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And, at first, it was the research question... The PICO, PECO, SPIDER and FINER formats

Y, al principio, fue la pregunta de investigación ... Los formatos PICO, PECO, SPIDER y FINER

Micaela Sánchez-Martín, Marina Pedreño Plana, Ana Isabel Ponce Gea and Fernando Navarro-Mateu

University of Murcia, Murcia, Spain

**“There are no unanswered questions, only poorly formulated questions”
(Morpheus, character from the Matrix movie tetralogy)**

Abstract

Designing a clear and structured research question facilitates the research process and increases the chances of success. The characteristics of the PICO format (P: Study population or participants; I: Intervention; C: Comparison; and O: the expected Outcome or effect of the intervention) and other alternatives that have been proposed are discussed. later: PECO (Population, Exposure, Comparison, O-result), SPIDER (Sample-sample, PI-Phenomenon of Interest- phenomenon of interest, Design-design, Evaluation- evaluation and Research type or type of investigation) and FINER (Feasible -feasible, Interesting-interesting, Novel-novel, Ethical-ethical and Relevant-relevant). The teaching of these formats and their practice in teaching settings will facilitate their introduction among young researchers.

Keywords: Research questions; PICO; PECO; SPIDER; FINER.

Resumen

El diseño de una Research question clara y estructurada facilita el proceso de investigación y aumenta las probabilidades de éxito. Se comentan las características del formato PICO (P: Población de estudio o participantes; I: Intervención; C: Comparación; y O: el Resultado (Outcome, en inglés) esperado o efecto de la intervención) y de otras alternativas que se han propuesto posteriormente: PECO (Población, Exposición, Comparación, O-resultado), SPIDER (Sample-muestra, PI-Phenomenon of Interest- fenómeno de interés, Design-diseño, Evaluation- valuación y Research type o tipo de investigación) y FINER (Feasible-factible, Interesting-interesante, Novel-novedoso, Ethical-ético y Relevant-relevante). La enseñanza de estos formatos y su práctica en Scenarios docentes facilitará su introducción entre los/as jóvenes investigadores/as.

Palabras clave: Preguntas de investigación; PICO; PECO; SPIDER; FINER.

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Correspondence: Marina Pedreño Plana, University of Murcia, Murcia, Spain
Email: marina.pedreno@um.es

Key points

What is known

- One of the key phases in any research project is to clarify the subject matter.

What this work contributes

- Using a structured format to develop the research question facilitates the process and increases the likelihood of success.
- The most commonly used formats use the acronyms PICO, PECO, SPIDER and FINER.

Practical scenario

A student of a master's degree in education asks for your help in choosing his dissertation topic. You quickly notice that she has many interesting ideas. However, they are vague and general ideas on different topics that have aroused their interest during their studies. In the orientation process, we help the student to prioritise the topics that interest him/her most. During the Master's degree, he participated in several initiatives with the flipped classroom methodology which interested him a lot (Scenario 1). He is also attracted by the school consequences for students exposed to bullying (Scenario 2), as well as the implementation of Information and Communication Technologies (ICT) in Education (Scenario 3). After acknowledging their interest and motivation, you clarify the need for them to choose among the different topics proposed and to transform them into research questions as a previous step to answer the following question: What is your research question?

What are we talking about? The research question

As Greenhalgh (2015) points out, if the question is posed in the wrong way or if answers are sought from the wrong sources, all efforts to answer the research objectives will be in vain. Strictly speaking, the beginning of any research project is to be aware of the need for information, which leads us to transform that need into a concrete question.

The problem or question is the trigger for any research, which will always be conditioned by the paradigmatic perspective we assume and, therefore, will determine the different decisions taken throughout the research process, since the most appropriate research design will be established in order to provide an answer to the problem posed.

Before considering any design, it is necessary to thoroughly document the state of the art to determine whether the proposed research is relevant. The research process begins when a problem is posed and the path to finding the answer is embarked upon. The proper framing of the question is an important and necessary condition for the proper planning of the research work. Therefore, it is necessary to carefully delimit it and, for this purpose, it is essential that the researcher has carried out an in-depth bibliographic search of the scientific knowledge related to the topic of study, which in turn makes it possible to precisely delimit the objectives and/or hypotheses of the research work.

The starting point for all scientific research is an interest in an initial research topic or idea that helps to advance the understanding of the topic. Research ideas can come from a variety of sources: individual experiences, written materials, audio-visual materials, personal conversations, observations of events, and so on. The issues raised in this way are too vague and need to be carefully analysed in order to be transformed into more precise approaches. Therefore, in order to further develop the research, it is necessary to restrict these topics to more concrete questions, for example: I want to research about, because

I would like to know who, what, when, where, why, if, how. Based on these questions we will formally structure the initial research idea by formulating the problem statement. The proper formulation of the research question defines the scope of the study and allows for a better grounding in the research process by expressing more precisely what is being studied (the research objectives), with whom the study is being carried out (subjects) and what information is to be collected (variables/indicators).

Therefore, choosing the research topic is one of the first fundamental tasks a researcher faces at the beginning of any project (Schwab et al., 2021). The final choice of the topic must take into account different circumstances related to: i) the state of the art or scientific knowledge to date and its scientific relevance; ii) the resources available to the researcher, both in terms of time and financial, logistical and human resources; and iii) the researcher's own personal interests and motivations. Different sources or strategies for identifying potential research topics have been described (Thabane et al., 2009). In general, this decision should be made after a literature search and reading to identify opportunities to contribute to scientific knowledge, together with a personal reflection of our real possibilities, both personal and those of our environment.

To increase the chances of success of our research project, it is crucial to transform the initial idea into a clear and concrete research question. This is not an easy task, especially for those who are new to research (Schwab et al., 2021; Stark & Woods, 2022). Returning to the initial scenario, without adequate training and experience, it is very common to write it in a general and ambiguous way. This situation should be avoided as a poorly or poorly formulated research question increases the chances of choosing the wrong research design and project design, makes it difficult to interpret the results, and is subsequently more likely to be a rejected study in the results publication process (Ali, 2021; Fandino, 2019).

Another common mistake is to try to answer several questions at once in a single research project. Attempting to answer several related research questions in a single project can be an efficient strategy because, if well thought out, it would be a good use of available resources. However, it is often better to focus on a single primary research question and assess other possible related questions as secondary (Thabane et al., 2009). Among other reasons because the choice of the type of primary question often determines the most appropriate research design to pursue the answer (Sackett & Wennberg, 1997).

In short, much of the success of a research project depends on the researcher's ability to translate his or her ideas into well-grounded research questions. But what elements does a research question have to have in order to be considered well-constructed?

The PICO format

One of the most widely used formats for developing research questions is the one known by the acronym PICO (Navarro-Mateu & Martín García-Sancho, 2007; Richardson et al., 1995; Stark & Woods, 2022). Initially, it arose with the initial objective of developing a structured question with the basic elements to subsequently develop a strategy for searching bibliographic information as efficiently as possible, facilitating access to the best scientific evidence and incorporating it in making the best decision in different fields of action. This model was initially developed in the context of Evidence-Based Medicine (EBM) and subsequently extended to other fields, such as Evidence-Based Practice (EBP) or Evidence-Based Education (EBE) (Baños et al., 2021; Sánchez-Martín et al., 2022). Nowadays, its use has been extended to the field of research as a way of clearly specifying the essential elements for developing an appropriate research question (Richardson et al., 1995; Stark & Woods, 2022; Thabane et al., 2009).

According to this model, a well-constructed research question should specify four basic elements (Table 1): P: Study population or participants; I: Intervention; C: Comparison; and O: Expected outcome (Outcome) or effect of the intervention.

Table 1

Description of PICO strategy

Initials	Description
P <i>Population</i>	Main characteristics of the participants or population to be studied. Briefly define the inclusion characteristics of the participants in the study on whom the intervention to be studied is to be carried out.
I <i>Intervention</i>	Intervention (ICT, prevention, reading habits...) to be studied.
C <i>Comparison</i>	Characteristics of the control intervention with which the main intervention is to be compared. A control intervention is not always implemented.
O <i>Outcome</i>	Specifies what is the main outcome to be measured when examining the effect of the intervention, what is expected to improve in the experimental group when the intervention is applied and how it is to be measured.

Since its introduction, the PICO format has undergone several adaptations to make its use more flexible in different contexts. One of the first was the inclusion of a fifth element, the time criterion (T), becoming known as PICOT (Fineout-Overholt & Johnston, 2005; Riva et al., 2012; Thabane et al., 2009). The latter criterion specifies the time frame in which the research project is planned. On the other hand, a control or comparison intervention is not always available, so the PIO (Population, Intervention, OR-outcome) format has been proposed (McKeon & McKeon, 2015).

Table 2

Description of PICO strategy

	P Population	I Intervention	C Comparison	O Outcome	T Time
Scenario 1	During the master's degree he participated in several initiatives with the Inverted Classroom methodology that interested him a lot.				
Elements	Students of Research Methodology of the Master's X.	Use of flipped classroom strategies.	Traditional classes.	Acquisition of competences and academic results.	Over the course of an academic year.
Research question	In Master X, does the use of a teaching methodology based on the inverted classroom strategy (I), compared to the traditional methodology (C), improve the level of acquisition of competences and academic results (O) in the students of the research methodology subject (P) during the academic year 20__ - 20__ (T)?				
Objective	To test whether the inverted classroom teaching methodology (I) improves the acquisition of competences and academic results (O) in the students of Master X (P) during the academic year 20__ - 20__ (T) to a greater extent than the traditional methodology (C).				
Hypothesis	If the inverted classroom methodology (I) is applied in Master X during the academic year 20__ - 20__ (T), then the students (P) will improve the acquisition of competences and will obtain better academic results (O) than if the traditional methodology (C) is applied.				

Other formats: PECO, SPICE, and SPIDER

As it was developed in the medical field, the description of the elements of the PICO format was oriented towards the search for therapeutic interventions in the healthcare context. Early attempts to

generalise its use to other areas of knowledge revealed a number of difficulties that could arise. Some of the most frequent examples are: i) when the interest does not lie in a specific intervention, but in exposure factors (both risk and protective) to different outcomes (PECO format); or ii) difficulties in applying it in research with a qualitative approach (SPIDER format).

Table 3 presents a practical example of the PECO (Population, Exposure, Comparison, OR-outcome) format proposed preferably for observational research designs, in which exposure to various risk or protective factors is analysed (McKeon & McKeon, 2015; Mintzker et al., 2022).

Table 3

Example of the application of the CEECP format to a research problem in Education

	P Population	E Exposition	C Comparison	O Outcome
Scenario 2	He is also very interested in the school consequences for pupils exposed to bullying.			
Elements	Secondary students.	Bullying.	No bullying.	School failure.
Research question	Secondary students (P) who have been exposed to situations of bullying or harassment at school (E), are they more likely to fail at school (O) than their unexposed peers (C)?			
Objective	To test whether there are differences in the chances of school failure (O) between students (P) who have been exposed to bullying situations (E) and those who have not been exposed to bullying (C).			
Hypothesis	Students (P) who have been exposed to bullying situations (E) are more likely to fail at school than (O) students who have not been exposed to bullying (C).			

On the other hand, the SPIDER tool is designed to structure research questions in mixed methods and qualitative studies (Cooke, et al, 2012). If we look at the content of Table 4, we can see how this tool focuses more on "Participants" than on representative samples and "Phenomena of interest". In addition, it specifies the type of "Data collection technique", which can guide the research process, as well as the "Assessment" of the constructs under study and whether the "Type of research" is qualitative or mixed.

Table 4

Description of the SPIDER strategy

Initials	Description
S <i>Sample</i>	Group of people to be studied, without trying to generalise results to the general population, so small samples are used.
PI <i>Phenomenon of Interest</i>	Similar to Intervention/Exposure. Examines how and why certain phenomena, experiences, behaviours and decisions occur.
D <i>Design</i>	Techniques used for data collection. The choice of design depends on what the qualitative research plan will be (interviews, focus groups, observations, etc.).
E <i>Evaluation</i>	Similar to Outputs/Outcomes. Evaluation results can be more subjective (views, opinions, attitudes, etc.).
R <i>Research Type</i>	Refers to the type of research, which can be mixed method or qualitative, where different research designs can be chosen (e.g. phenomenology, grounded theory, ethnography, case study, etc.).

Based on the third scenario initially proposed and following the example of the research problem proposed by Porto-Castro (2022) from a quantitative perspective, Table 5 presents a practical example, in a qualitative evaluation context, of the application of the SPIDER format (Cooke et al., 2012; Methley et al., 2014):

Table 5

Example of the application of the SPIDER format in qualitative research

	S <i>Sample</i>	PI <i>Phenomenon of Interest</i>	D <i>Design</i>	E <i>Evaluation</i>	R <i>Research type</i>
Scenario 3	He is also attracted by the implementation of Information and Communication Technologies (ICT) in Education.				
Elements	Hearing Language Specialists, Therapeutic Pedagogy Specialists, Guidance Team and Tutors.	and Use of technological resources.	of Interview.	Teaching-Learning Process.	Qualitative. Grounded Theory.
Research question	What is the perception of the specialists involved in attention to diversity in compulsory education (S) of the use of technological resources (PI) in the Teaching-Learning process of their students (E)?				
Objective	To explore, by means of an interview (D), the perception of the specialists involved in the attention to diversity in compulsory education (S) of the use of technological resources (PI) in the teaching-learning process of their pupils (E).				
Hypothesis	In qualitative methodology, hypotheses are not posed at the beginning of the research; they emerge as we analyse the information provided by the participants.				

The SPICE tool (Martínez Díaz et al., 2016) can be used to evaluate the results of a service, project or intervention. Table 6 describes each of the elements of this type of question and Table 7 provides a practical example of how to use this tool based on the first scenario.

Table 6

Description of the SPICE strategy

Initials	Description
S <i>(Setting)</i>	What is the context or Scenario in which the evaluation takes place?
P <i>(Perspective)</i>	Who are the users/beneficiaries of the service/programme?
I <i>(Intervention)</i>	What is the intervention to evaluate?
C <i>(Comparison)</i>	What is the intervention compared to? What are the alternatives?
E <i>(Evaluation)</i>	How is the outcome of the intervention measured?

Table 7

Example of the application of the SPICE format to a research problem in Education

	S Setting	P Perspective	I Intervention	C Comparison	E Evaluation
Scenario 1	During the Master he participated in several initiatives with the Inverted Classroom methodology that interested him a lot.				
Elements	Compulsory Secondary Education Classroom.	Students.	Flipped classroom methodology.	Traditional methodology.	Motivation.
Research question	In Compulsory Secondary Education (S) classrooms, do classes in which the inverted classroom methodology (I) is implemented, as opposed to traditional classes (C), improve the motivation (E) of students (P)?				
Objective	To test whether motivation (E) in the Compulsory Secondary Education (S) classrooms improves student motivation (P) to a greater extent when the inverted classroom methodology (I) is applied than when a traditional methodology (C) is not applied.				
Hypothesis	If we introduce inverted classroom methodologies (I) in Compulsory Secondary Education (S) classrooms, the motivation (E) of students (P) improves to a greater extent than if we apply the traditional methodology (C).				

Although other less frequently used acronyms have also been proposed, for example: CIMO, ECLIPSE, PESICO, PIPOH, PECORD, among others (Martínez Díaz et al., 2016; Schiavenato & Chu, 2021), there is a recent advocacy for the application of the original PICO format universally in any research context and in different scientific disciplines (Nishikawa-Pacher, 2022).

The FINER criteria

Although other less frequently used acronyms have also been proposed, e.g. CIMO, ECLIPSE, PESICO, PIPOH, PECORD, among others (Martínez Díaz et al., 2016; Schiavenato & Chu, 2021), there is a recent advocacy for the application of the original PICO format universally in any research context and across different scientific disciplines (Nishikawa-Pacher, 2022).

Table 8

FINER criteria for formulating a good research question

Meaning	Description
F (Feasible)	<ul style="list-style-type: none"> ▪ Ensures the appropriateness of: <ul style="list-style-type: none"> · the research design. · the sample size. · the research team. · the resources available. ▪ Takes into account possible losses/abandonments. ▪ Prioritises realistic outcome measures.
I (Interesting)	<ul style="list-style-type: none"> ▪ Responds to the interest of researchers, publishers and potential readers.
N (Novel)	<ul style="list-style-type: none"> ▪ Approaches the research problem from a different perspective. ▪ Replicates, confirms or refutes previous findings. ▪ Generates new hypotheses and meets information needs.
E (Ethical)	<ul style="list-style-type: none"> ▪ Complies with research ethics standards.

	<ul style="list-style-type: none"> ▪ Assessed by a local Research Ethics Committee.
R (<i>Relevant</i>)	<ul style="list-style-type: none"> ▪ Influences and contributes to the improvement of current practice. ▪ Stimulates new and future lines of research. ▪ Provides a precise answer to specific research questions.

NOTE: Adapted from (Fandino, 2019; Stark & Woods, 2022).

For example, to answer each of the questions elaborated in the three scenarios, the most appropriate research designs would be to use an experimental study for scenario 1, an observational study for scenario 2 and a qualitative grounded theory study for scenario 3. However, each of these designs poses specific challenges in terms of their own methodological characteristics, strengths and limitations. Specifically for the first scenario, the application of criterion F (Feasibility) of the FINER strategy, depending on the availability of resources (funding, human resources, among others) or the time frame, could lead researchers to opt for other options. The implementation of a randomised controlled experimental study (ideal design), being more complex, requires much more resources and it is more feasible to use other research designs. For example, they could prioritise conducting a systematic review-meta-analysis of the topic first (Sánchez-Martín et al., 2022), or they could opt for a longitudinal observational cohort study, in which the research topic is analysed using other experiences from the recent past. In summary, both the different research question formats we have discussed so far and the FINER criteria are a great help in defining the study design, but they are not deterministic. The research team has the option to choose or decide according to their interests or possibilities.

Also, the novelty of the research indicated by the FINER acronym needs to be qualified. In general, there is a tendency to prioritise the novelty of research projects. Journals tend to accept and publish more frequently research that provides new knowledge that contributes to scientific progress. In our view, the emphasis on novelty in research should not underestimate the importance of replication studies in advancing scientific knowledge as part of the process of validating results (Van Bavel et al., 2016). Recently, the replicability of scientific studies has been questioned in various areas of knowledge, such as in psychology (Open Science Collaboration, 2015) and, in general, in the social sciences (Camerer et al., 2018). As a consequence, interest in replication studies in which attempts are made to recreate the same findings by other research groups in independent samples are being re-evaluated (Bouter & Riet, 2021).

Conclusions

Translating the research topic of any project into a well-structured question using the PICO format, or any of the alternatives that currently exist, helps students starting their research career to explicitly incorporate all the relevant elements.

The use of these tools to pose research questions can help to clarify and classify the concepts in their research problem. As you have seen throughout this paper, there are many frameworks available, and choosing one or the other depends on the nature of your research. These tools are useful, but optional, as not all research is aligned with the same components.

They also make it easier for both editors and future readers to clearly, quickly and efficiently identify the topic under study. This initial process is considered one of the first building blocks in the research process. Its use requires some initial effort and practice. However, we believe that it is an effort well spent and that it greatly facilitates communication among the research community and, above all, the supervision of novices in their first steps of their research career.

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Appendix

Infographic on the research question

The research question



Developing a good research question allows you to:

- Clearly define the topic to be investigated.
- Facilitate the explicit identification of what is being studied (object), on whom (subjects) and what results/information (variables).
- Choose the most appropriate research design.

An elaborated question with a well-structured format helps to include all important elements. **Different formats** have been proposed for different research objectives or designs.

PICO (T)	PECO	SPIDER	SPICE
General model or for intervention questions	Exposure to risk/protective factors	Mixed Methods and Qualitative Studies	Evaluation of programmes/services
Elements			
P -Population	P -Population	S -Sample	S -Setting
I -Intervention	E -Exposition	PI -Phenomenon of Interest	P -Perspective
C -Comparison	C -Comparación	D -Diseño	I -Intervention
O - Outcome	O -Outcome	E -Evaluación	C -Comparación
T -Time or time frame		R -Research Type	E -Evaluation

A good research question should comply with the **FINER** criteria:

- ✓ Feasible
- ✓ Interesting
- ✓ Novel
- ✓ Ethical
- ✓ Relevant