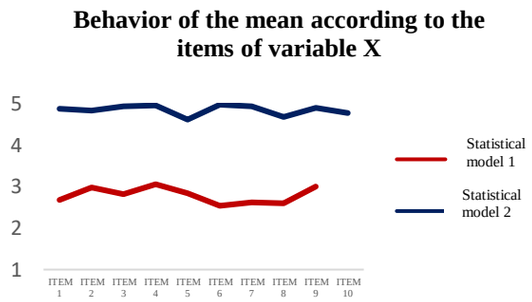


**Figure 8**

Plot of means of the variable X "information"

*Source: Own elaboration*

**Box 10**

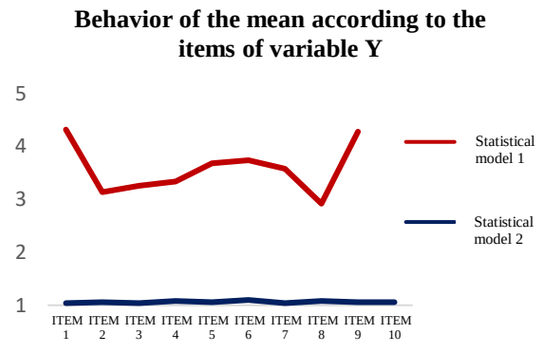


**Figure 9**

Plot of means of the variable Y "uncertainty”

*Source: Own elaboration*

On the other hand, through the analysis of the study variables, it is possible to estimate a percentage reduction or increase in each dimension (knowledge and ignorance) as the case may be, categorising the former into high and low according to the scale of measurement of these, of which such results can be perceived graphically through the figures shown below. The following graphs, figures 10 and 11, show the index and percentage of initial knowledge present in the population sample in which, out of a total of 450 responses, 302 of them fell into the classification of low knowledge and only 148 into high knowledge, with their corresponding percentages equivalent to 67% and 33% respectively. As the parameter was manipulated, it also experienced an increase, which can be seen in figures 12 and 13, with an effective percentage in high knowledge of 98%, so that only 2% of the sample continues to present low knowledge.

**Box 11**

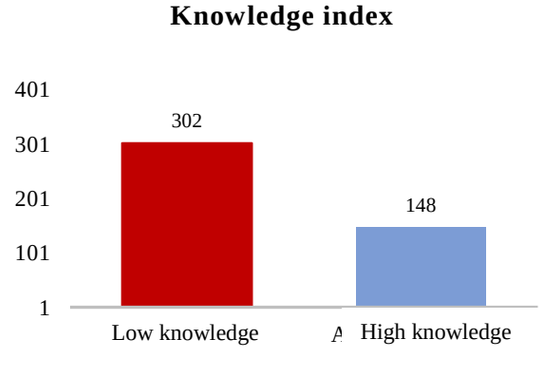


**Figure 10**

Knowledge level graph of model 1

*Source: Own elaboration*

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## Box 12

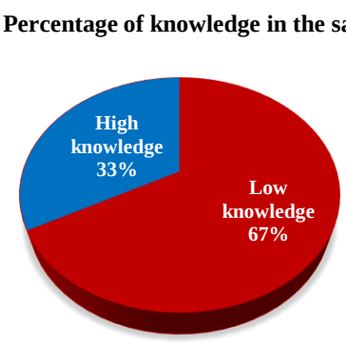


**Figure 11**

Graph of percentage of knowledge of model 1

*Source: Own elaboration*

## Box 13

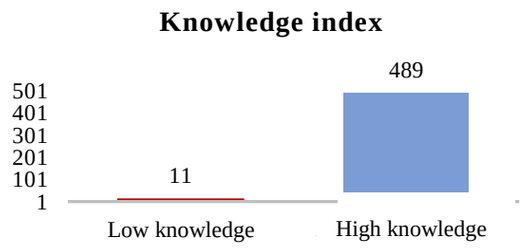


**Figure 12**

Knowledge level graph of model 2

*Source: Own elaboration*

## Box 14

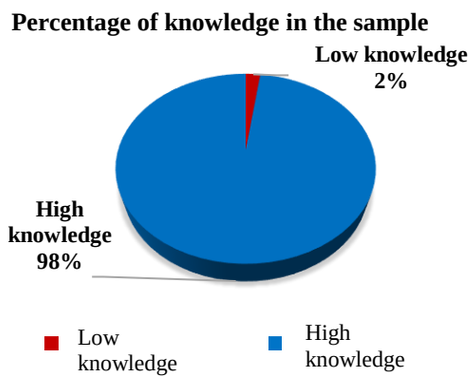


**Figure 13**

Graph of percentage of knowledge of model 2

*Source: Own elaboration*

On the other hand, with regard to the response variable, it is possible to observe the initial state of the index and percentage of ignorance (dimension of the variable 'uncertainty') in figures 14 and 15, in which it can be seen that, out of 450 responses, 326 are in the high ignorance classification, representing a percentage of 72%, while only 28% are in the low ignorance classification.

As this is the factor that determines the acceptance or rejection of the hypothesis, it can be effectively confirmed that the variable 'uncertainty' was positively affected, presenting a considerable reduction in the percentage existing in the population, reducing it to 2% in the classification of "high ignorance", so that 98% are in the category of "low ignorance", the same results that can be seen in figures 16 and 17.

## Box 15

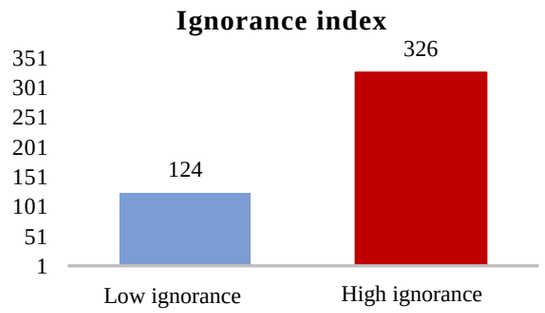


**Figure 14**

Ignorance level graph of model 1

*Source: Own elaboration*

## Box 16

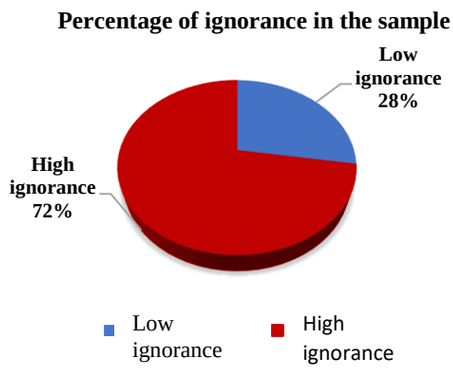


**Figure 15**

Percentage of ignorance graph for model 1

*Source: Own elaboration*

## Box 17

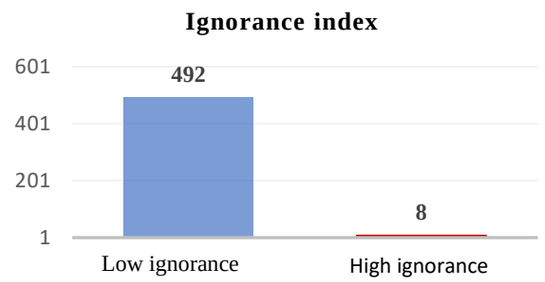


**Figure 16**

Ignorance level graph for model 2

*Source: Own elaboration*

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**Box 18**

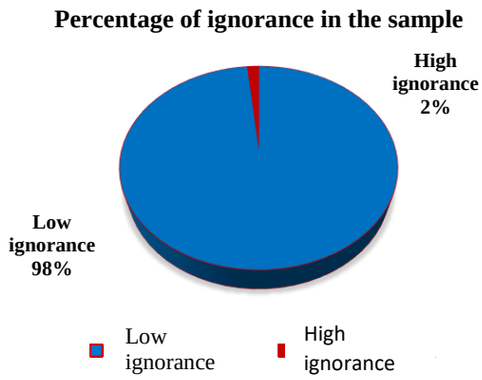


**Figure 17**

Percentage of ignorance graph for model 2

*Source: Own elaboration*

## Conclusions

Ultimately, the analysis of the data obtained allows us to sustain that the stated hypothesis is satisfactorily fulfilled, achieving the reduction of ignorance in the population in significant percentages based on the quantitative interpretation of the results, properly covering the research objectives initially established with positive effects on the persuasion of the population when categorising and interpreting the information related to the blood donation process as well as the maximisation of the quality of the same.

With regard to the study variables, as 'uncertainty' is dependent on the 'information' variable, together they are categorised as inversely proportional variables, so that the X factor (information) increased, which in turn had an influence on the dismissal of ignorance (the 'uncertainty' dimension).

Also, according to the minority of the historical background presented, and the results obtained, it can be supported that the previously analysed technological approach is positioned as a competent alternative in terms of innovation in the field of blood donation.

## Conflict of interest

The authors declare that they have no conflicts of interest. They have no known competing financial interests or personal relationships that might have appeared to influence the article reported in this study.

## Author contribution

*Nava-Fombona, Gabriel:* Contributed to the project idea. He contributed to the research design, the type of research, the approach, the method and the writing of the article.

*Vazquez-Pantaleon, Fco. Javier:* Contributed to the research method and technique. Supported the development of the architecture of the web system, supported the design of the field instrument, as well as writing the article.

*Cuellar-Rodriguez, Megan Brillith:* Carried out the systematisation of the state of the art. Supported in the development of the web system. Supported in the design of the field instrument. Also contributed to the writing of the article.

*Morales-Torres, Edson Uriel:* Supported the development of the web system. Supported in the design of the field instrument. He carried out the data analysis and systematisation of results, as well as writing the article.

## Availability of data and materials

The data were obtained through a rigorous instrument carried out by the authors of the article and applied to the end users.

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## Abbreviations

| | |
|---|---|
| API´s | Artificial Neural Network |
| ARCO | Acceder, Rectificar, Cancelar, Oponer |
| FVL | Fundación Valle del Lili |
| VPS | Servidor Privado Virtual |
| APP | Aplicación |
| PHP | Preprocesador de Hipertexto |
| HTML | Lenguaje de Marcado de Hipertexto |
| CSS | Hojas de estilo en cascada |
| JS | JavaScript |
| MySQL | Mi Structured Query Language |

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