

Triads in Scientific Structure and Functionality

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Abstract

Human nature has developed many ways of approaching daily issues and problems. One of these methods is the scientific approach, which has allowed mankind to make material progress. The scientific approach is different from the common one because it is based on a method, laws, principles, theories, univocal language and because of the enormous amount of information it needs to process. As a result, university institutions that produce knowledge from research require that projects and research reports be formulated according to certain requirements that are set forth in their academic rules and regulations. Therefore, each university has a unique way of presenting these works, which will depend on the scientific tradition of the institution and the scientific training of its authorities and teachers. At present, these are presented as articles, disregarding the differences between the nature of each type of document. A thesis that is supported in a university is different than an article that is published in a journal; likewise, the format of some works place the conjecture in the research problem chapter; others in the research methodology section; and others in an independent section. When performing an analysis of different sources, it is considered necessary to start from the existing knowledge and present a vision for the study in inquiry triads that allow the researcher to understand the interconnections among the research components, which are typical of a system.

Keywords: Triad, Scientific Research, Structures, Connection, Functionality, System.

INTRODUCTION

If research papers are presented in a higher institution, the regulations and formats will depend on the research lines of the institution, the scientific training of the professors, and the ideas that each of them has about the subject (Moeed, 2013). Being a good professional in their field and having published articles in indexed journals are reference parameters; however, these are not the only parameters considered. Scientific research must be understood as a system where its constituent elements are interconnected and linked to the surrounding world. In addition to this, the principles of the classification of science are usually left aside. Therefore, in the social field, relational studies are often confused with observational explanatory studies (Arbaiza, 2013); descriptive studies are considered qualitative; predictive studies are presented without experimental support (Hernández et al., 2014); and applicative studies are developed without having carried out an intervention program (Vargas, 2009). In the natural sciences, research begins with experimental explanatory studies, and qualitative, descriptive, and relational studies are ignored; in many cases, this is not considered scientific.

After a long research process, from the qualitative (Flick, 2015)—which is usually called exploratory, where the concepts are defined—to the quantitative (Arbaiza, 2013)—where the aim is to describe the facts, relate variables, experiment with them, predict probable scenarios, and apply them to solve problems—this study formulated a proposal in order to improve the understanding of scientific methodology, for the purposes of understanding society, improving it, or solving a problem that affects it (Arbaiza, 2013). The current lines of research (González and Núñez, 2020) support inquiry studies, which go through all the research phases and allow a deeper knowledge of the subject or problem to be developed or a solution to be obtained.

The scientific route must be followed (Bunge, 2019; Ramos, 2014; Caballero, 2013). First, the qualitative process must be undertaken, where concepts are defined, phenomena are interpreted, categories are built, and theories are elaborated upon. The basis of this phase includes the logic, metrics, designs, methods, and techniques that

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correspond to the moment of scientific inquiry. Thus, the qualitative and quantitative moments in research are where there is no contradiction (Supo and Zacarías, 2024). In other words, one cannot measure what is unknown; what has not been defined; and whose constituent elements are not known and how they are linked, internally and externally (Senge, 2000).

If the concepts are fully defined, and if there are consistent or partially structured theories, then the variables can be measured and statistics can be applied, thus deepening the line of research. Quantitative studies make it possible to measure variables, relate them, establish causality, predict events, and apply what is known to solve problems or improve a conflictive situation (Vargas, 2009). Therefore, it is necessary to understand the research process from holistic, integral, and systematic perspectives, taking into consideration three taxonomic principles: a) the principle of exhaustiveness; b) the principle of exclusion; and c) the principle of parsimony (Supo and Zacarías, Methodology of Scientific Research, 2020). This allows the criterion of alignment (Yunkor-Romero and Ochoa-Pachas, 2023) to be incorporated so that the levels of research, objectives, hypotheses, point estimates, variables, dimensions, and indicators are not confused.

METHODS

This study was exploratory, and it used the inductive method, the technique of observation, descriptions, and a documentary analysis. It took into account the various formats that have been developed by universities and/or institutions of higher education and that often generate controversy among researchers (Martinez-Corona et al., 2023). The objective of this study was to identify the components of a scientific study based on the concept of a triad, in terms of the reality, the theory, the design, and the results and their analysis.

Reality: First Triad

Those who are engaged in research intend to study reality by formulating hypotheses and developing answers or solutions to the difficulties they are studying through the definition of terms and the structuring of criteria. Science investigates reality (Latour, 2021), and for this purpose, it employs all of the mechanisms and instruments necessary to discover or rediscover it (Lavado, 2020). This implies viewing the problem within a spatio-temporal context, providing tentative answers, and defining a purpose to concretize the value of the results. Thus, reality is constituted as the first triad of research, and it is made up of the following: a) the research topics or dilemmas; b) the tentative answers or solutions to those topics or problems, which are developed either through conjecture or by applying statistics to obtain estimates; and c) the research objectives, which must be aligned with both the topic or dilemma and the conjecture.

The first component comprises the research topics or problems (Bunge, 2019), which are framed in an objective or subjective reality and, therefore, must be identified. For this purpose, the categories to be conceptualized are first indicated, and then the variables to be measured or counted are defined within a given line of research. The researcher defines the idea of the topic to be developed and must be clear about whether he/she is going to conduct a qualitative or quantitative study, for which he/she must seek as much information as possible in safe and reliable databases. He/she must review the literature on the subject to be developed and determine the state of knowledge of the topic (Lavado, 2018; Rodríguez, 2007). Once the inquirer has the necessary information, he must determine what type of study he is going to conduct: either an exploratory study or a measurement of the variables. Likewise, he must also determine at what level of research he will develop his work. Once these parameters have been defined, the work will correctly establish the limits of the study, since it will be known whether categories or variables will be studied. Their corresponding subcategories or dimensions will be identified and the respective questions will be adequately formulated. The problems will be reinforced with the justification, importance, and limitations of the above, which will provide support to the research topic (Dehalwar and Nishant, 2023).

The second component is the answer to the question or subject. The human mind observes a problem and immediately provides a probable answer or solution; this is because human beings seek to know, solve, or improve situations (Lavado, 2018; Supo, 2015). As the first three levels of research, the exploratory, descriptive, and relational levels usually employ designs of a holistic character (specifically the exploratory) that are sectorized, cross-sectional, and observational, where the inductive method is used. Then, the mind seeks to

develop a greater knowledge of the subject, and to deepen this knowledge for particular elements. The statements are of an empirical character and can sometimes formulate empirical laws that correspond to second-level statements (Fardet et al., 2021). On the other hand, in explanatory, predictive, and applicative research, it is necessary to start from a theory that explains, predicts, or solves the problem being studied. In these investigations, experimental designs are used with interventions and treatments and by using the deductive method, since the statements are of the third level, i.e., the work is conducted with theoretical laws and robust and consistent theories (Fife and Gossner, 2024; Rodríguez, 2007).

The third component comprises the objectives, because once the problematic reality is known and the answers to these difficulties or the topic to be investigated have been worked out, then the objectives must be written. They must correspond in number and level to the research problems (Supo and Zacarías, 2024; Supo and Zacarías, 2020). The objectives must be aligned, i.e., if the problem is relational, the objective must be relational; if the problem is explanatory, the objective must also be explanatory; and if the question is technological, the objective must correspond to that analytical intention (Haro et al., 2024). This alignment criterion makes it very easy to evaluate the scientific inquiry, and it is amalgamated with the categories and subcategories or variables and dimensions, since these are the inputs used to elaborate upon the problems, objectives, and research responses (Yunkor-Romero and Ochoa-Pachas, 2023).

Concepts and Theories: Second Triad

The second triad corresponds to the so-called theoretical framework and is constituted by the research precedents, the theoretical bases, and the definition of the terminology used in the study (Lederman and Lederman, 2015; Piscocoya, 2007). This triad is the sustenance, or the cognitive basis, of the study. Within this triad are the preceding studies, i.e., those that were conducted prior to the researcher's work and can be international, national, and/or local. These works should be of the same research level as the study being carried out, as well as the study variable, which acts as a compass in the search for background information. This obliges the researcher to review the summary, the methodology, the data processing, and the results (Romero-Carazas et al., 2024). It should be considered that, if there are no theses of the same level and variable of study, a new topic and/or problem should be studied, and more exhaustive searches should be carried out to find as much information as possible.

The theoretical bases refer to the theories to be used in the research work, and they are based on principles, laws, concepts, and propositions (Varpio et al., 2020). If the studies are exploratory, descriptive, or relational, for which the inductive method is used, one would begin by defining the variables and dimensions along with their characteristics, properties, functions, applications, and uses; on the other hand, if the studies are explanatory, predictive, or applicative, for which the deductive method is used, then one would start from the theory that will support the study by making use of the concepts and definitions developed by the theory, which must be robust and consistent. If the methods used are different, the development of this part must also be different, because in inductive studies, the starting point is defined by the particular facts needed to reach a generalization, and the theory is complementary; in deductive studies, the starting point is the theory, which will serve to analyze the event, fact, or phenomenon investigated (Varpio et al., 2020; Lavado, 2020; Gómez et al., 2010).

The third element of the theoretical framework comprises the terms to be defined. In principle, the variables and dimensions must be conceptualized precisely if the studies are quantitative; if the research is qualitative, the categories and subcategories are defined (Kivunja, 2018). Sometimes, the definition of terms is confused with a glossary, but it should be understood that the definitions must be supported by an author, if the study is inductive, or by a theory, if the study is deductive (Lavado, 2008). The terms that make up this element must be supported by an expert author or specialist in the subject matter addressed or by a solid theoretical basis.

Designs: Third Triad

The third triad corresponds to the designs, the strategies (Köhler et al., 2023), and how the research results will be obtained (Cubo et al., 2019). The design is made up of a) the methods; b) the techniques; and c) the instruments. Designs are flexible and refer to how data and information will be obtained in order to answer the research question. According to their origins, designs can be a) community or ecological, with an etiology that corresponds to the social sciences; b) experimental, with origins in the natural sciences; c) epidemiological, with an etiology in the health sciences; or d) based on the validation of instruments, with an origin in the behavioral sciences (Supo and Zacarías, 2024).

The first component is the method. It can be defined as a set of techniques and procedures that will be used in the research based on reasoning (Bickman and Rog, 2009; Behar, 2008). These can be a) an inductive method or b) a deductive method. It should be noted that these two methods are linked, like energy–matter or oxidation–reduction; this implies that, only for reasons of work or study, they are separated into the inductive method, which progresses from facts to generalizations, and the deductive method, which uses theories to explain the events that occur in nature and/or societies.

Techniques form the second component; they are conceptualized as a set of prescriptive procedures that allow for the collection of data and information (Gil, 2011). Techniques are classified as follows: a) documentary; b) observational; c) descriptive; d) interview; e) survey; or f) instrument validation (Supo, 2015). Every technique is linked to a certain resource or instrument: the observation technique is linked to the observation guide resource; the documentary technique must have a resource called the documentary matrix to order for the sources of information, quotations, and references to be used; and the description technique must have a description matrix resource to make notes, elaborate on, and order the numerical scheme, the main ideas, and the secondary ideas, which will allow them to be related to the documentary technique. In the case of interviews, the interviewer is the instrument that will evaluate the interview and the interview guide allows for the ordering of the questions to be asked. For survey techniques, instruments called scales, questionnaires, and inventories are used (Supo, 2015; Hernández et al., 2014).

Instruments are the tools that will facilitate the collection of data and information required for the development of the study. There are mechanical instruments that will allow direct measurements of the characteristics of a variable, provided that it is numerical; if the variable is categorical, an instrument called a logical or documentary instrument must be constructed, which must go through a process of internal validation to enable the documentary tool to have content, construct, and reliability validity.

Analysis: Fourth Triad

The fourth triad consists of the following: a) a population; b) data ordering and tabulation; and c) data processing and interpretation. The population, which refers to the totality of the study units, must be precisely and accurately identified (Salas, 2018), taking into account the inclusion and exclusion criteria. These units can be objects, constructs, events, individuals, legal entities, or organizations, among others. To calculate a representative sample of the population, it must be indeterminate, unreachable, or infinite, so a formula is used according to the type of variable and the type of population. In social studies, the equality of categorical variables and finite populations is usually used (García et al., 2023). In qualitative studies, the concepts of study scenarios and participants are incorporated; although there is a population, its treatment is entirely at the convenience of the researcher, statistics are not used as a primary source, and it is at the discretion of the researcher to decide who will or will not participate (Thanh et al., 2023).

The ordering and tabulation of the data corresponds to the second component of the triad, which is called the analysis. This will allow for better processing of the data by ordering, cataloging, and tabulating them according to the procedures applied to the information collected (De la Puente, 2018).

The procedures and interpretation of data make up the third component to be employed in the research. In a quantitative study, statistical tools are used, from hypothesis testing to point estimation, and they can be different depending on the levels of research (Medina et al., 2023). If the study is descriptive and has a numerical

variable of interest, Student's t-test is used for a single sample, whereas if the variable is categorical, the goodness-of-fit test is used. If the study is relational and the variables are dichotomous nominal categorical variables, the X² and Cohen's kappa index are used, but if the categorical variable is ordinal, Kendall's tau beta or Spearman's rho are used (Supo and Zacarías, 2024). On the other hand, if the variable is numerical, Pearson's correlation test is used. In the case of qualitative studies, data processing is carried out using logic, argumentation, hermeneutics, construction, and heuristics, among others (Supo and Zacarías, 2024; Ñaupas et al., 2023).

Results: Fourth Triad

The results constitute the fourth triad. After processing the information, we continue with the following: a) discussions; b) conclusions; and c) recommendations. The discussions in the inductive work are based on the objectives, which will make it possible to highlight the information obtained inductively; then, a comparison will be made with international, national, and local antecedents, taking into account whether there are similarities or discrepancies, always on the basis of the main variable. The theory is used first when the study is deductive, which means that the discussion is based on the chosen theory for this purpose, and it takes into consideration and compares the obtained results and demonstrates that this theory accurately explains the studied phenomenon. After that, the results should be compared with those obtained by other researchers in their corresponding research works (Supo and Zacarías, 2024). These comparisons can establish coincidences or discrepancies, for which it is necessary to verify the methods, techniques, and instruments that have been used in previous works in order to have a more consistent discussion.

Conclusions are propositions that can admit or reject the hypotheses or specific estimates based on the obtained results. All of the above aspects must be considered to reach a good conclusion (Verma et al., 2024). Conclusions can have the following structure: a) a connector, to link the previous paragraphs with the conclusion; b) a reaffirmation of the assertion, based on the obtained results; c) the points that have been developed throughout the work; and d) a critical reflection, where appreciations are given on the subject. The conclusion can then end with a quote, a question, or a suggestion. A conclusion can also be drawn based on the results obtained.

Finally, the recommendations should be based on the obtained results, discussions, and conclusions, taking into consideration that the research should be aligned with the problems, answers, and objectives, and should be directed with the designs and the processing and analysis of the data (Salas, 2018).

CONCLUSIONS

First: The triads described in this work allow the research process to be understood logically, within a system that seeks to deepen knowledge or solve a problem. This implies that every inquiry process from the scientific perspective has a triadic understanding that will enable a better understanding of the phenomenon, matter, event, object, or construct that is being investigated.

Second: The triads that correspond to examining the existing knowledge on a given topic or problem are the triad of reality and the triad of the theoretical framework. These triads respond to the research question by determining what reality tells us and what has been studied about that reality.

Third: The triads that will answer the question of how to carry out the study are the triads of design, analysis, and results. These triads define how the results will be obtained, the tools to be used, and how these results will be presented, as well as their treatment, in order to discuss them, reach consistent conclusions, and present recommendations.

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