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Journal of Technology and Innovation

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Presentation of content

In the first article we present, *Development of a prototype of a natural disaster prevention system using the Arduino platform*, by Echandi-Pacheco, Rodolfo & Caridad-Estrada, Marco, with adscription in the Universidad Fidélitas, in the next article we present, *The lack of terminal efficiency of the students of the 2018-2022 generation of the Faculty of Engineering of the Universidad Autónoma de Campeche*, by Turriza-Mena, Roselia Lorena, Canul-Turriza, Román Alejandro, Cach-Coba, Brenda Madelin and Quej-Cosgaya, Héctor Manuel, with adscription in the Universidad Autónoma de Campeche, Instituto Campechano, in the next article we present, *Dynamic web application for dissemination of blood donations and registration of donor candidates implementing e-advertising*, by Nava-Fombona, Gabriel, Vázquez-Pantaleon, Fco. Javier, Cuellar-Rodriguez, Megan Brillith and Morales-Torres, Edson Uriel, with adscription in the Tecnológico Nacional de México - Instituto Tecnológico de Lázaro Cárdenas, in the next article we present, *Administrative audit of a topography company in the State of Michoacán*, by Díaz-Azamar, Álvaro, Olguin-Jácome, Zulema, Parra-Valis, Dionicio and Lira-Vazquez, Isabel, with adscription in the Tecnológico Nacional de México / Campus Tuxtepec.

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Development of a prototype of a natural disaster prevention system using the Arduino platform

Desarrollo de un prototipo de un sistema de prevención de desastres naturales utilizando la plataforma Arduino

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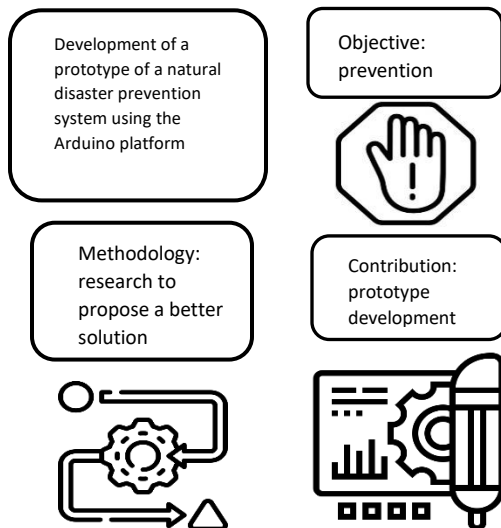


Abstract

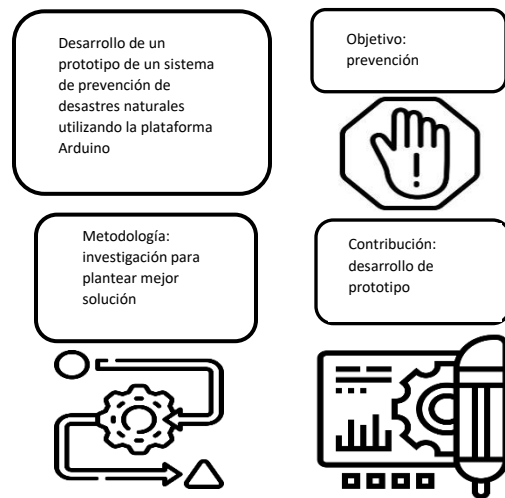
Nowadays, new forms of innovation are constantly sought in the technological field to face the new needs that, we as a society, encounter on a daily basis. The main objective of this project is to help communities where prevention is essential due to their geographical location that makes them more vulnerable to this type of natural disasters and thanks to technologies like Arduino it is easier to find the solutions that our society needs. Arduino allows the installation and configuration of multiple sensors such as ultrasonic, pulse and temperature, among others, which means that the system can be placed on bridges that cross rivers, providing an important solution for communities in the face of natural disasters.

Resumen

Hoy en día se buscan constantemente nuevas formas de innovación en el campo tecnológico para enfrentar las nuevas necesidades que como sociedad se encuentran en el día a día. El objetivo principal de este proyecto es ayudar a las comunidades donde la prevención es imprescindible debido a su ubicación geográfica que las hace más vulnerables a este tipo de desastres naturales y gracias a las tecnologías como Arduino es más fácil encontrar las soluciones que nuestra sociedad necesita. Arduino permite la instalación y configuración de múltiples sensores como los ultrasónicos, de pulso y de temperatura, entre otros, lo que hace que el sistema pueda ser colocado en puentes que cruzan ríos, brindando una solución importante para las comunidades frente a los desastres naturales.



Arduino, Sensors, Prototipo



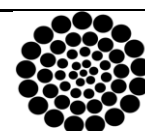
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Introduction

This article seeks to show how technology, if applied correctly, can play a very important role in society by providing positive solutions.

In many countries, including Costa Rica, there are communities in rural areas close to rivers, where they are frequently affected by flooding due to the overflowing of rivers, mainly during the rainy season. For example, on both main slopes of the country, the Pacific and the Caribbean, there are river systems that periodically overflow their banks and flood nearby areas, generating negative impacts on the communities and the local economy (Quesada, M., 2003). Even in some of these areas it is common to find bridges over rivers at the entrance to communities where high rainfall can cause the bridge to be destroyed. Based on this letter, it was decided to look for a solution that would try to warn and prevent disasters in these areas.

One of these tools is the Arduino, which in general terms is an open source electronic creation platform based on free hardware and software that is very easy to use by technology creators and developers (Torrente, O., 2013).

Thanks to tools such as Arduino, which is very versatile, the development of a prevention system for this type of disaster was an ideal solution, since, with a large number of components available on the market, such as different types of sensors and actuators, it has been possible to create a prototype that meets the purpose of helping to prevent disasters in these communities.

Therefore, the project's main objective is to monitor certain conditions and alert in case of a possible flood, taking into account the increase in river flow. However, it will also have other functionalities that contribute to the same objective and thus be able to offer a more complete product that provides a greater benefit to society.

Methodology

The idea of developing a prototype to help the rural population with natural disasters entails carrying out research on the Arduino platform, considering how the components that are linked to it connect and function, and which devices are necessary to provide a solution to the problem of flooding.

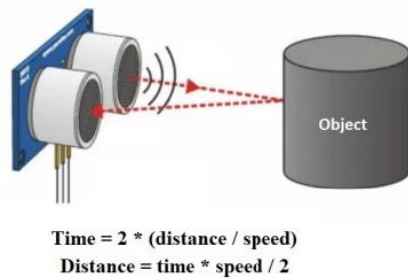
Therefore, the components that will be used in the prototype along with the Arduino platform will be described below, these components are as follows:

Ultrasonic sensor

It is in charge of measuring the distance by means of a high frequency pulse, which can work to measure the water level. When the ultrasonic sensor detects that the river is very high, a signal would be sent to activate a servomotor and thus lower the needle on the bridge so that the cars do not pass and avoid a catastrophe. Figure 1 shows a picture of the sensor and how it works.

According to [Naylamp Mechatronics \(2024\)](#) the technical specifications of the sensor are:

..	Operating Voltage:	5V	DC
..	Operating Current:	15mA	
..	quiescent current:	<	2mA
..	Measuring range:	2cm to	450cm
..	Accuracy:	+/-	3mm
..	Angle of aperture:		15
..	Ultrasonic frequency:		40KHz
..	Minimum TRIG trigger pulse duration (TTL level):	10	µS
..	ECO output pulse duration (TTL level):	100-25000	µS
..	Dimensions:	45mm x 20mm x 15mm	
..	Minimum waiting time between one measurement and the start of another:	20ms	(50ms recommended)

Box 1**Figure 1**

Ultrasonic sensor

Source:

<https://tecnopatafisica.com/tecno3eso/teoria/robotica/27-hcsr04>

Pantalla LCD

It is a small display on which data about the current status of the water flow is shown. An Arduino LCD is a liquid crystal display that is used to display information in Arduino projects. Arduino LCDs are popular because of their ease of use and low cost. One of the most common types of Arduino LCDs is the 16x2 LCD, which has a resolution of 16 characters by 2 lines.

Box 2**Figure 2**

LCD pin layout 16x2

Source:

<https://controlautomaticoeducacion.com/arduino/lcd/>

LCD displays have different characteristics because they are manufactured in different sizes and their use depends on the need, the common sizes in the market are 16x2 LCD (2 rows and 16 characters), 20x4, 20x2 and 40x2.

As explained by Castaño (2019) of the 16 pins, 12 pins will be used to make a basic connection. As shown in figure 2, these pins are as follows: 'RS' pin which controls in which part of the LCD memory the data is being written. Read/Write' pin (R/W) selects the read or write mode. Pin 'EN' this pin enables the registers. Data pins 'D00-D07' where bits are sent to write to a register. CONTRAST' pin which adjusts the contrast of the LCD display. Pin A and Pin K 'backlight' (Bklt+ and Bklt-) which control the backlight of the LCD display. And the Vcc and GND power pins.

Light-emitting diodes (LEDs)

According to MecatrónicaLATAM (2021), the light-emitting diode (LED) is a light source that emits photons when a very low intensity electric current is received, as shown in figure 3.

Three LEDs (green, yellow and red) will be used to indicate how serious the water level is. If the water level is higher than 0 cm and lower than 59 cm all LEDs are off. If the water level is higher than 60 cm and lower than 89 cm the yellow led is on, and finally if the water level is higher than 90 cm the red led is on.

Box 3**Figure 3**

Light-emitting diodes (LEDs)

Source:

<https://electronicaradical.blogspot.com/2011/02/led-diodo-emisor-de-luz.html>

An LED diode can only be forward biased, meaning it conducts current and emits light, while reverse biased LEDs do not conduct current and do not emit light. It is important to include a series current limiting resistor in the circuit to avoid excessive forward current, which can damage the LED diode. In circuits where a voltage of 5V is used, it is common to use a 330Ω resistor (MecatrónicaLATAM, 2021).

Servomotor This actuator will help to close or open the access through the bridge, this with the help of the ultrasonic sensor, as it will automatically tell you if the flow reaches a certain level of danger to close the gate or barrier that is on the bridge and thus prevent any catastrophe when a vehicle passes. A servomotor, as shown in Figure 4, is a drive device that contains a decoder inside, which converts mechanical motion into digital pulses interpreted by a motion controller. They also use a driver, which together form a circuit to command position, torque and speed. (Aula21, 2024).

Box 4



Figure 4

Servomotor

Source: <https://emacstores.com/servomotor/>

DC motor with H-bridge

This is intended to open and close the gates that control the flow of water in the river. It will also depend on the signal received by the ultrasonic sensor, if the level is high it will open the gate to help move the water through the tributaries on site.

Box 5



Figure 5

Different types of DC motors

Source:

<https://www.automatizacionparatodos.com/puente-h-arduino/>

It is important to mention that a DC motor, as shown in figure 5, is basically a load which, when supplied with the necessary voltage, will rotate in one direction. All DC motors have a polarity indicated, i.e. a positive and a negative terminal. If you change the polarity of a DC motor, the only thing that will happen is that it will turn in the other direction. (Gastélum, 2021). In addition, to be able to perform the opening and closing function, an H-bridge circuit is needed to help us control the direction of rotation of the DC motor and thus have the functions of opening and closing.

A circuit known as an H-bridge allows to manipulate the direction of the electric current in one or the other direction, this is achieved by means of four transistors. They are arranged in such a way that when you need to turn the motor in one direction, two are activated; and when you want to turn the motor in the other direction, the other two are activated (Gastélum, 2021).

The H-bridge, L293D allows driving up to two DC motors with supply voltages (pin 8) between 4 and 36 volts.

Force sensor

The force sensor shall be used to monitor the weight of the vehicles. It will close the doors or gates of the bridge if the vehicle in question exceeds the weight limit.

Box 6

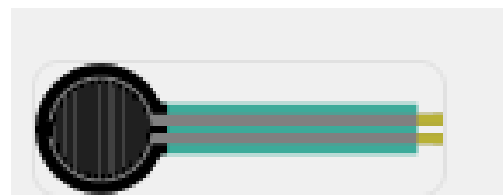


Figure 6

Sensor FSR 402

Source: https://www.makerguides.com/es/fsr-arduino-tutorial/#Basic_construction

The sensor varies its resistance according to the pressure or force applied to the circular area. The harder it is pressed, the lower its resistance. When not pressed, its resistance is greater than $1M\Omega$.

The FSR 402 sensor consists of two membranes and a spacer adhesive as shown in figure 6. The conductive membranes are separated by a thin air gap when no pressure is applied. One of the membranes contains two traces running from the tail to the detection zone (the round part as shown in figure 2). These traces are intertwined, but do not touch. The other membrane is coated with a conductive ink. When the sensor is pressed, the ink short-circuits the two traces with a pressure-dependent resistance (Bakker, 2023).

Temperature sensor

The temperature sensor will measure the ambient temperature and at the same time issue a warning alert when temperatures are too high or too low in order to avoid a risky situation affecting the integrity of people.

Box 7

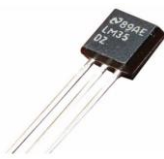


Figure 7

Temperature sensor

Source: <https://www.hwlibre.com/sensore-de-temperatura/>

The LM35 temperature sensor is used for all types of projects. The output of this sensor is analogue and it is calibrated directly in degrees Celsius. The temperature it admits ranges from 2° C to 150° C. (García, 2018).

Active Buzzer

Finally, the buzzer or buzzer will be the audible alarm if an emergency situation arises and thus be able to warn audibly what is happening.

Active buzzers or buzzers are devices that generate a sound of a certain frequency as shown in Figure 8. This incorporates a simple oscillator so it is only necessary to supply current to the device to emit sound.

Box 8



Figure 8

Active Buzzer

Source: <https://www.luisllamas.es/arduino-buzzer-activo/>

On the other hand, they have the disadvantage that the tone of the emitted sound cannot be varied, so melodies cannot be emitted, which can be done with passive buzzers (Llamas, 2016).

Results

Firstly, figure 9 shows the block diagram in which the main components of the prototype that was developed can be observed in a simple and schematic way. Basically, there is an Arduino board to which different types of sensors were added that allowed having parameters to detect a natural disaster emergency and thus be able to warn people in the community.

Box 9

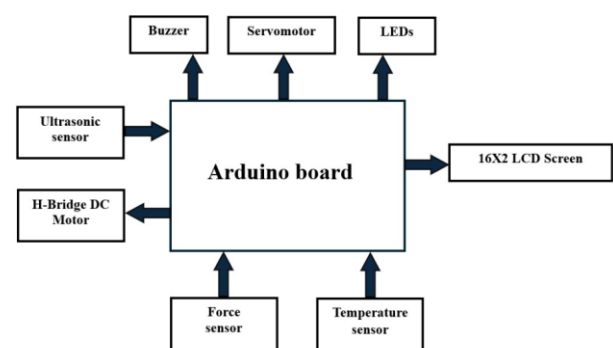
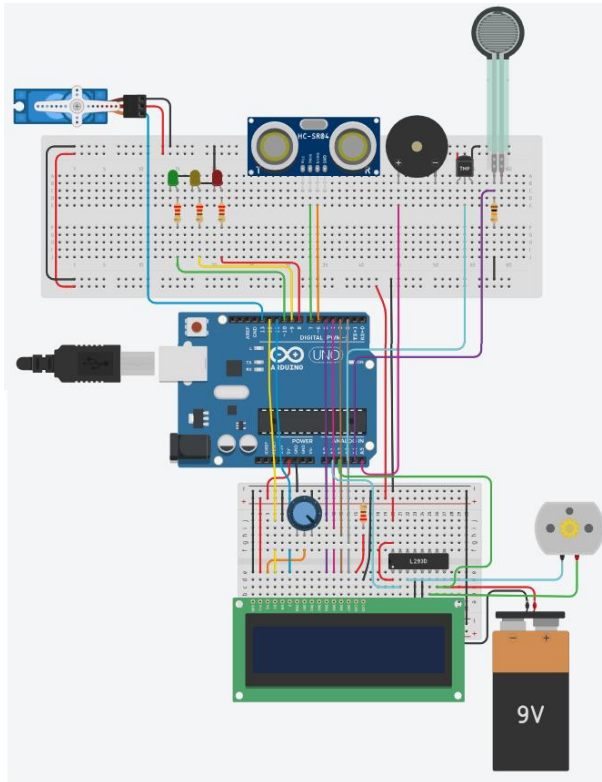


Figure 9

Block diagram of the prototype

Source: Own Elaboration

Once the circuit design had been assembled, and the functionality of each of its components was clear, the circuit was assembled, but not before foreseeing a correct arrangement of each of its parts to ensure the correct functioning of the whole project, as shown in figure 10.

Box 10**Figure 10**

Presentation of the prototype

Source: Own elaboration

The following procedure was followed to connect the different components of the project:

- a) servomotor: it has 3 pins to connect it, a supply voltage is required (connection to Vcc and GND). The servomotor control pin was connected to pin 13 of the Arduino.
- b) DC motor: has 2 pins to connect, a supply voltage is required (connection to Vdc and GND). Depending on how it is polarised (Vcc-GND / GND-Vcc) so will be its direction of rotation. The DC motor pins were connected to pins 3 and 6 of the H-bridge.
- c) H-bridge (L293D): has 16 pins to connect. For the prototype, in addition to the connections to Vdc and GND, the inputs on pins 2 and 7 and the outputs on pins 3 and 6 will be used to connect and manipulate the DC motor. The pins to connect the H-bridge to the Arduino board will be on pins A1 and A2 (which will be used as digital pins 15 and 16, respectively).
- d) Ultrasonic sensor: it has 4 pins which are Vcc, TRIG which is connected to pin 7 of the Arduino, ECHO which is connected to pin 6 of the Arduino and GND which is connected to ground.
- e) LEDs: Each LED is connected to a 220 ohm resistor to protect it and prevent damage. It is important to remember that the leds have polarity and it must be respected for them to work. In the case of the green LED: the cathode is connected to ground and the anode is connected to a 220 ohm resistor and the output of this is connected to pin 10 of the Arduino. In the case of the yellow LED: the cathode is connected to ground and the anode is connected to a 220 ohm resistor and the output of this is connected to pin 9 of the Arduino. In the case of the red LED: the cathode is connected to ground and the anode is connected to a 220 ohm resistor and the output of this is connected to pin 8 of the Arduino.
- f) active buzzer: the positive pin of the buzzer is connected to pin A5 (which will be used as digital pin 19) and the negative pin to ground.
- g) temperature sensor: it has three pins, Vcc for the positive, Vout pin for the output voltage in millivolts (mV) which is connected to the analogue input A3 of the Arduino and GND which is connected to ground.
- h) Force sensor: has two pins, one of which is connected directly to 5 volts (Vdc). The other pin connects to pin A4 of the Arduino. In addition, between this connection and the Arduino a 10k ohm resistor is connected to ground.
- i) LCD display: has 16 pins, of which only 12 will be used as shown below:
 - Pin 1 - Vss, connects to GND (ground).
 - Pin 2 - Vcc, connects to 5 V (positive).
 - Pin 3 - Vee, connects to a 10 K Ω potentiometer to adjust the display contrast.
 - Pin 4 - RS, connects to digital pin 12.
 - Pin 5 - RW, connects to GND (ground).
 - Pin 6 - E, connects to digital pin 11.
 - Pin 11 - D4, connects to digital pin 5.
 - Pin 12 - D5, connects to digital pin 4.

Article

Pin 13 - D6, connects to digital pin 3.
 Pin 14 - D7, connects to digital pin 2.
 Pin 15 - LED+, is connected via a resistor* to Vdc.
 Pin 16 - LED-, is connected to GND (ground).

* This resistor can vary between 160 Ω and 220 Ω . When the implementation is done, the corresponding tests must be done. Pins 15 and 16 are responsible for switching on the LCD backlight. It is not mandatory to connect them, but it is recommended.

Regarding the programming code, some important comments used in the prototype are presented below.

At the top of the IDE, the libraries are included and the pin variables are defined. For the LCD display, the LiquidCrystal.h library will be used. Also in this same part, it is required to initialise the library indicating the pins of the interface, as follows: LiquidCrystal lcd(12, 11, 5, 4, 3, 2); corresponding to pins RS, EN, D4, D5, D6, D7.

For the servo motor, the Servo.h library will be used, which makes it very easy to position the servo motor at the desired angle. Once the libraries have been called and the global variables have been created, you will have the void setup section. This contains the initialisation of the components as input or output of the Arduino board (Arduino Factory, 2022).

The instructions written within the void setup() section are executed only once at the moment of powering up (or resetting) the Arduino board. (MCI Electronics, 2024)

On the other hand, the Serial.begin(9600) instruction will be used to initialise or open the serial port communications so that the IDE can communicate with the Arduino board.

The pinMode() command will also be used to declare each of the pins as inputs or outputs as appropriate.

The lcd.begin() command will be used to declare the dimensions of the LCD. And the instructions Motor.attach(), to indicate the pin where the servomotor is connected and Motor.write(), to place the servomotor in the start position.

The last section will be the void loop() where all the operating code for the different components of the project will be written. This means, that the code in the void loop() section runs all the way from the first line of code to the last one, and once it reaches the last one, it starts again from the first line of code, and so on and so on. (MCI Electronics, 2024).

Finally, three different types of sensors (ultrasonic, force or weight and temperature) were implemented for the prototype to collect all the necessary information for the system to work as expected.

In addition, four actuators (LCD screen, buzzer, LEDs, servomotor and DC motor) were used to provide visual and audible alerts when an event occurs and to avoid catastrophes or to warn the population in advance of any problems that may arise.

An ultrasonic sensor was used to measure the distance using ultrasonic waves, counting the time between the emission and reception of the river flow.

On the other hand, the three LEDs were used to indicate the severity of the rising water. And the LCD display to show the water flow information as well as the water level and temperature.

The force sensor combined with the servomotor will help to close the barriers or gates of the bridge. Likewise, the servomotor has the specific function of opening and closing the barrier to regulate the passage of vehicles across the bridge in order to safeguard the integrity of the bridge and/or to prevent vehicles from passing in case the flow rate is too high.

While the temperature sensor monitors the value in the environment and with preset values will issue a prevention alert when temperatures are too high or too low in order to avoid any risky situation affecting the integrity of people.

The DC motor will help to close or open the flow gate, so that when the flow reaches a certain danger level it should close the gate to prevent it from overflowing and avoid any catastrophe.

Finally, the buzzer will sound an alarm when an emergency situation arises to alert the whole community of what is happening.

Conclusions

The project as such aims to help the population either to avoid catastrophes or to warn in advance of any type of anomaly registered by the different sensors.

The system is designed to be implemented in critical areas where communities are mostly affected by floods caused by overflowing rivers.

With the knowledge obtained, it was possible to achieve what was proposed in order to obtain the full functionality of the circuit. In addition, it should be noted that, with the experience gained in the project, it has been possible to understand more about the use of technological tools such as Arduino, which makes small ideas can become great projects of social good, depending on the use to which these tools are put.

Declarations

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 paper.

Authors' contribution

Each of the investigators has a 50% contribution each to the points developed in this research.

Availability of data and materials

Data for this research are available according to the sources consulted.

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Abbreviations

CC	direct current
GND	negative or earth
LCD	liquid crystal display
LED	light emitting diode
Vcc	DC voltage

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
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

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The lack of terminal efficiency of the students of the 2018-2022 generation of the Faculty of Engineering of the Universidad Autónoma de Campeche



La falta de eficiencia terminal de los alumnos de la generación 2018-2022 de la Facultad de Ingeniería de la Universidad Autónoma de Campeche

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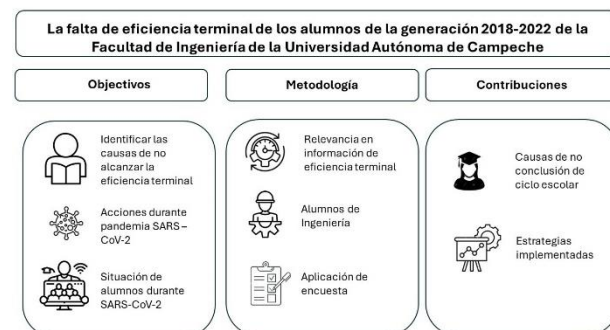
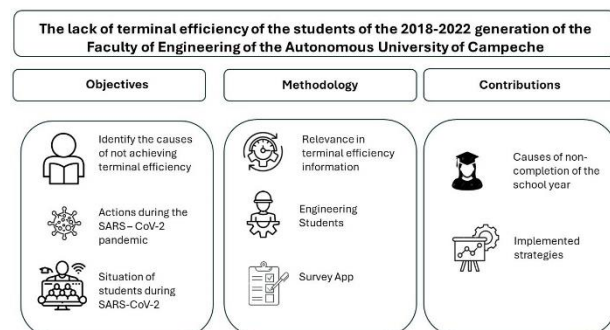


Abstract

The research addresses academic completion in the Faculty of Engineering of the Autonomous University of Campeche (UAC) during the 2018-2022 generation, especially affected by the COVID-19 pandemic. Despite the reputation of the UAC and its efforts to maintain educational quality, several causes are identified that contribute to low terminal efficiency. A quantitative and descriptive approach was used, surveying 200 students about various factors such as academic support, study conditions, and the effectiveness of online classes. The results indicate that many students faced difficulties such as lack of devices, internet connectivity problems, and loss of family employment, which impacted their ability to complete their studies. In addition, the lack of teaching support and emotional problems were also relevant factors. It is concluded that, despite the UAC's efforts to mitigate the impact of the pandemic, the combination of internal and external factors limited the terminal efficiency of this generation. Possible solutions are suggested to improve the academic situation of students in the future.

Resumen

La investigación aborda la terminalidad académica en la Facultad de Ingeniería de la Universidad Autónoma de Campeche (UAC) durante la generación 2018-2022, especialmente afectada por la pandemia de COVID-19. A pesar de la reputación de la UAC y sus esfuerzos por mantener la calidad educativa, se identifican varias causas que contribuyen a la baja eficiencia terminal. Se utilizó un enfoque cuantitativo y descriptivo, encuestando a 200 estudiantes sobre diversos factores como apoyo académico, condiciones de estudio y la efectividad de las clases en línea. Los resultados indican que muchos estudiantes enfrentaron dificultades como la falta de dispositivos, problemas de conectividad a internet y la pérdida de empleo familiar, lo que impactó su capacidad para completar sus estudios. Además, la falta de apoyo docente y problemas emocionales fueron factores relevantes. Se concluye que, a pesar de los esfuerzos de la UAC para mitigar el impacto de la pandemia, la combinación de factores internos y externos limitó la eficiencia terminal de esta generación. Se sugieren posibles soluciones para mejorar la situación académica de los estudiantes en el futuro.



Terminal efficiency, Education, Campeche

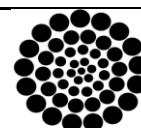
Eficiencia terminal, Educación, Campeche

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Introduction

Currently, educational institutions are in an area of constant opportunity, which is their school enrollment since thousands of students enter each educational period and few complete. Universities play a primary role in the development and improvement of the terminal efficiency of students and that is why the Autonomous University of Campeche (UAC) is among the school institutions that constantly works to achieve terminal efficiency.

The purpose of this research is to identify the causes that influence the lack of terminal efficiency among students of the Faculty of Engineering of the UAC of the generation. Despite the prestige and principles of this educational institution, which for decades has trained young people with leadership and initiative skills in each of its faculties, it is examined why in the year 2022 it has been affected by the phenomenon of efficiency terminal in university students. It is recognized that this period coincided with the pandemic, and in response, the Autonomous University of Campeche prepared its teaching staff and improved its infrastructure by implementing a support model to guarantee the continuity of academic services.

Likewise, this article investigates and searches for the causes that led to not achieving the desired terminal efficiency, taking as a parameter the number of students who entered and had to graduate from the generation studied, this despite the UAC having carried out actions to combat the problem that was arising due to the SARS-CoV-2 pandemic.

Methodology

Terminal efficiency is a very relevant topic for any educational institution and even more so for the Autonomous University of Campeche, so before delving into the topic it is necessary to know what the words terminal efficiency mean; It is observed that the term efficiency is not a new concept since within the administrative language, in the first years of the 20th century, Frederick Taylor, the greatest precursor of scientific administration, established a theory that focused on work management, through the study of times and movements of execution of the working day of workers in factories, in this way it was possible to increase productivity, thereby increasing efficiency in the processes. The same author defines efficiency as the orientation towards the best way to execute or carry out things or work methods, using resources such as people, machines, raw materials, in the most rational way possible (Chiavenato, 2007).

Likewise, there are other definitions of terminal efficiency such as that of the Ministry of Public Education (SEP) in Mexico, which in numerical terms states that it is “the proportion between the number of students who enter and those who graduate from the same generation, considering the year of entry and year of graduation according to the duration of the study plan” (Pérez, 2016). Likewise, (Martínez, 2001, as cited in Pérez, 2016) defines terminal efficiency as the proportion of students who finish a degree in relation to those who started it and considers that it is a dimension of quality that must be considered since the cost of education depends on it. the products of higher education (Domínguez *et al.*, 2014).

Applying Taylor's theory at educational levels, it would then be said that the main function of higher-level educational institutions falls mainly on all the participants involved in it, such as: director, academic secretary, coordinators, teachers, tutors and parents. ; then the magnitude of the commitment that each of them has will be the impact on the achievement of the proportion of students who manage to graduate in relation to those who entered, thus reaching the appropriate terminal efficiency (López *et al.*, 2008).

There are factors that can influence the terminal efficiency of young university students, such as internal and external factors. Internal ones refer to those that the institution must focus on to increase what is called terminal efficiency, that is, the number of enrolled students is the same as the number that completely completes their level of studies.

Starting from the situation that afflicts the UAC in question of the terminal efficiency term, it is important to mention the following. The Autonomous University of Campeche is an institution whose mission is to train capable professionals who can develop in the environment of our country and towards other borders; Therefore, one of its main objectives is to have greater enrollment and have terminal efficiency on par.

The methodology of this study has a quantitative and descriptive approach, it seeks to describe, explain, and predict the phenomena that occur around the research, in the same way it was analyzed what the strategies would be to resolve such a situation that afflicts the institution. For this topic, the students of the 2018-2022 generation of the UAC Faculty of Engineering were chosen at random. It must be emphasized that in 2019 the country was in a SARS-CoV-2 pandemic situation.

When starting the investigation on the terminal efficiency of the students of this generation, it is important to know that according to the statistics of the beginning of courses of the 2018-2019 school year, the total school population in the entity of Campeche at the higher level was 32,167 students; of which, our University is considered the institution with the highest enrollment, with a total of 7,375 young people enrolled, that is, this represents 22.9 percent of the state total. Particularly, at the bachelor's level, a quarter of the students at this level throughout the state are students enrolled at the University (Autonomous University of Campeche, 2019).

We relate this last data to the year 2022 because it is the culmination of the 2018-2022 generation in which the UAC had 1,271 students who graduated; of which 590 were men and 681 women. The faculties with the most graduates were the following Health Sciences (507), Social Sciences and Law (267) and Administration and Business (228) (economía.gob.mx, s.f). Below are some images that reflect the situation.

Box 1

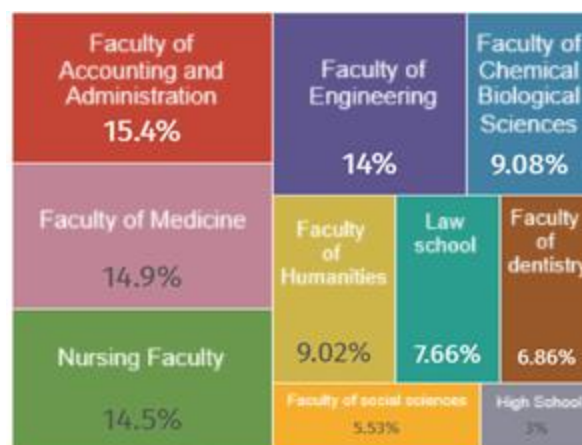


Figure 1
Graduates according to campus 2022

Source: *economía.gob.mx*. (s.f). *Universidad Autónoma de Campeche*.
<https://www.economia.gob.mx/datamexico/es/profile/institution/universidad-autonoma-de-campeche>

Box 2

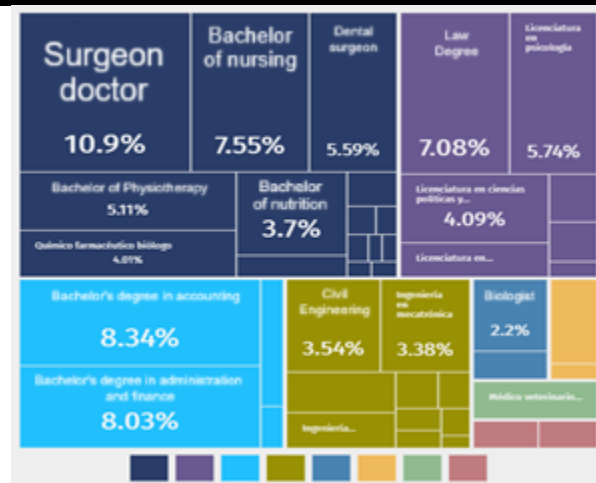


Figure 2
Graduates according to career 2022

Source: *economía.gob.mx*. (s.f). *Universidad Autónoma de Campeche*.
<https://www.economia.gob.mx/datamexico/es/profile/institution/universidad-autonoma-de-campeche>

In the same year (2022) the UAC obtained 64 graduates, of which 27 were men and 37 women. The areas with the most graduated students were Administration and business (23), Health sciences (23) and Natural sciences, mathematics, and statistics (9); Likewise, 971 students graduated from their studies. Figure 3 shows the total number of men and women graduates, graduates, and graduates.

Box 3

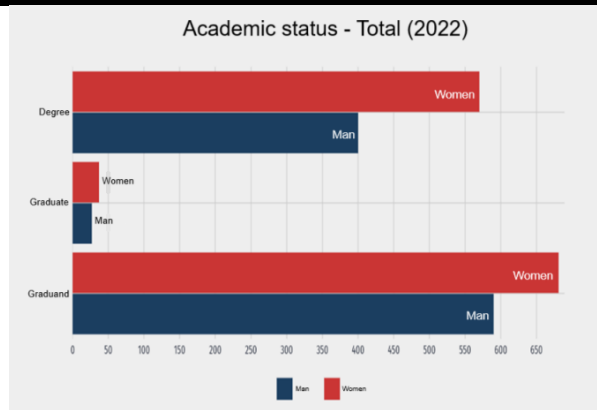


Figure 3

Graduates according to career 2022
 Source: *economía.gob.mx. (s.f). Universidad Autónoma de Campeche.*
<https://www.economia.gob.mx/datamexico/es/profile/institution/universidad-autonoma-de-campeche>

The main question to answer is: Where are the other enrolled students? Why does the UAC not achieve the terminal efficiency goal?

Next, questions were asked to the students. These questions were applied to a representative sample of 200 students from this 2018-2022 generation, who were acquiring online classes during the COVID-19 pandemic.

The questions refer to the ages at which the students of the Engineering degrees in: Computer Systems, Electrical Mechanics, Energy, Civil and Administration, Mechatronics and Software Technology were during the COVID-19 pandemic; the gender of the students; degree; place of residence; years of study at the UAC; failed subjects; tutor support; titration factors; online study efficiency; technology and software used online; online learning efficiency; place where classes were taken; technological resources of the Faculty of Engineering; internet at home; post-pandemic support; electronic devices at home; as well as the reasons why he did not complete the degree.

Results

We found that there are 148 19-year-old students, which represent 74% of the total university students surveyed, also 29 of them are 20 years old, which is equivalent to 14%, 14 students are 21 years old correspondingly. 7% and 9 mention having other ages, which represents 5% (Figure 4).

Box 4

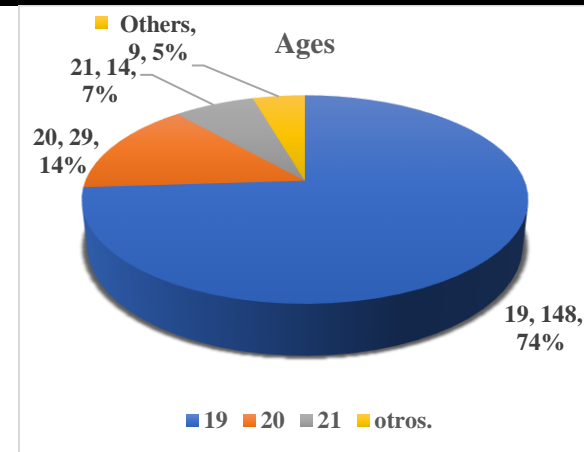


Figure 4

Age of the students of the 2018-2022 generation.
 Source: *Own elaboration*

Figure 5 shows that there are 154 young people with the male gender representing 77%, 44 students with the female gender which corresponds to 22% and 2 non-binary students representing 1%.

Box 5

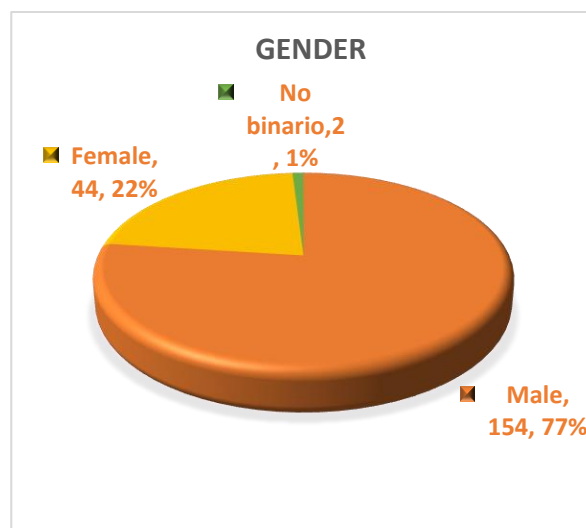


Figure 5

Gender of students of the 2018-2022 generation.
 Source: *Own elaboration*

The number and percentage of students for each degree in Engineering were obtained, which are as follows: Computer Systems, 34 students, which represents 17%, Electrical Mechanics, 21 university students with a percentage of 10%, Energy corresponding to 7%. , Civil and Administration, 70 young people corresponding to a percentage of 35%, Mechatronics, 39 students with a percentage of 20% and Software Technology with 21 students and a percentage of 11% (Figure 6).

Box 6

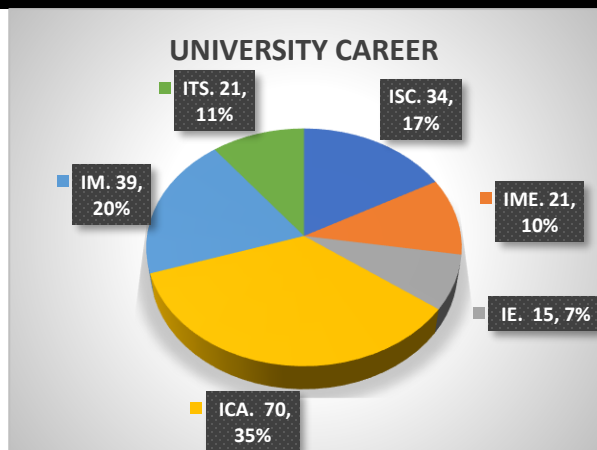


Figure 6

University career of students of the 2018-2022 generation.

Source: Own elaboration

Figure 7 shows that 94 students live in the municipality of Campeche, 10 live in the municipality of Calkiní, 15 live in the municipality of Hecelchakán and in the concept of others with several 81, they answered that they live in other municipalities of the same state, as well as in other states of Tabasco, Mérida and Veracruz.

Box 7

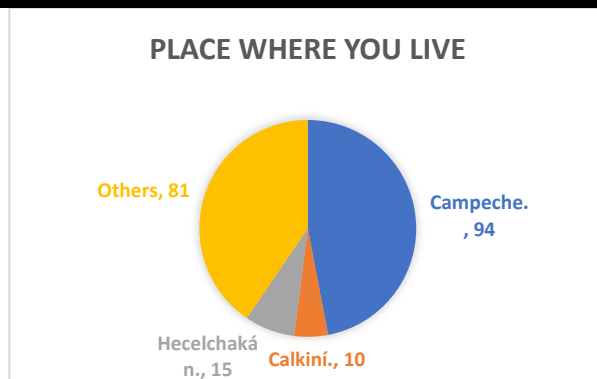


Figure 7

Place where the students of the 2018-2022 generation live.

Source: Own elaboration

In Figure 8 it is observed that there are 13 students who have been studying for a year at the Faculty of Engineering, which represents 7%, likewise 162 university students have a period of 2 years which corresponds to 81%, in the same way there are 13 students who are in the Faculty for 3 years representing 6% and in the case of others there are 12 students which corresponds to 6%.

Box 8

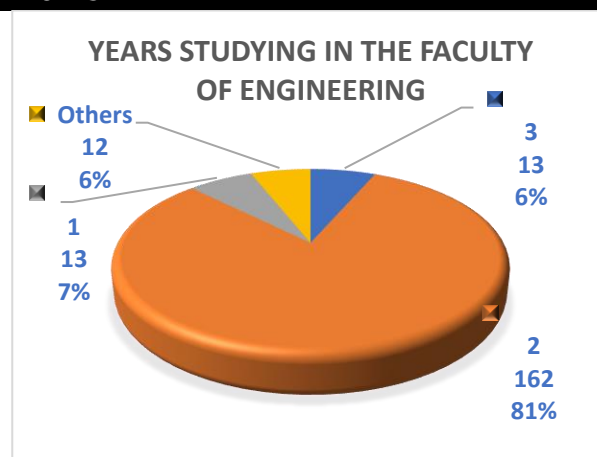


Figure 8

How many years have you been studying at the Faculty of Engineering of the Autonomous University of Campeche?

Source: Own elaboration

It was detected that 24 students have failed 3 subjects, 53 students have failed two subjects, 34 university students have failed one subject and 89 students have not failed any subject (Figure 9).

Box 9

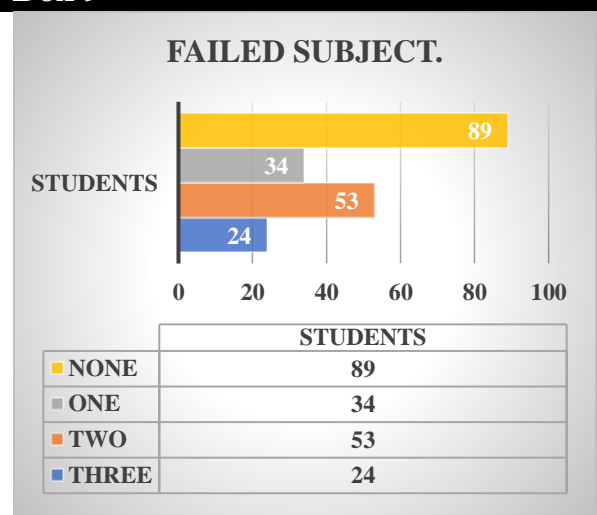


Figure 9

Do you have any failed subjects? If so, how many?

Source: Own elaboration

Through Figure 10 it is observed that, with respect to the question about support received from the tutors, 27 students of those surveyed responded with a yes, 117 students answered no and in the response of others, 56 students answered that They did not know and had no knowledge who their guardian was.

Box 10

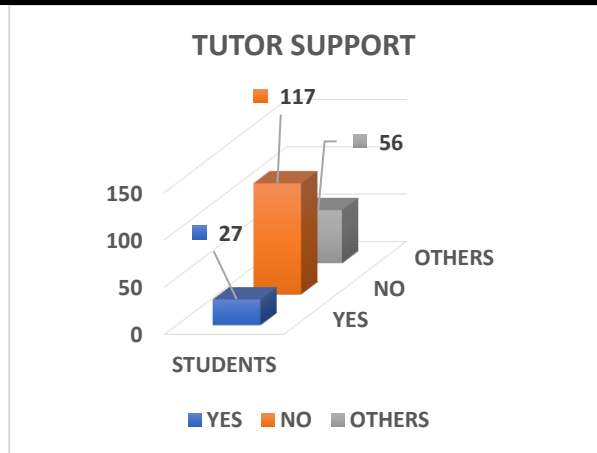


Figure 10

Have you received support from tutors or academic advisors during your academic career?

Source: Own elaboration

Figure 11 graphs the responses to the question: What factors do you consider most relevant to achieving the degree?; It is observed that 74 students mention that one of the relevant factors that would allow them to obtain a degree is personal motivation, followed by 48 university students who point out that the quality of teaching is important to achieve the aforementioned objective; Similarly, 38 students comment that family support is essential to graduate and finally 23 students point out that among other factors they encountered the death of the family member who supported them to continue studying and complete their studies; Likewise, the father of the family lost his job or, if applicable, the student lost his job.

Box 11

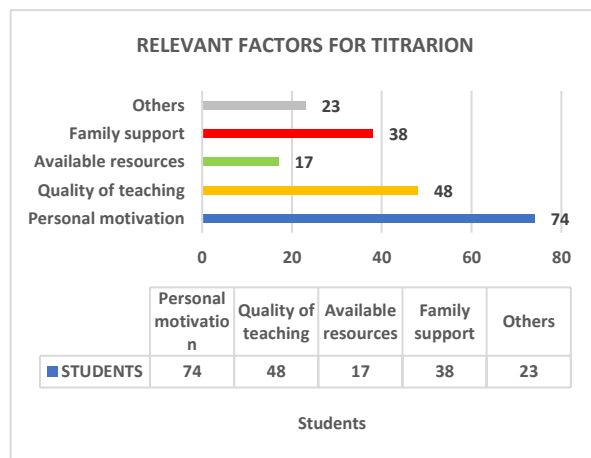


Figure 11

What factors do you consider most relevant to achieving the degree?

Source: Own elaboration

For the question How effective are your teachers when studying online? Figure 12 was prepared, which summarizes the responses obtained; It is observed that there are 7 students who consider that the teachers have not been useful at all when studying online, as well as 72 students think that the teachers have been slightly useful, in turn 80 university students mention that the teachers are moderately useful when studying online ; Likewise, 30 students consider that their teachers have been very useful and 11 students find their teachers extremely useful when studying online.

Box 12

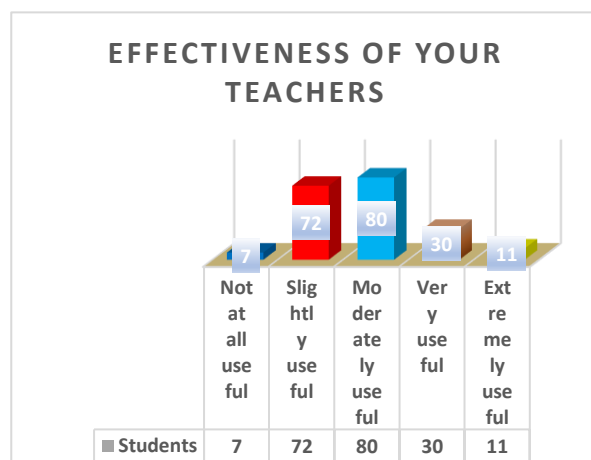


Figure 12

How effective are your teachers when studying online?

Source: Own elaboration

In relation to Are you satisfied with the technology and software you use for online learning?; It was obtained that 41 students surveyed responded that not at all, 53 students responded that they were slightly satisfied with technology and software such as online learning, another 58 university students responded that they were moderately satisfied, 44 responded that they were very satisfied and 4 that they were extremely satisfied (Figure 13).

Figure 14 presents the responses to the question: How effective do you think distance learning has been during the pandemic?; where it is observed that 74 students comment that distance learning has not been effective, representing 37% of 100%, 51 students indicate that said learning is slightly effective, this response represents 25%; Likewise, 40 university students responded that this way of learning has been moderately effective, which corresponds to 20%, 28 students responded with the answer that it is very effective, which response represents 14% and 7 students responded that it is extremely effective.

Box 13

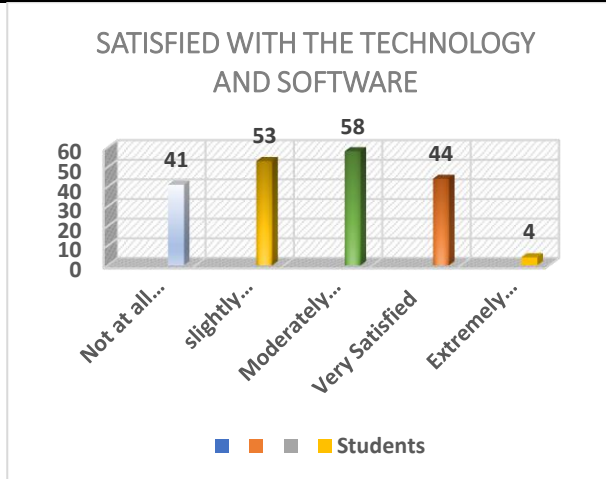


Figure 13

Are you satisfied with the technology and software you use for online learning?

Source: Own elaboration

Box 14

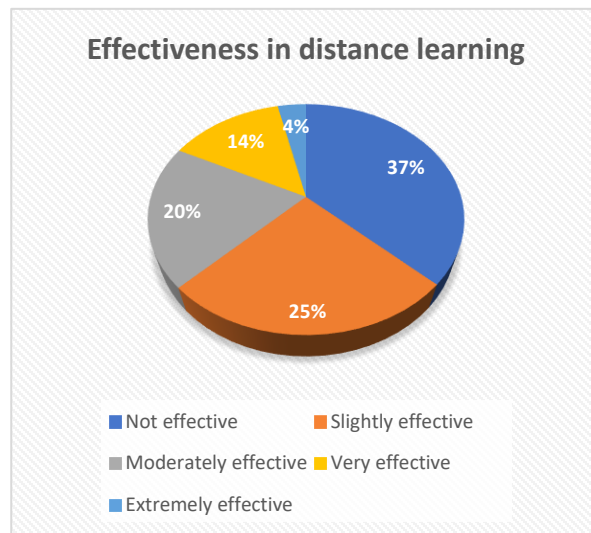


Figure 14

How effective do you think distance learning has been during the pandemic?

Source: Own elaboration

Figure 15 shows the number and percentages of the students surveyed: 31 of them answered that they had their own room during classes during the pandemic, this figure represents 15%; 66 students indicate that they had a shared room during said classes and this figure represents 33%, 65 university students took the classes online in their living room, which also represents 33% and 38 students respond that they took the classes online. external places of the home, such as parks, fields, etc. This data represents 19% of the representative sample.

Box 15

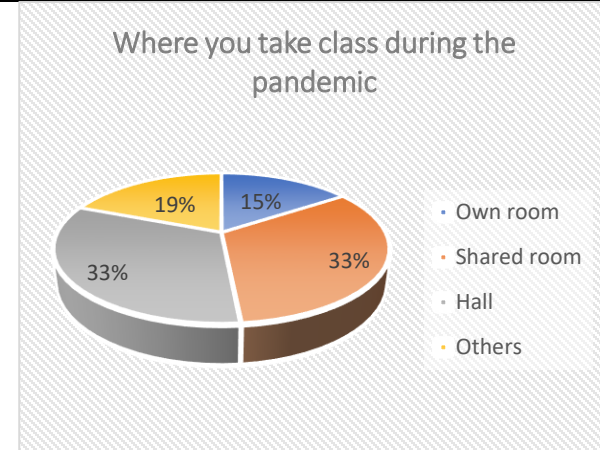
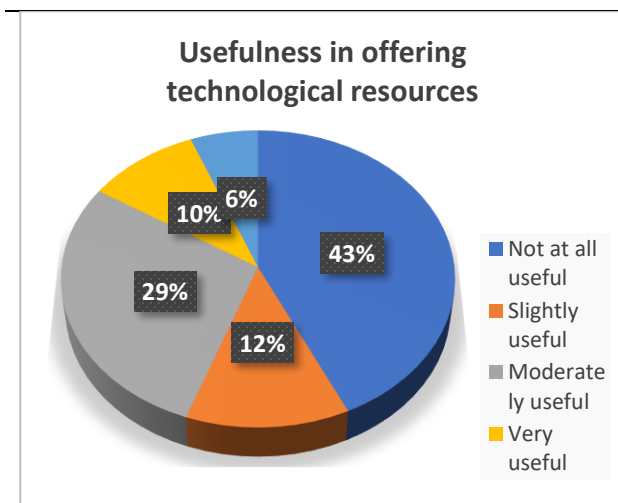


Figure 15

Where were you taking classes during the pandemic?

Source: Own elaboration

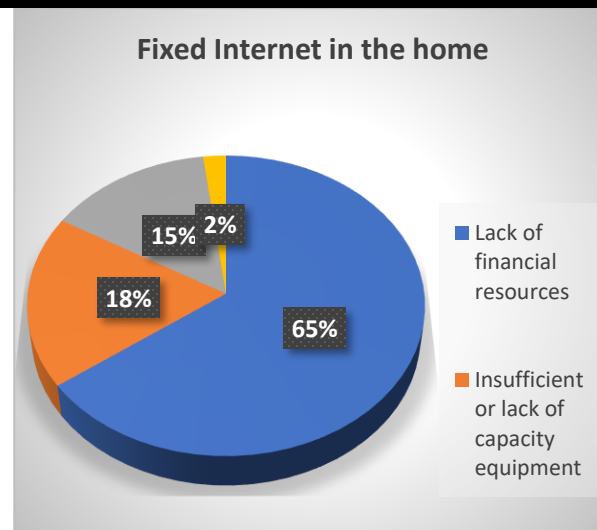
Box 16**Figure 16**

How helpful has the Faculty of Engineering been in offering technological resources for learning at home?

Source: Own elaboration

Figure 16 shows that 86 students surveyed answered that the technological resources have not been useful at all, this represents 43%, as well as another 25 students responded that the offering of technological resources by the Faculty of Engineering has been slightly useful, representing 12% of the total students surveyed; Likewise, 57 university students have answered that the offer of technological resources for learning at home has been moderately useful, representing 29% as a percentage. Likewise, 20 students responded that the offer of technological resources by the institution has been very useful. These responses represent 10% of the representative sample and finally 12 students responded that the offer of technological resources by the faculty has been extremely useful, representing 6%.

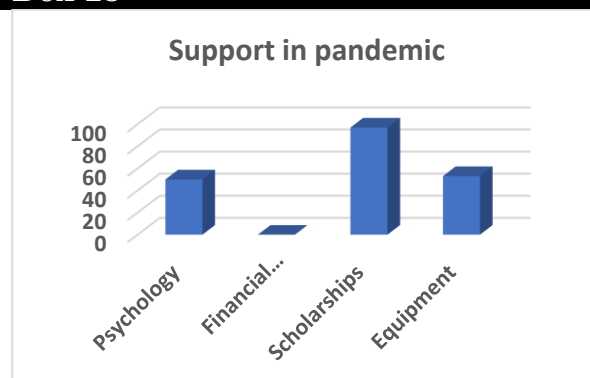
Figure 17 summarizes the responses to the question: Why don't you have fixed internet in your home? It is observed that 130 students surveyed answered that due to lack of economic resources, this figure represents 65% of the representative sample, as well as 37 students have insufficient equipment or no capacity corresponding to 18% of 100%, 29 university students answered that There is no internet in the town where they live, representing 15% and 4 students answered that others, this response represents 2% of the total percentages.

Box 17**Figure 17**

Why don't you have fixed internet in your home?

Source: Own elaboration

To the question: Have you received support from the engineering faculty after the COVID pandemic with topics like? It was found that 50 students have needed support related to the area of psychology, no student has received support in relation to financial resources, 97 university students have received support in the concept of scholarships and 53 university students have received support related to technological equipment (Figure 18).

Box 18**Figure 18**

After the COVID pandemic, have you received support from the Faculty of Engineering with topics such as

Source: Own elaboration

When asking how many devices do you have in your home to take your classes in times of the COVID-19 pandemic?; It was found that zero students comment that they do not have too many devices in the pandemic, 27 students respond that they have more than one device.

Likewise, 124 university students have only one device, 18 students answer that they do not have any device and 31 students answer with the response of others, which involve responses such as having borrowed devices (Figure 19).

Box 19

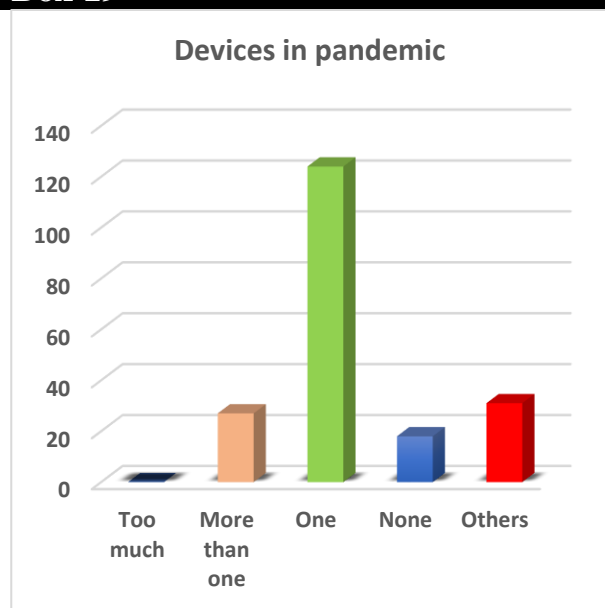


Figure 19

How many devices do you have at home to take your classes in times of the COVID-19 pandemic?

Source: Own elaboration

Figure 20 shows that 162 students answered yes and 38 students answered no to the question: Was the main reason why the last school year did not end was related to the COVID-19 pandemic?

Box 20

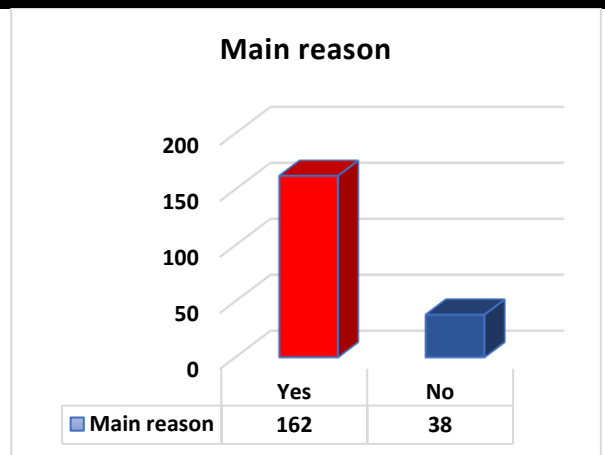


Figure 20

Was the main reason why the last school year did not conclude was related to the COVID-19 pandemic?

Source: Own elaboration

To find out some of the reasons why the students did not finish the school year, they were questioned about it and it was found that 36 students surveyed answered that they lacked any device to continue with school activities, 69 students mentioned that the reason for the why they did not finish the school year was because someone in the family lost their job, so the family income was reduced; Likewise, 46 university students indicate that they did not finish their studies because they became ill with COVID-19, 13 of the students comment that they could not complete their assignments and 36 students respond that their family became ill with COVID and some of the family members died as a result (Figure 21).

Box 21

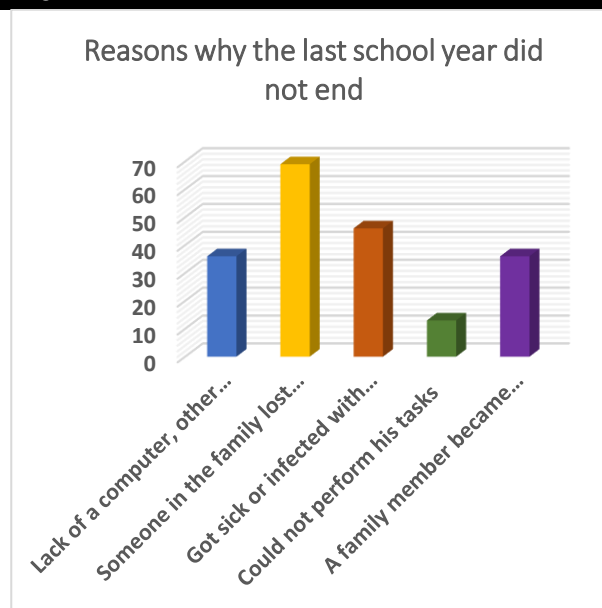


Figure 21

Some of the reasons why the last school year did not end was because:

Source: Own elaboration

When carrying out this research, several situations were found, the main one being communication with the students because the majority of the students of the engineering faculty of that generation are from some towns around the municipality of Campeche, others are no longer in the city left for other states and others did not accept interviews; It is also important to note that during this information inquiry, many findings were found that are reflected in the graphs prepared with the answers given by the students surveyed, such as:

Article

- The UAC, like many educational institutions, made its best efforts to implement strategies that helped psychological and physical academic well-being in the presence of the COVID-19 disease.
- Some of the students mentioned that taking online classes was more complex, since it involved greater effort and time in searching for information to complement what they saw in online classes.
- On many occasions they comment that the teacher's voice cannot be heard well and therefore the class cannot be understood, but this is due to the internet signal.
- Many of the students are in rural areas and towns far from the municipality of Campeche, which makes it difficult for them to have internet access, and some have limited resources and do not have this service.
- There were also students who indicated that it was difficult for them to concentrate in online classes because they did not have a personal room; most of the time they had to meet with other family members.
- The students shared a computer with the other siblings to listen to online classes; They did not have access to obtain another technological resource.
- Most of the students depend 100% financially on their parents or guardians and due to this disease, some of them died.
- Another situation that arose is that the parents or the student combined work and study and were left unemployed, thereby causing them to abandon their studies.
- Students have faced a lot of stress, depression, and sadness due to the situation they experienced.
- It is inevitable to deny that, although some teachers had knowledge of the use of technological tools, others did not have access or knowledge of said use. Although it must not be denied that the UAC offered courses for academic support in the face of this pandemic situation.

- For the teacher it was an overload of work, since they had to restructure the planning of the educational contents.

It is important to mention that, although the UAC implemented and applied actions to not have such a strong impact in the face of this pandemic, such as the delivery of computers to those students who required them, it was not enough for the number of students who needed them. Likewise, as Castañeda, Martínez and López (2021) point out, in times of the COVID-19 pandemic, society experienced moments of anguish and great fear of possible contagion, but not only in that situation but also faced the conditions of poverty, unemployment and discrimination against those people who were infected, so the stressful life that university students faced in the face of this pandemic was also decisive in achieving terminal efficiency as a goal of the UAC (Castañeda, Martínez and López, 2021).

Conclusions

The purpose of this research was to know what were the causes that impact not achieving the terminal efficiency of the students of the 2018-2022 generation of the Faculty of Engineering of the Autonomous University of Campeche. Although it is known that every university educational society (directors, academic secretaries, coordinators, administrative staff, teachers, students, and the general public) has faced challenges in the face of this disease (COVID-19).

The adaptation of the Faculty of Engineering of the University to this situation was very complicated, but not impossible, so it can be concluded that terminal efficiency is not achieved in this 2018-2022 generation for the reasons already presented in the results and only the following solutions can be proposed, which are presented in Table 1:

Box 22

Table 1

Causes and solutions for the lack of terminal efficiency of the students of the 2018-202 generation of the Faculty of Engineering of the Autonomous University of Campeche

Causes	Solutions
Dropping out of school by students due to not having technological equipment to carry out their academic activities.	Creation of a financial fund for contingencies such as: the acquisition of technological equipment and other justified causes that affect the educational progress of students.
Students who were studying and working at the same time, and during the pandemic were left without jobs and without the possibility of continuing studying their degree.	Among its indicators of the Faculty of Engineering is to monitor the career path of graduates; However, there must be management to carry out a permanent campaign to improve the situation of those students who continue studying academically and have not graduated or completed their studies and in which their main source of economic resources no longer exists so that there is support and can continue their studies towards completion.
Lack of knowledge and apathy on the part of the teacher in relation to the use of different technological tools.	The Autonomous University of Campeche has always been interested in ensuring that its teachers are constantly trained. Although there is training for teachers at the end of each semester in the topics where it is necessary to strengthen the academic part; It is also necessary for teachers to commit to training, updating, and applying disciplinary, technological and psychological areas whose impact falls on university students.
The processes are very slow, causing the procedures to not be resolved in a timely manner according to the needs of the applicant.	It is proposed to analyze the processes by the responsible people and establish improvements in them to speed up the procedures, not only academic, but also administrative.
The job bank is coordinated from the central department of the UAC, so the Faculty of Engineering does not have knowledge of the labor needs required by the state.	The innovation of a department that is in charge of the job pool from the Faculty of Engineering is proposed to be able to cover the labor needs required by the state, in this way school dropouts are reduced by those students who require a job to continue with his studies.
Although it is not the UAC's task to ensure that the Internet exists in the places where the students live or reside, it is the responsibility of supporting the students so that they do not remain stagnant in their studies and can continue with them.	Manage with the competent authorities technological tools that allow the student to have the Internet in places with zero connectivity.
They do not have mobile devices.	Support of mobile phones so that students have this tool.
Anxiety, anguish, fear, etc. by teachers and students.	The solution is missing: Create workshops, increase psychological care, strengthen the tutoring program, others.

Declarations

Conflict of interest

The authors declare no interest conflict. They have no known competing financial interests or personal relationships that could have appeared to influence the article reported in this article.

Author contribution

TMRL: Conceptualization, data curation, methodology, supervision, validation, writing – original draft

CTRA: data curation, methodology, software, visualization, writing – review & editing

CCBM: investigation, validation, visualization, writing – review & editing

QCHM: visualization, writing – review & editing

Availability of data and materials

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Abbreviations

UAC: Universidad Autónoma de Campeche.

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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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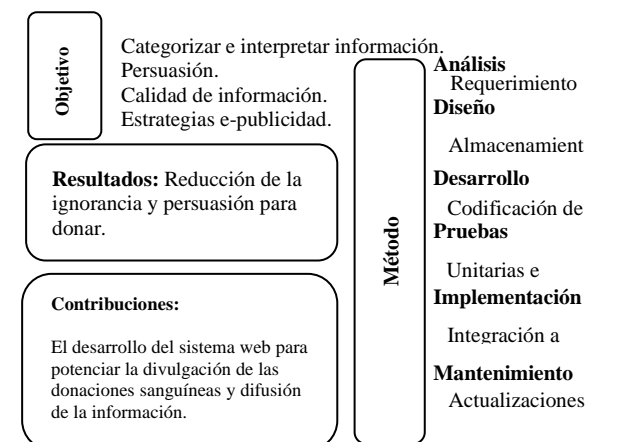
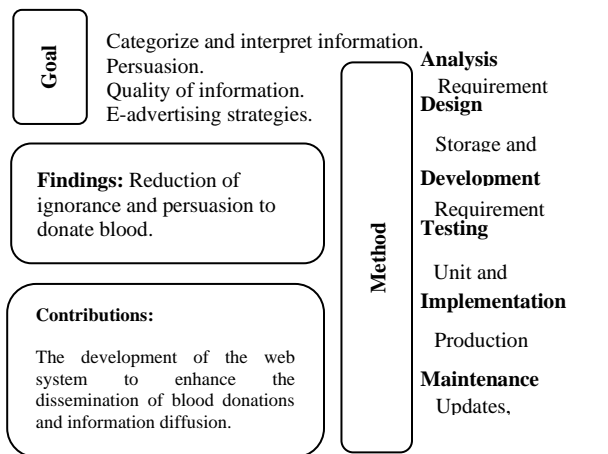
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Abstract

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.

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.



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

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.

Methodology

The present research has been carried out according to the stages of development of quantitative methodology mentioned in (Morejón 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.

Population and sample

Box 1

Table 1

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

Variables	Dimensiones	Indicaciones	Ítems	Scale	Instrument	Source
Information (IX) (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)=1point 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 (VV) (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)=1point 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	Cuantitativa	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: cuantitativa										

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

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).

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.

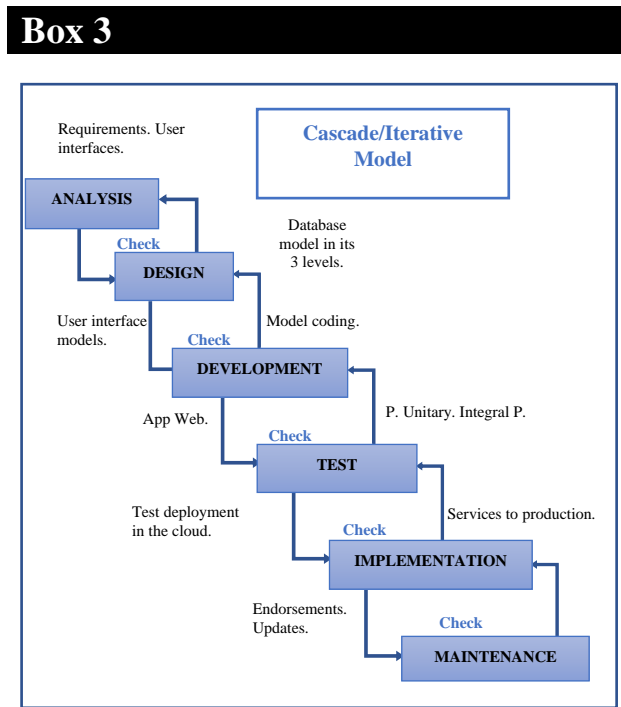


Figure 2

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 (Morejón 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.

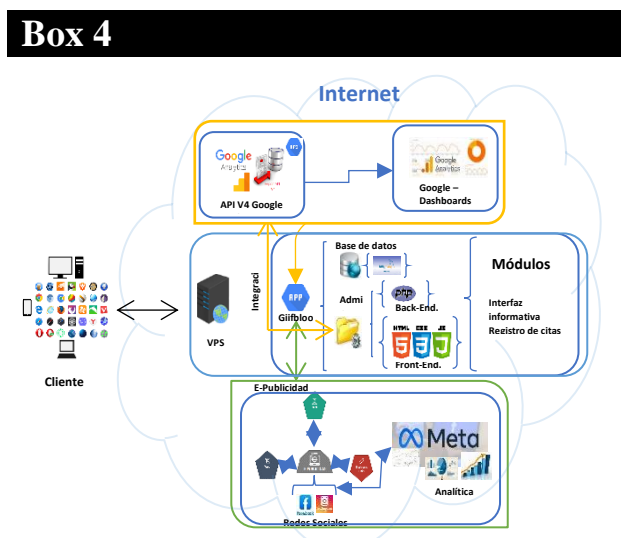


Figure 3

Web System Architecture: analytics, integration and E-advertising

Source: Own elaboration

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

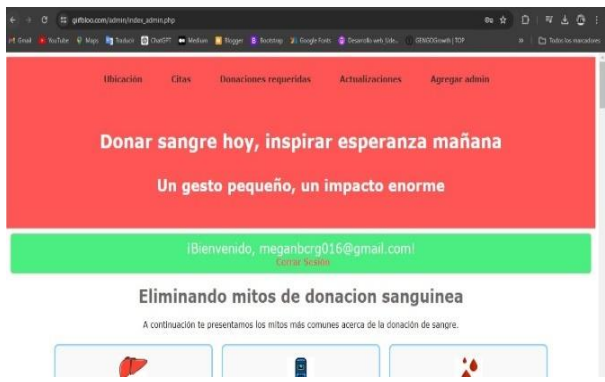


Figure 4

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

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

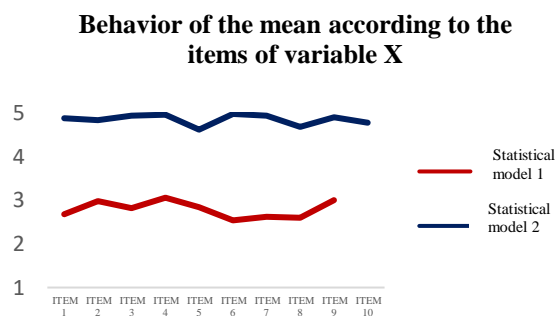


Figure 8 Plot of means of the variable X "information" Source: Own elaboration

Box 10

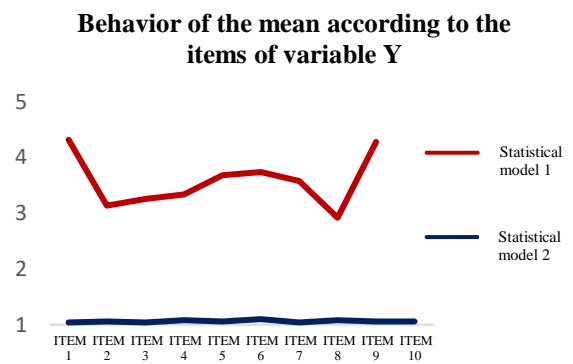


Figure 9 Plot of means of the variable Y "uncertainty" Source: Own elaboration

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

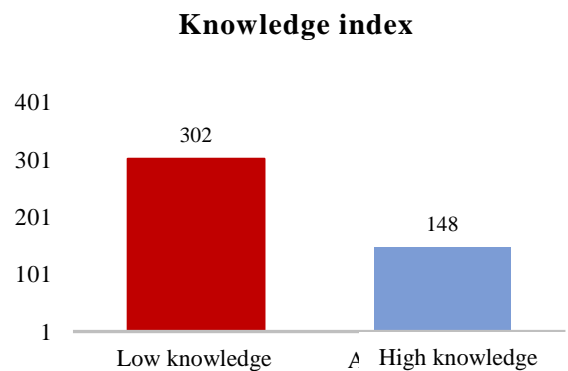


Figure 10 Knowledge level graph of model 1 Source: Own elaboration

Box 12

Percentage of knowledge in the sample

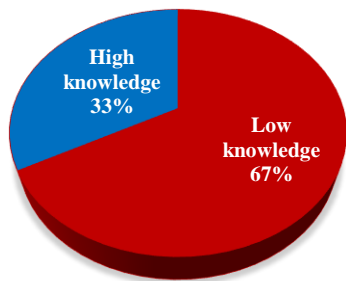


Figure 11

Graph of percentage of knowledge of model 1
 Source: Own elaboration

Box 13

Knowledge index

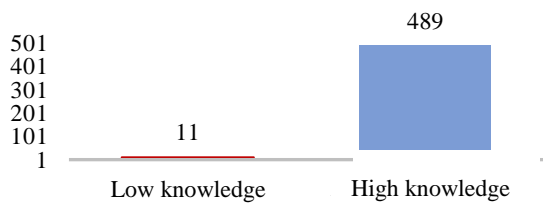


Figure 12

Knowledge level graph of model 2
 Source: Own elaboration

Box 14

Percentage of knowledge in the sample

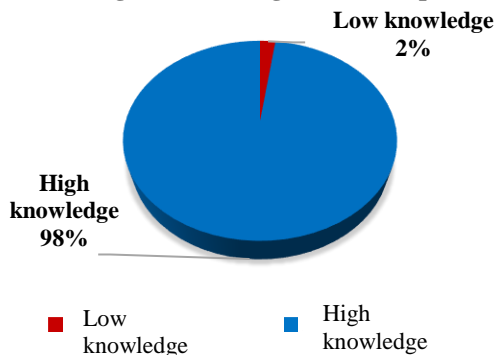


Figure 13

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

Ignorance index

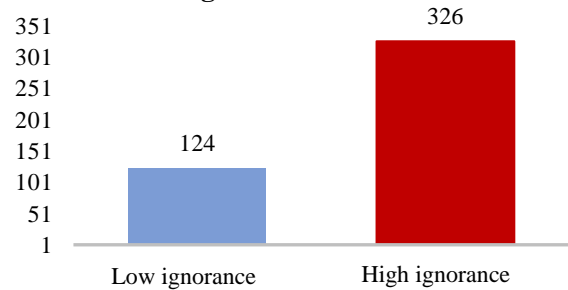


Figure 14

Ignorance level graph of model 1
 Source: Own elaboration

Box 16

Percentage of ignorance in the sample

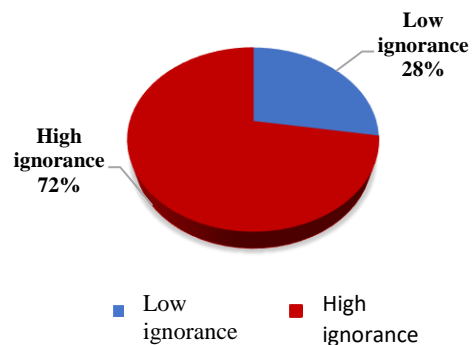


Figure 15

Percentage of ignorance graph for model 1
 Source: Own elaboration

Box 17

Ignorance index

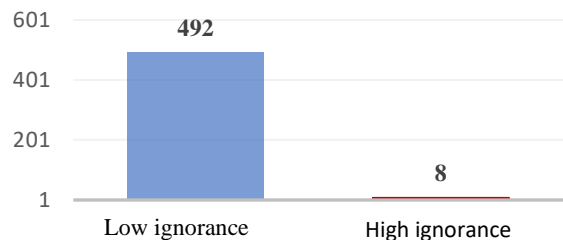
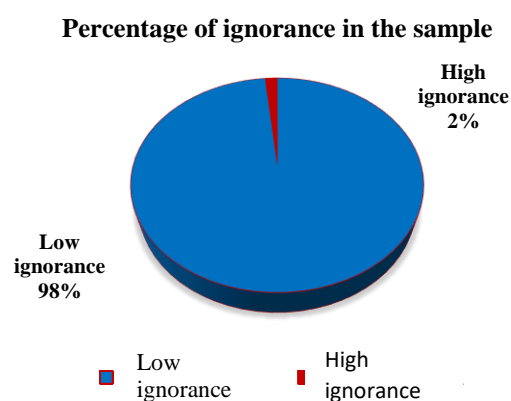


Figure 16

Ignorance level graph for model 2
 Source: Own elaboration

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.

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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 Mercado de Hipertexto
CSS	Hojas de estilo en cascada
JS	JavaScript
MySQL	Mi Structured Query Language

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Administrative audit of a topography company in the State of Michoacán

Auditoria administrativa a una empresa de topografía del Estado de Michoacán

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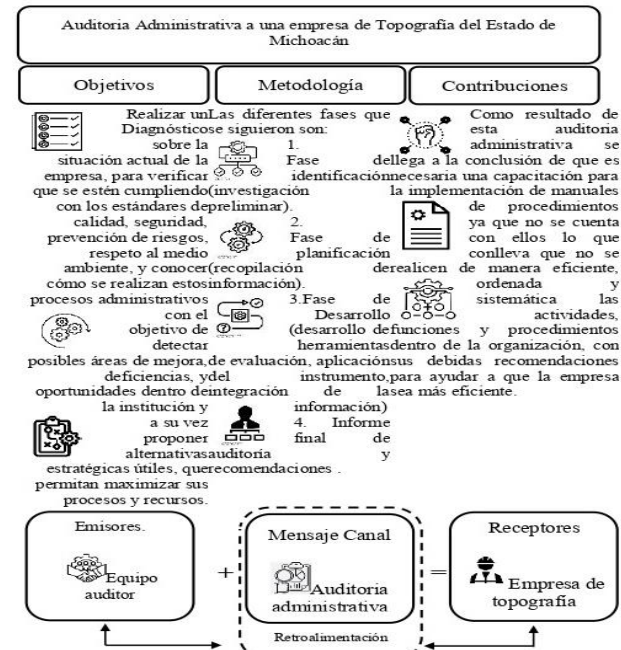
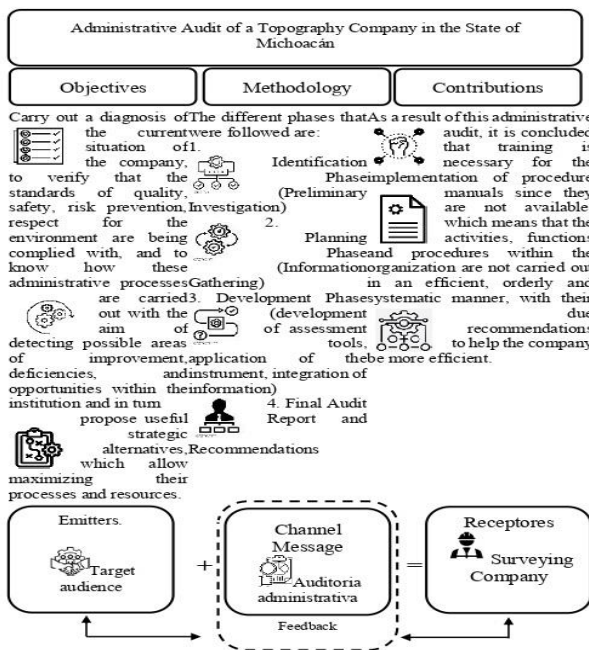
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Abstract

An administrative audit was carried out on a company dedicated to the surveying service in the state of Michoacán. The process was carried out through field, descriptive and documentary research, through interviews and questionnaires that were applied to the Coordinator, Topographers and operational personnel. Subsequently, a diagnosis was made to be able to analyze and categorize all the information collected. Based on the results obtained, it is observed that training is necessary for the implementation of procedure manuals since they are not available, which means that the activities, functions and procedures within the organization are not carried out in an efficient, orderly and systematic manner.

Resumen

Se realizó una auditoría administrativa a una empresa dedicada al servicio de topografía en el estado de Michoacán. El proceso se llevó a través de una investigación de campo, descriptiva y documental, mediante entrevistas y cuestionarios que fueron aplicados al Coordinador, Topógrafos y personal operativo. Posteriormente se realizó un diagnóstico para poder analizar y categorizar toda la información recopilada. Con base en los resultados obtenidos se observa que es necesaria una capacitación para la implementación de manuales de procedimientos ya que no se cuenta con ellos lo que conlleva que no se realicen de manera eficiente, ordenada y sistemática las actividades, funciones y procedimientos dentro de la organización.



Administrative, deficiencies, development

Administrative, Deficiencies, Development

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Peer review under the responsibility of the Scientific Committee **MARVID**[®] - in the contribution to the scientific, technological and innovation **Peer Review Process** through the training of Human Resources for the continuity in the Critical Analysis of International Research.



Introduction

Administrative auditing is a systematic process of analysis, evaluation and diagnosis of an organization's activities and resources in order to improve its efficiency, effectiveness and profitability. This type of audit focuses on reviewing and improving administrative processes, organizational structures, policies, procedures, internal control systems, and the management of human, financial, and material resources. It is critical that it is carried out at least once a year to investigate and ensure that administrative activities are being carried out correctly.

The evaluation instruments used were Questionnaires, Relevant Aspects Questionnaire, Documentary Analysis Questionnaire and Formulation of the Administrative Diagnosis. These were applied and answered by three employees from each horizontal line of the organizational structure. PCAD, S.A de C.V. offers surveying services that support the construction sector.

The management audit seeks to ensure that resources are used appropriately, that objectives are achieved effectively, and that applicable rules and regulations are adhered to. This involves reviewing and analyzing processes, procedures, policies, and organizational structures to identify areas for improvement and opportunities for optimization. To subsequently provide recommendations to improve the management and performance of the organization.

The results showed that it is necessary to make and implement manuals, both for procedures and organization. This with the purpose of documenting the activities that are carried out in the different areas of the company, in which each of them is detailed, establishing the positions and jobs, mission, objectives and goals that must be governed for the fulfillment of these.

The establishment of manuals, policies, guidelines and goals are undoubtedly essential for the efficient and safe operation of an organization, providing clarity, coherence and support in the management of various operations.

Methodology

The methodology for the research is graphically represented in Figure 1, where the different phases that were followed are listed:

1. Identification Phase (Preliminary Investigation)
2. Planning Phase (Information Collection)
3. Development Phase (Development of Assessment Tools, Implementation of the Instrument, Integration of Information)
4. Final Audit Report and Recommendations

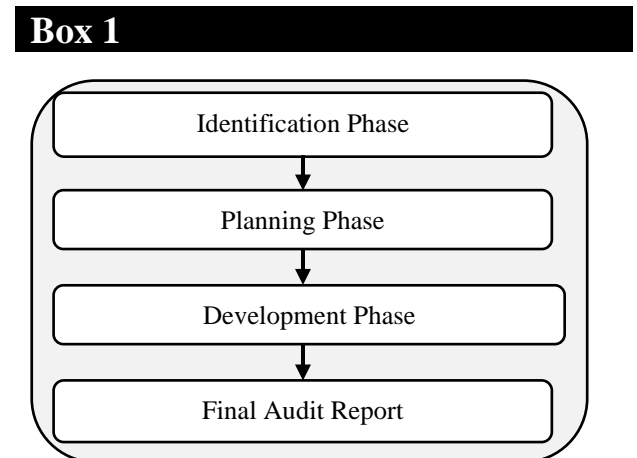


Figure 1
Methodology for research

Instrument to be used

The purpose of the evaluation instruments used for this research is to obtain information related to the activities and functions of the sales area. The preliminary questionnaire consists of 10 items with open-ended questions. The audit questionnaire consists of 40 items with open-ended, multiple-choice, and Likert questions. The relevant aspects and document analysis sheets are filled with information about the company obtained through observation, survey, interview, findings and evidence, and then the Final Audit Report is generated.

Box 2
Table 1

Assessment Tool	
Administrative process	Maximum Points
Planning	350
Organization	250
Address	200
Control	200

Note: The figure indicates the scoring criteria chosen for the audit

Box 3

Table 2

Performance Measurement

Likert scale	
Score	Interpretation
801-1000	Excellent
601-800	Very Good
401-600	Well
201-400	Regular
0-200	A Little

Note: The figure indicates the scoring criteria chosen for the audit

Results

This methodology helps to decide specific aspects of the organization, which can be positive or negative. With the results obtained, recommendations are made that, if implemented, bring improvement and growth to the company.

The results are as follows:

Box 4

Table 3

Relevant aspects ballot.

Stage	Specific Element	Result of the analysis
Planning	Mission-Vision	Absence of mission and vision. Employees are not aware of these.
	Objectives, goals and values	The objectives are not established, the employees do what the bosses order them to do.
	Procedures & Processes	Absence of manuals and procedures. Employees perform activities as they know how, without any guidance.
Organization	Organizational culture	The structure is defined by the company, however, there are constant changes when opening new jobs.
	Human resources	The staff is competent, but requires training.
Direction	Leadership & Communication	There is no good communication within the work area.
	Technological information	The staff does a good handling of the equipment, however, some need to be replaced.
Control	Systems	Absence of a mechanism to channel complaints and suggestions.
	Distribution of space	Transportation equipment is scarce, which takes time away from activities.

Note: The Cédula indicates relevant aspects by Stage of the administrative process

Box 5

Table 4

Document Analysis Certificate.

Document	Result of the analysis
Organization Manual	There is no established organizational manual, which means that the jobs or responsibilities or functions of each worker are not established.
Manual de procedimientos	There is no manual of procedures. The information is not detailed, orderly, systematic or comprehensive, nor is it a document containing instructions, responsibilities and information on policies, functions, and management of systems.

Note: The Cédula indicates relevant aspects by Stage of the administrative process

Box 6

Table 5

Maximum Points Earned.

Stage	Specific Element	Maximum Points	Points Earned	%
Planning	Mission-Vision	150	70	17
	Objectives, goals and values	100	50	
	Procedures & processes	100	50	
	Total	350	170	
Organization	Organizational Culture	80	70	23
	Human Resources	170	160	
	Total	250	230	
Direction	Leadership & Communication	140	90	12
	Technological information	60	30	
	Total	200	120	
Control	Systems	80	50	16
	Distribution of space	120	110	
	Total	200	160	
Total by Processes		1000	680	68%

Note: The image shows the maximum points obtained from the administrative stages

The institution are in the "VERY GOOD" range, so they are in the expected result, but not in the optimal one.

Conclusions

The data provided by the assessment instruments applied in the surveying service company by stage of the administrative process are described below.

Planning: Creation of the mission and vision, making the staff known and making them aware of the importance and its application in daily life, which leads to carrying out their activities with an incorrect approach, at the wrong time and without guidance.

Organization: There is collaboration on the part of the staff, however, by not respecting the jobs there is duplication of functions and lack of hierarchy.

Management: There are deficiencies in Leadership due to poor communication among employees, it is difficult for them to adapt and integrate their skills and aptitudes in the performance of their activities.

Control: The management of information is efficient according to the activities they perform and their performance is acceptable.

As a result of this administrative audit, it is concluded that employees must know the organizational manual and be aware of the execution of activities, functions, work hand in hand with the procedures manual and make sure that it is clear; Having good communication allows them to give better service to customers as part of the good service that must be offered to them.

Recommendations

When conducting interviews and questionnaires with the personnel of the PCAD company, we were able to verify that there are many failures due to the poor labor relationship between most of the workers.

It is recommended in Planning and Organization:

Implement an organization and procedures manual, so that workers know their functions and activities to be performed, as well as make them aware of the company's philosophy and the importance of their performance.

In Management and Control, create an internal control system that covers all areas of the company, including training on the functions to be performed, establish a formal communication system in which real-time information is allowed to reach all personnel.

It is important that an administrative audit is carried out at least twice a year, with the aim of complying with the Follow-Up Phase and measuring the results with the previous one, which allows us to understand and evaluate the performance of the organization (Balderrabano Briones, 2024).

Declarations

Conflict of interest

The authors declare no interest conflict. They have no known competing financial interests or personal relationships that could have appeared to influence the article reported in this article.

Author contribution

Díaz-Azamar, Álvaro: Writing the draft **version** of the manuscript

Olguin-Jácome, Zulema: Carefully proofread and revise the final version following the format and guidance;

Parra-Valis, Dionicio: Fill out the required forms to submit the article

Lira-Vazquez, Isabel: Modify the manuscript according to the Evaluation made by the reviewers

Availability of data and materials

The data obtained in the investigation are available in the final report of the administrative authority.

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Abbreviations

PCAD, S.A de C.V.: Company that provides support to the construction sector and project workshops.

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Antecedents

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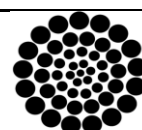
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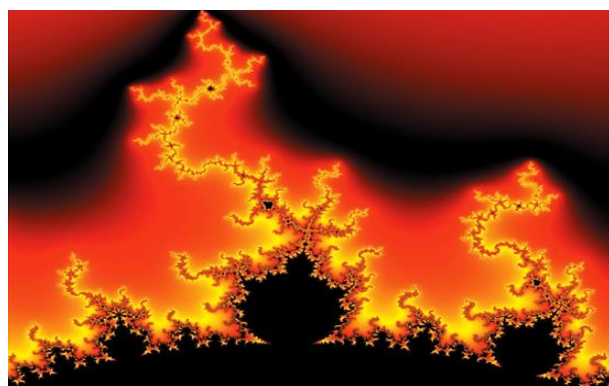


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List abbreviations in alphabetical order.

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ANN Artificial Neural Network

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