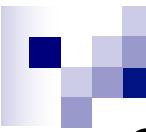


# Scientific Research Process – Theoretical Part

ESPE 2020



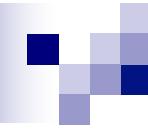


## Outline

- 1. Introduction**
- 2. Problem Definition.**



**2**



# Introduction

- Research is the process of discovering **facts** and **knowledge** about **phenomena** that take place **around us**.
- Research is important because it **enriches** our **understanding** and help us to **solve problems**.
- The aim of this presentation is to **describe** the **scientific research process**.

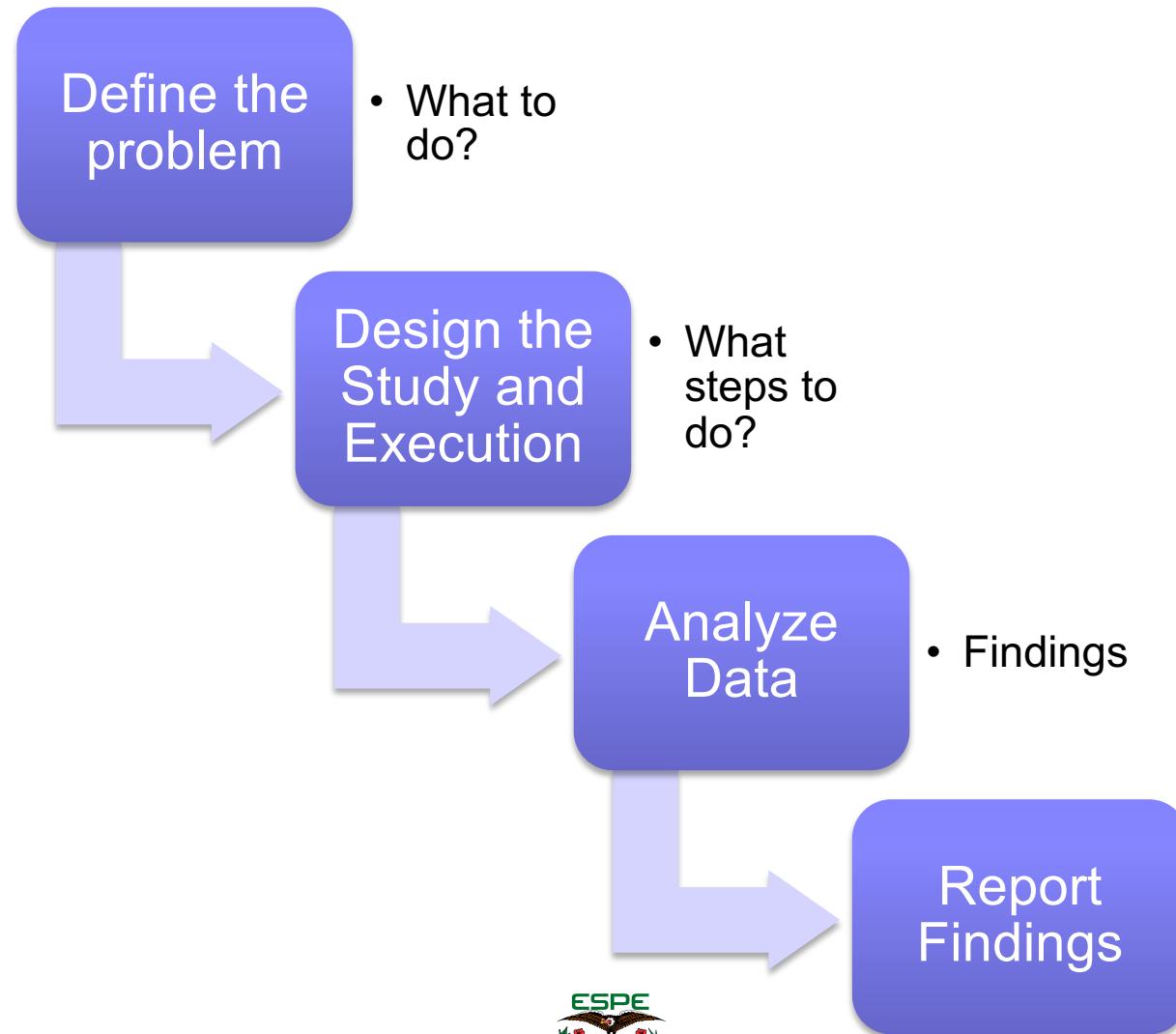


# Introduction - Characteristics of Scientific Research

- **Conscious** -> should have a specific aim or purpose.
- **Systematic** -> Should follow a defined plan of investigation.
- **Objective** -> it should be free from opinion and feelings of the researcher.
- **Replicable** -> it should be possible for others to reproduce the study.



# Introduction - The Scientific Research Process



# Introduction - The Scientific Research Process

Define the problem

- What to do?

- The fuel that drives the scientific process
- Constitutes the basis of any research method.



# Introduction - The Scientific Research Process

Design  
the Study

- What steps to do?

- Variables identification
- Methodology Definition
- Study design
- Execution
- Collect data



# Introduction - The Scientific Research Process

Analyze  
Data

- Findings

- Data analysis
- Interpret Findings



# Introduction - The Scientific Research Process

## Report Findings

- Papers
- Books
- Thesis

- Distinguished research with extraordinary results has not been published
- Such research have died as:
  - Forgotten data,
  - Unavailable tools,
  - Unused material and valuable results.

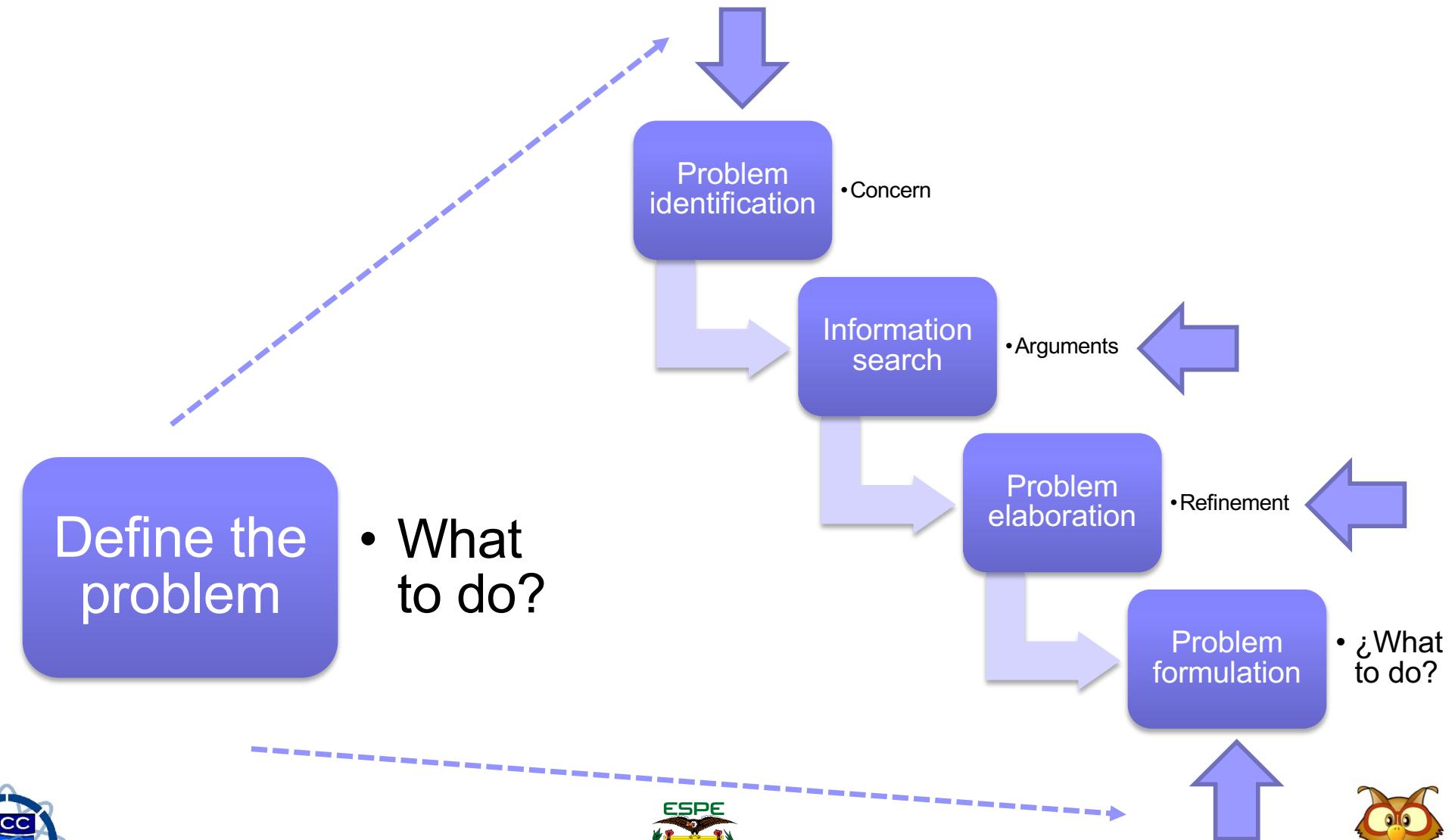


# Scientific research process - Define the Problem

- The ***scientific research process*** seeks to ***address a problem***.
- The ***first step*** in this investigative process is to ***define the problem***.
- The problem definition will give us ***purpose and direction*** to the research process.



# Scientific research process - Define the Problem



# **Scientific research process - Define the Problem**

## **- Problem Identification**

- Choice of the problem to be studied
  - Choice the problem not the subject
  - Subject is more general
  - Subject contains the problem
- The problem must be defined precisely and clearly



# Scientific research process - Define the Problem - Search for information

- Research projects start with ideas that:
  - Help to solve problems
  - They contribute knowledge
  - They raise questions
- These ideas should be:
  - Novel
  - Promising
  - Exciting
  - Inspiring



# Scientific research process - Define the Problem - Search for information

- Sources that can generate research ideas:
  - Experiences – Learning by doing
  - Written and audio-visual material – Unstructured knowledge embodies years of effort and hard work
  - Theories
  - Conversations
  - Articles and other reliable sources on Internet  
(basic literature reviews)



# Scientific research process - Define the Problem - Problem Elaboration

- A series of information must be identified to refine the problem:
  - The problem
  - The problem's consequences, and
  - The problem's possible causes.
- This information outlines the problem
- Techniques:
  - Problem Tree
  - Ishikawa fish bone
  - Analyze this link: <https://prezi.com/ibhf23fdtezy/arbol-del-problema-y-espina-de-pealdo/>

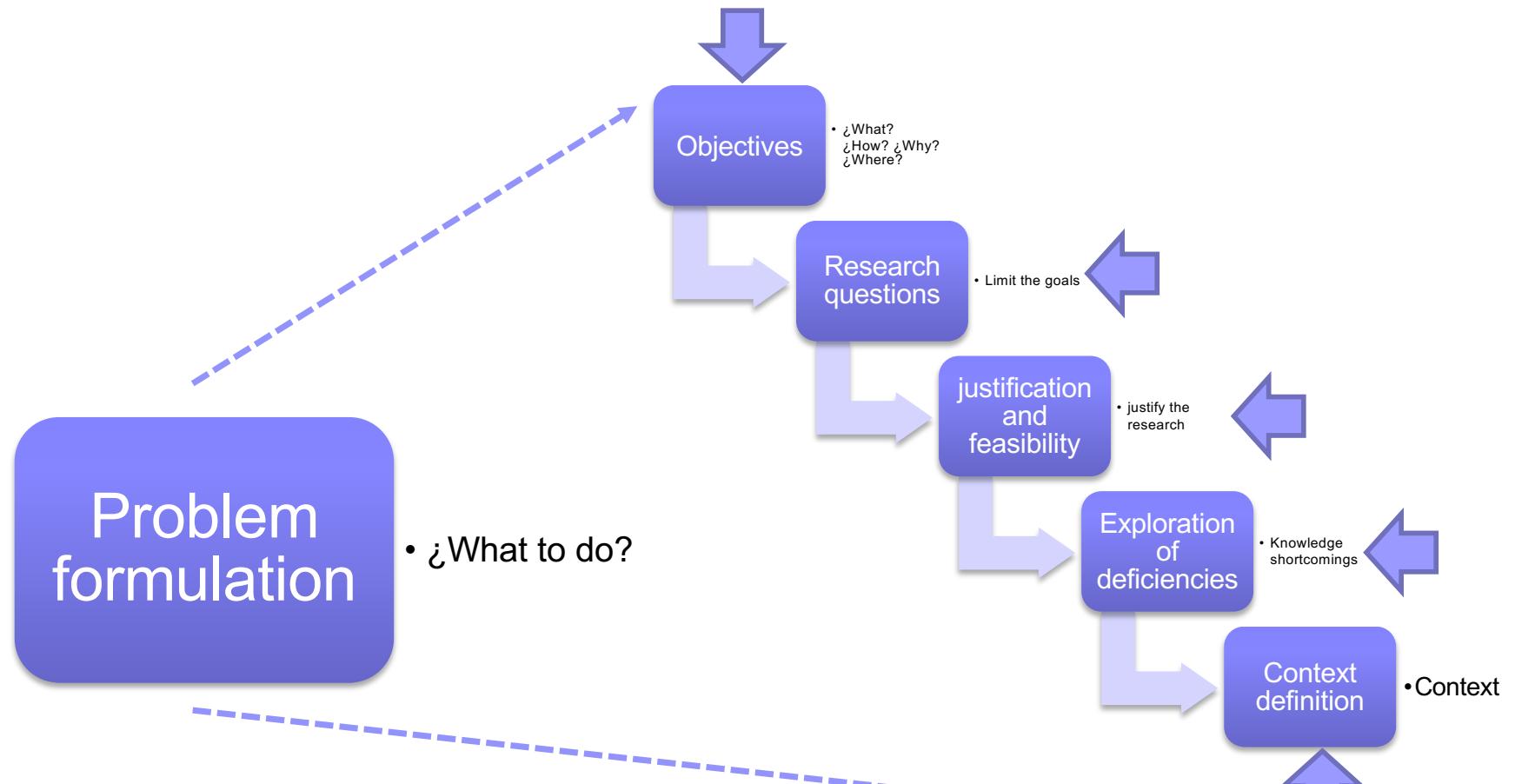


# Scientific research process - Define the Problem - Problem Formulation

- The formulation of the problem consists of delimiting the problem more categorically through:
  - Objectives
  - Research questions
- This allows:
  - Justify and analyze the viability of the research
  - Explore deficiencies in knowledge of the problem
  - Analyze the context where the phenomenon of interest develops.



# Scientific research process - Define the Problem - Problem formulation stages



# **Scientific research process - Define the Problem - Problem formulation – Research Aim**

- It is necessary to establish what the research intends.
- An investigation seeks to solve a particular problem; Thus:
  - It must be mentioned what it is, and
  - The way you plan to solve it
- Other research seeks to test a theory or provide empirical evidence in favor of it.



## **Scientific research process - Define the Problem - Problem formulation – Research Aim**

- An objective points to what is desired in the investigation
- They must be clearly expressed to avoid possible deviations in the research process
- The specified objectives must be consistent with each other.
- They are the study guides
- Do not to lose sight of them throughout the study.



# Scientific research process - Define the Problem - Problem formulation – Research Aim

- Some suggestions to state the purpose of a research:
  - State each objective in a separate sentence or paragraph
  - Focus on exploring and understanding a single phenomenon, concept, or idea.
  - Use words that suggest exploratory work ("reasons", "motivations", "search", "inquiry", "consequences", "identification", etc.).
  - If the phenomenon or concept is not well known, provide a general description of it.



# Scientific research process - Define the Problem - Problem formulation – Research Aim

- Use verbs that communicate the actions that will be carried out to understand the phenomenon.
- Avoid words that may denote bias in the study that imply a specific result.
- Mention study participants. Sometimes they can be:
  - Animals
  - Vegetable species
  - Human
- Identify the initial place or environment of the study.



# Scientific research process - Define the Problem - Problem formulation – Research Aim

VERBOS SEGÚN NIVELES TAXONÓMICOS (diversas fuentes)												
1 CONOCER		2 COMPRENDER		3 APLICAR		4 ANALIZAR		5 SINTETIZAR		6 EVALUAR		
Anotar	Parear	Asociar	Identificar	Acopiar	Esbozar	Agrupar	Ilustrar	Administrar	Integrar	Apoyar	Hipotetizar	
Archivar	Perfilar	Cambiar	Ilustrar	Ajustar	Escoger	Analizar	Inferir	Argumentar	Inventar	Argumentar	Interpretar	
Bosquejar	Presentar	Clasificar	Indicar	Aplicar	Examinar	Articular	Inspeccionar	Arreglar	Juntar	Calibrar	Justificar	
Citar	Recitar	Comparar	Inferir	Apreciar	Experimentar	Asociar	Interrogar	Categorizar	Lograr	Calificar	Juzgar	
Contar	Reconocer	Completar	Informar	Bosquejar	Generalizar	Calcular	Investigar	Coleccionar	Manejar	Categorizar	Medir	
Decir	Recordar	Concluir	Interpretar	Calcular	Implementar	Categorizar	Ordenar	Combinar	Modificar	Comparar	Predecir	
Deducir	Registrar	Construir	Localizar	Calibrar	Ilustrar	Clasificar	Organizar	Compilar	Organizar	Concluir	Probar	
Definir	Relacionar	Contrastar	Manifestar	Cambiar	Interpretar	Comparar	Perfilar	Componer	Originar	Considerar	Recomendar	
Describir	Relatar	Convertir	Notificar	Catalogar	Manipular	Considerar	Plantear	Construir	Planificar	Contrastar	Relacionar	
Distinguir	Rememorar	Decodificar	Opinar	Clasificar	Medir	Contrastar	Ponderar	Crear	Plantear	Convencer	Resolver	
Duplicar	Repetir	Defender	Parafrasear	Completar	Modificar	Criticar	Predecir	Deducir	Preparar	Criticar	Resumir	
Encontrar	Reunir	Describir	Predecir	Computar	Modular	Cuestionar	Preguntar	Derivar	Producir	Decidir	Revisar	
Enumerar	Rotular	Determinar	Preparar	Conectar	Mostrar	Debatir	Probar	Derivar	Proponer	Defender	Seleccionar	
Escribir	Reproducir	Diferenciar	Reconocer	Construir	Operar	Deducir	Reconocer	Desarrollar	Proyectar	Determinar	Tasar	
Especificar	Seleccionar	Discriminar	Redefinir	Delinear	Organizar	Desglosar	Relacionar	Diagramar	Reacomodar	Diagnosticar	Validar	
Examinar	Señalar	Discutir	Reescribir	Demostrar	Practicar	Detectar	Relatar	Dirigir	Reagrupar	Discriminar	Valorar	
Identificar	Subrayar	Distinguir	Referir	Desarrollar	Predecir	Detectar	Resumir	Diseñar	Recetar	Distinguir	Verificar	
Indicar	Tabular	Establecer	Reformular	Descubrir	Preparar	Determinar	Seleccionar	Documentar	Reconstruir	Enjuiciar		
Listar	Unir	Estimar	Relacionar	Diagramar	Producir	Diferenciar	Señalar	Ensamblar	Recopilar	Escoger		
Marcar		Explicar	Relatar	Diseñar	Programar	Discriminar	Separar	Escribir	Reescribir	Estandarizar		
Memorizar		Expresar	Reorganizar	Dramatizar	Reestructurar	Distinguir	Separar	Escribir	Relatar	Estimar		
Mencionar		Extender	Representar	Ejemplarizar	Relatar	Dividir	Solucionar	Especificar	Reordenar	Evaluar		
Mostrar		Extrapolar	Resumir	Elegir	Resolver	Esquematizar	Subdividir	Establecer	Resolver	Evidenciar		
Nombrar		Formular	Revisar	Emplear	Seleccionar	Examinar	Sustituir	Explicar	Resumir	Explicar		
Ordenar		Generalizar	Seleccionar	Encontrar	Solucionar	Experimentar	Tasar	Formular	Revisar	Fundamentar		
Organizar			Solucionar	Enlazar	Tabular	Identificar	Valorar	Generalizar	Simplificar			
			Traducir		Transferir			Generar	Sintetizar			
				Utilizar			Idear	Transmitir				



# **Scientific research process - Define the Problem - Problem formulation – Research Questions (RQ)**

- Complement to ensure compliance with objectives
- It is intended to respond at the end of the study to validate the achievement of the objectives.
- RQs must be consistent with the objectives.



# **Scientific research process - Define the Problem - Problem formulation - Justification**

## **■ Justification is important according to:**

- Convenience
- Social relevance
- Practical implications
- Theoretical value, and
- Methodological utility.

## **■ Quantitative data can be included to dimension the study problem, although the approach is qualitative.**



# **Scientific research process - Define the Problem - Problem formulation - deficiencies in problem knowledge**

- Conclusions based not on the investigation of information sources
- Comparison between the own bases and created from the literature review



# **Scientific research process - Define the Problem - Problem formulation - Context**

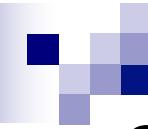
- **Definition**
- **Factors that positively and negatively affect the phenomenon**
- **Generalizable or not**
- **Particular or not**



# Scientific Research Process – Practical Part

ESPE 2020





## Outline

# 1. Case description



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Diseñado por: Efraín R. Fonseca C.

# Scientific research process - Define the Problem

## - Problem Identification

### ■ Problem:

- Accidents around the use of liquefied petroleum gas as fuel are very common around the world.

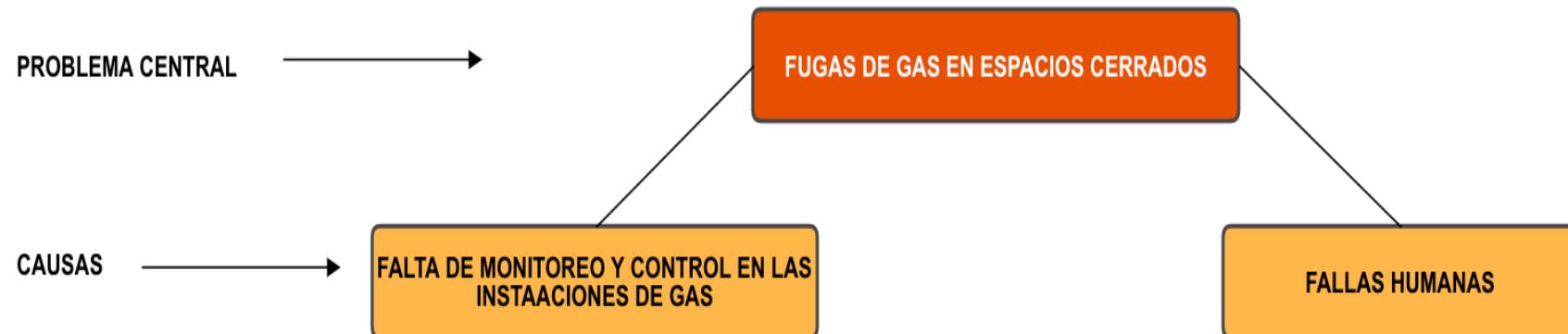
### ■ For example:

- A ski resort in Poland exploded in December 2019, killing 8 people.
- In France 3 people were injured after the explosion of gas coils in a laboratory while maintaining IN 2019.
- In Quito city there is a gas explosion every 82 hours.



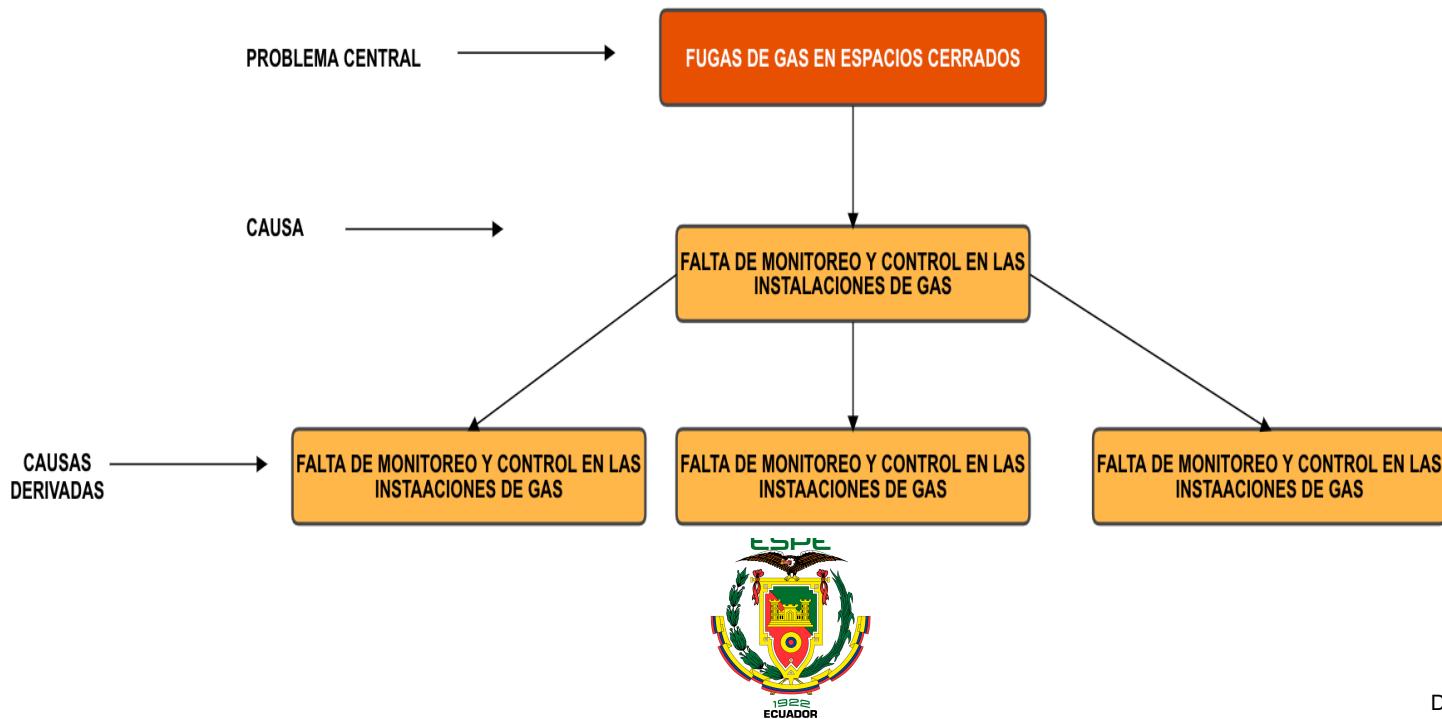
# Scientific research process - Define the Problem - Search for information

- Basic literature review showed that the problem is mainly due to (Vásconez, Celi, Ayabaca, & Rocha-Hoyos, 2018) :
  - The lack of monitoring and control of gas facilities, and
  - Due to human error.



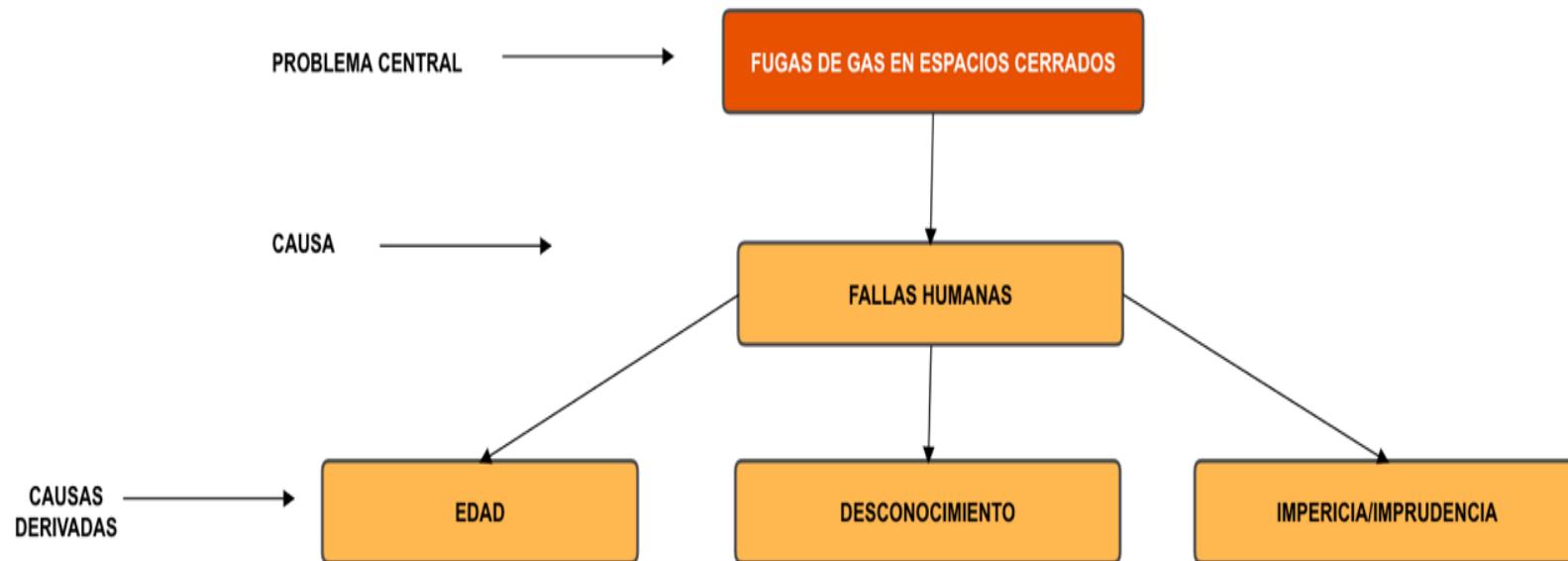
# Scientific research process - Define the Problem - Search for information

- New gas installations omitted the design and storage of gas cylinders, although there is the NTE INEN 2260 (2010) standard.
- The standard only focuses on good installation practices for cylinders used as fuel, but it does not refer to minimum requirements that spaces must meet to house gas.
- There is also no monitoring or regular maintenance of the components of gas installation (Vásconez, Celi, Ayabaca, & Rocha-Hoyos, 2018).



# Scientific research process - Define the Problem - Search for information

- As indicated before, human failure is another main cause, the most common being ignorance, lack of skill and recklessness (Jácome, 2015).

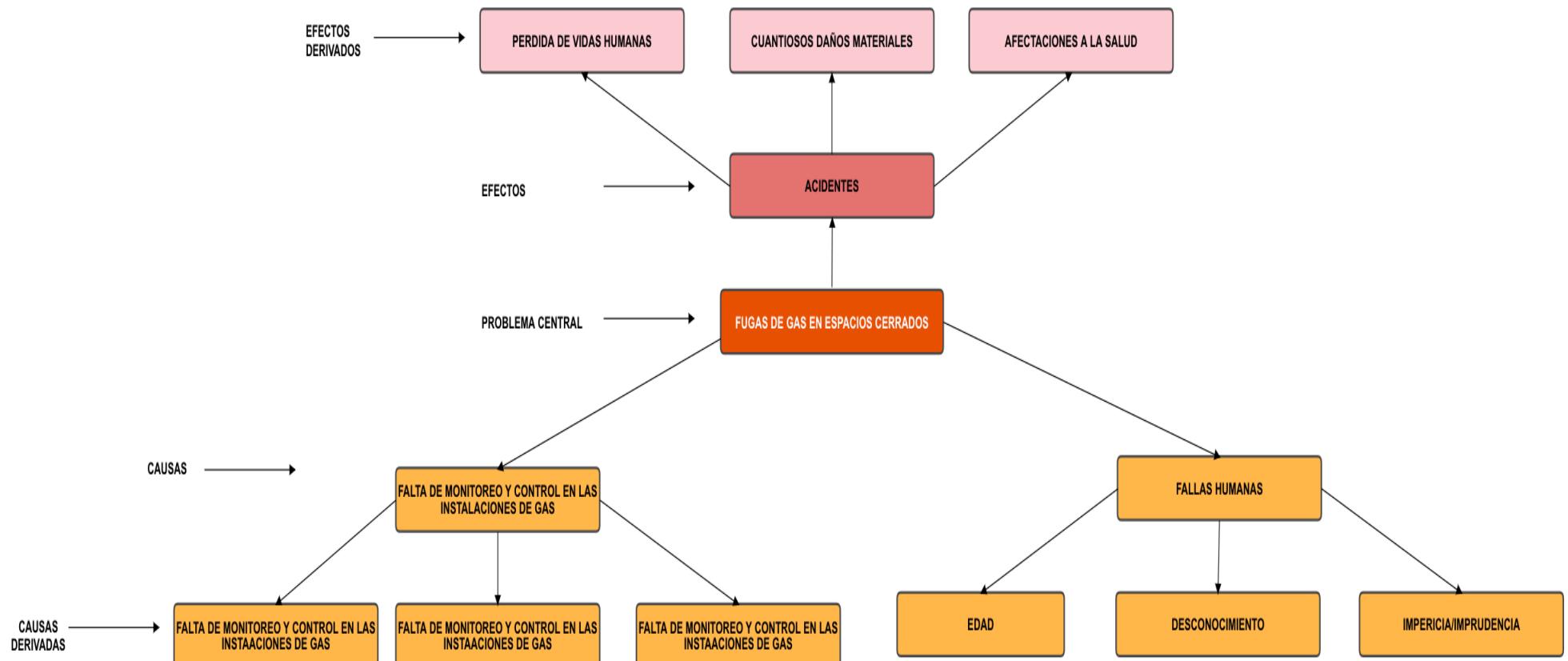


# Scientific research process - Define the Problem - Search for information

- The most serious effects are accidents.
- Accidents cause:
  - Wounded,
  - Death, and
  - Destruction.



# Scientific research process - Define the Problem - Problem Elaboration



# Scientific research process - Define the Problem - Problem Formulation

## General Objective

- **To implement** a low-cost predictive system **focused on** the analysis and monitoring of the accumulation of gases in closed spaces, **using** data science techniques and embedded systems based on free hardware.

## What?

- **To implement** a low-cost predictive system

## How?

- **using** data science techniques and embedded systems based on free hardware

## Why or for what?

- **focused on** the analysis and monitoring of the accumulation of gases in closed spaces



# Scientific research process - Define the Problem - Problem Formulation

## □ Specific objectives

- SO1: To define the problems related to the accumulation of gases in closed spaces by means of a cause-and-effect analysis through a preliminary investigation of the literature.
- SO2: To study the feasibility of a proposed solution to the problems surrounding gas accumulation in closed spaces through a systematic review of preliminary literature.
- SO3: To design and build the hardware and software solution that allows the collection and analysis of data from a real scenario....

## □ What?

- To define the problems related to the accumulation of gases in closed spaces

## □ How?

- by means of a cause-and-effect analysis through a preliminary investigation of the literature.



# Scientific research process - Define the Problem - Problem Formulation

## □ Research questions (RQ)

- At least 2 RQ for each SO
- RQs help narrow the scope of SOs
- RQs make SOs achievable
- RQs define the research' scope

SO1: To define the problems related to the accumulation of gases in closed spaces by means of a cause-and-effect analysis through a preliminary investigation of the literature.	SO1-RQ1: What are the main causes for gas leaks in closed spaces? SO1-RQ2: What are the most tangible consequences around the accumulation of gas in closed spaces?
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# Scientific research process - Define the Problem - Problem Formulation

- Research Justification
  - Is written as a lecture
  - Highlighting the importance of the investigation
- The lack of control policies derived from a scarce allocation of resources to projects that promote the revision of liquefied petroleum gas installations for domestic or industrial use by state control agencies and little or no monitoring of ideal parameters of air quality in these sites caused by the ignorance of the control organisms that dictate these standards, ...

