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# THE CONSTRUCTION OF SCIENTIFIC KNOWLEDGE

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## ABSTRACT

This article deals with Science and the construction of scientific knowledge. The text is intended mainly for undergraduate students, and its relevance is based on the need for students to understand the scientific scope, and acquire and build knowledge, especially at the beginning of the course, so that they can expand intellectually, personally, socially, and professionally. Indeed, the appropriation of already consolidated knowledge and the acquisition of new knowledge is possible in many ways, however, the construction of scientific knowledge differs from one branch of knowledge to another. This text presents and discusses issues necessary for the beginning of scientific research: the concept of Science, types of knowledge, scientific language, scientific discursive genres, methodological possibilities, procedures, and instruments for generating data and for analysis, among other issues relevant to scientific practice. The intention is for this text to contribute to the construction of knowledge about the object that it proposes to investigate. One should not think that these are easy tricks nor are they known by everyone who enrolls in undergraduate courses; the reality is different and requires a detailed exposition and explanation, especially for those new to scientific research.

**Keywords:** Science. Knowledge Construction. Scientific Research.

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## INTRODUCTION

The construction of scientific knowledge through scientific research can, in theory, have its origins in Basic Education, but it is from the moment students enter undergraduate school that they find themselves struggling with how to proceed in the field of research. To begin scientific research, it is necessary to understand what Science is and the procedures for carrying it out. Knowing and using scientific language, the most common discursive genres linked to the construction of scientific knowledge, and elementary methodologies and instruments are essential conditions for beginning scientific research and, from there, contributing to the production and expansion of various types of knowledge. This article deals precisely with basic issues that provide the beginning researcher with the conditions to carry out scientific research.

The first section presents the concept of Science and reflects on the types of knowledge, with emphasis on scientific and empirical or popular knowledge. It also discusses not only the characteristics but also how scientific knowledge is constituted, in contrast to other types. The second part focuses on language, scientific language, and scientific discursive genres that are present in research and knowledge construction in all branches of knowledge. The third part focuses on the construction of scientific knowledge, as well as the path to be followed in an investigation, with emphasis on methodology, types and methods of research, and procedures used for scientific work. It also presents the necessary apparatus, both for research and analysis, through which the researcher can carry out his/her work. This part includes contributions from Marconi and Lakatos (2010); Severino (2007); and Triviños (1987); among others.

Finally, in the Final Considerations, the discussion is resumed about the urgent need to provide students, at the beginning of their undergraduate studies, with methodological artifacts that are essential for future scientific investigations. It is argued that, in addition to appropriating knowledge from other people's research, academics need to know how to proceed to contribute to the construction and expansion of Science.

## SCIENCE AND TYPES OF KNOWLEDGE

Science is a human creation. It is based on the need that human beings have to find reliable answers about a given subject or object, and therefore it is not closed in on itself. The answers found by it can be improved, expanded, and challenged, and thus knowledge is constructed temporally and spatially. According to Bachelard (1996, p.17), "knowledge of

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reality is light that always casts some shadows. It is never immediate and complete." In this continuous and dynamic construction, everyone, in some way, and with the most diverse methods, can contribute to its expansion and transformation.

## CONCEPT OF SCIENCE

Etymologically, Science means knowledge, however not all types of knowledge belong to Science; To achieve this, it is necessary to use systematic methods and techniques, which, in the research process, are capable of providing answers to the questions posed, the results of which are then universally evaluated. Scientific knowledge differs substantially from that produced empirically or popularly, but even though there are differences between them, there are points of contact, as Severino (2007, p. 100) says: “it is always the link between a theoretical network and empirical data, it is always an articulation of the logical with the real, of the theoretical with the empirical, of the ideal with the real”.

There are other types of knowledge. Lakatos and Marconi (2010) refer to the four classic ones: scientific, empirical (popular), philosophical and religious. They further clarify that only scientific knowledge is based on scientific proof, but that does not mean that the others should be disregarded. In this text, empirical and scientific knowledge are substantially highlighted.

### Empirical Knowledge

Empirical knowledge comes from everyday life, from personal experiences, from the immediate observation of events and is transmitted to future generations through the social discursive dialogic exchange, as Voloshinov (2013, p. 162) teaches, for whom “It can be said that any verbal communication, any verbal interaction, develops in the form of an exchange of statements, that is, in the form of dialogue”. In this turn, the empirical is generated in the wake of what is acquired in everyday life or by chance, from the experiences of others, teaching, and learning, in a process of human and social interaction. It is unsystematic, is much more related to beliefs and values, and is, therefore, part of ancient traditions.

For Kopnin (1978, p. 152),

> In empirical thought, the object is represented in the aspect of its relations and external manifestations accessible to living contemplation. [...] The practical

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application of empirical knowledge is restricted, being, in the scientific sense, any starting point for the construction of theory.

Empirical knowledge (also known as popular knowledge) is a form of knowledge that remains at the level of experiences, according to a subjective interpretation, previously established and adopted by the social group as truth. Marconi and Lakatos (2010, p. 59) state that “It can be said that vulgar or popular knowledge, latu sensu, is the common, current and spontaneous way of knowing, which is acquired through direct contact with things and human beings”. They continue to state that empirical or popular knowledge “Is the knowledge that fills our daily lives and that is possessed without having sought or studied, without applying a method and without having reflected on anything”.

In this sense, empirical knowledge is that which we use in everyday life, is generally utilitarian, and is linked to work life and day-to-day activities without requiring thinking about procedures and analysis of actions.

**Scientific Knowledge**

Scientific knowledge is based on the capture of the essence of the object, of the real, of the exact or close to the exact, obtained systematically through methods, techniques, and instruments of investigation. In search of this, the scientist aims to know, in addition to the phenomenon itself, the causes that produced it and, to this end, he classifies, compares, reflects, analyzes, synthesizes, individualizes, generalizes, particularizes, seeks to understand and conceptualize the external and internal properties of the object studied, always in search of the principles and concepts that structure knowledge, which becomes universally valid. This type of knowledge is always under construction; therefore, it is not something definitive since it opens up new possibilities for review and reassessment of the results. Popular knowledge, on the other hand, is considered an inexorable truth, something like “it is like this because it is like this and that’s it”, there is no benefit of the doubt or openness to reflection since it is evaluative and does not depend on proof.

Said like this, it may seem that scientific and empirical knowledge are not connected. On the contrary, there are differences, but they are not mutually exclusive. Scientific knowledge can be developed from knowledge derived from common sense since empirical or popular knowledge can generate questions that lead to research and scientific investigation, that is, what common sense does not answer, science can answer. Just like

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scientific knowledge, empirical knowledge is valid. Differences between them lie in the use and application of a method. While in scientific knowledge, questions, verification, analysis, and discussion are supported by a theoretical basis, with defined technical methods; empirical knowledge is structured in an unsystematic, sensitive, subjective, and uncritical way; without necessarily having as much effort to seek the reasons for the fact or phenomenon, as Lakatos and Marconi (2010, p. 58) explain:

> Vulgar or popular knowledge, sometimes called common sense, is not distinguished from scientific knowledge either by the veracity or the nature of the known object: what differentiates them is the form, the mode, the method, and the instruments of knowledge.

For Kopinn (1978, p. 153), scientific knowledge reflects the object or phenomenon studied in its essence, and its practical application is almost unlimited. In this sense, knowledge “assumes a truly universal character and seeks to produce truth in all the concreteness and objectivity of its content”. This universality and concreteness give scientific knowledge an unrestricted field of practical application, as it is made up of the internal properties of the object or phenomenon.

## LANGUAGE AS AN ELEMENT FOR THE CONSTRUCTION OF KNOWLEDGE

For the implementation of a scientific investigation, as well as the organization and recording of the data collected or generated, language is a fundamental element in the entire process. Thus, the researcher needs to know it and identify its characteristics, functions, and forms to use it effectively to achieve the research objectives.

### LANGUAGE

Of all human inventions, language is the most fascinating. Through language, it was and is possible for man to produce and expand diverse knowledge about the visible and imaginary world. From the most remote times until today, it continues to enable individuals to learn knowledge, construct and share other knowledge necessary for life in society, so it is not necessary to say that language continues to be the greatest human endeavor, as stated by Colello (2012, p. 16):

> Among all human achievements, language is the one that contributes most to making a person a true human being. In its relationship with the world, the word constitutes the best representation of symbolic potential, capable of making the suture between the being, the individual in particular, society, and the frame of

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references that is embodied in each object, each inquiry, and each personal positioning.

That said, the concept of language present in this text follows the postulates of the theory of the Philosophy of Language, whose conception postulates that language is, by yes, a material created by human need and action and, at the same time, a condition for the process of understanding and constructing knowledge, through dialogue and interaction.

It enables the subject to organize thoughts, ideas, emotions, and feelings to communicate, understand the culture produced, interact with others and their discourses, as well as create oral or written statements, present in the course of life in society. Its dialogic and interactional function allows all human beings, at the same time, to construct and share discourses to not only actively and formally participate in the great social, cultural, and scientific dialogue, narrowing the spatial and temporal distances that separate us, but also to advance in the construction of scientific knowledge.

Finally, language, conceived as social, dynamic, and constitutive, acts in the formation of man (his consciousness, his personality), in the relationship with others because, as Geraldi (2015, p. 85) says, “We are each one with the other in the irrefutable continuity of history”. Thus, it operates in the apprehension, construction, and expression of everything that exists, both inside and outside the subject, and therefore, inevitably, it must be present in all phases and dimensions of the investigative process.

**Language and its forms of use**

Human language is not static and is therefore constantly changing. Because it is dynamic, new words, expressions, and linguistic forms may emerge, which generally enable communication and interaction between people, as well as the apprehension and construction of culture. These are called varieties (or variants) of language, which refer to the different ways of use, taking into account the choice of words, the construction of the statement, and even the tone of speech. Language changes according to culture, region, time, context, social class, age, and gender. These changes are classified into 4 groups:

Diachronic variations. These are the changes that occur chronologically throughout history. For example, there are the words oiro - gold, causa - thing, Vossa mercê - Vosmecê - Você - cê, and louro - Loira, which confirm the changes that language goes through.

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Diatopic variations. These are modifications resulting from geographic locations. Mandioca - aipim - macaxeira, for example, are terms used to name the same tuber in different regions. Just like menino = guri - moleque - piá and cerveja = bera - breja - cerva.

Diastratic variations. These are changes that occur in the social sphere. They result from the habits, social class, age, gender, and culture of people when expressing themselves.

Diaphasic variations. These are situational or stylistic variations in which the speaker or writer, to express themselves, defines what level of language to use considering the situation, the place, the environment, the person (and their characteristics) with whom they speak or to whom they write. For example, using bassora instead of vassoura, tá instead of está, and cê or ocê instead of você are examples of this variation.

Given the above, it is necessary to recognize that language cannot be a vehicle for discrimination or prejudice. No form of expression is superior to another. Standard, colloquial, artistic, jargon, slang, and regional language variants are different ways of using language, and therefore should not be considered errors, but rather possibilities of use. In this regard, it is possible to state that there are no errors in language, but rather inadequacies in its use. This understanding is supported by the (BRASIL, 1998, p. 29):

Variation is constitutive of human languages, occurring at all levels. It has always existed and will always exist, regardless of any normative action. Thus, when we speak of “Portuguese Language” we are talking about a unity that is made up of many varieties.

As demonstrated, language is not an immobile phenomenon, nor is it closed in on itself. It is confirmed that, when using it, whether for speaking or writing, it is necessary to consider who one is speaking to or writing to, as well as the situation, environment, and conditions of the listeners or readers. For the construction of scientific knowledge, for example, the standard variant language is used, considered scientific, presented and discussed below.

**Scientific language**

Scientific language, in particular, is characterized by being impersonal, objective, and precise. This means that the writer of some scientific discursive genre must stick to denotation, that is, use words, expressions, and periods that only give rise to an interpretation of the subject or object in question.

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The scientific text must be informative so that its content can be understood objectively, with clarity and precision. Therefore, one should choose terms that are more appropriate for the logical understanding of what one intends to express. The use of terms with a figurative sense, many adjectives, or qualifying expressions should not be predominant in scientific writing. It is possible to state that it is prudent and avoid them when writing scientific texts.

To write well, knowledge about the subject is required. This knowledge comes from what Jakubinskij (2015, p. 88) called “apperceptive mass”, whose content results from the assimilation of information and culture already produced. That said, it is necessary to read a lot, in addition to discussing, reflecting, and analyzing the available material about the subject on which one is going to write. The act of reading allows not only to extract the content of the statement but also helps to recognize how language is mobilized in written form.

## SCIENTIFIC DISCURSIVE GENRES

The use of verbal language, whether for speaking or writing, occurs through texts (statements) that belong to some discursive genre. Bakhtin (2016) cites secondary and primary discursive genres. These refer to immediate, everyday use in the process of communicative interaction, and the former, because they are more elaborate, are created and disseminated in more complex cultural conditions and environments. The scientific texts presented below belong to the scope of secondary discursive genres.

The texts present in society are manifested in the form of genres, which are manifestations of language, verbal or non-verbal, with their structure that fulfills a discursive purpose. Some of the genres used in everyday life are: poems, requests, emails, official letters, leaflets, notes, chronicles, receipts, short stories, contracts, reviews, letters, plays, memorials, song lyrics, minutes, recipes, guides, memos, cartoons, sermons, etc.

When referring to the importance and necessity of discursive genres, Bakhtin (2016, p. 39) states that the process of communication and human interaction could not happen without their presence, because “If the genres of discourse did not exist and we did not master them, if we had to create them for the first time in the process of discourse, to freely construct each statement for the first time, discursive communication would be almost impossible”. Below, the most common scientific discursive genres in the construction of

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scientific knowledge are presented and discussed: abstract, report, research project, and scientific article.

**Abstract**

A summary is a scientific discursive genre that aims to provide the reader with an overview of the text in question. According to NBR 6028, from the Brazilian Association of Technical Standards – ABNT – an abstract is “A concise presentation of the relevant points of a text, providing a clear and quick overview of the content and conclusions of the work”. Although there are three types of abstracts – indicative, informative, and critical –, this article highlights the informative one, which aims to present the main points that make up the original text, providing an overview of it. Below, we present two possibilities for abstracts, which meet specific scientific purposes.

Simple abstract – characterized by brevity; that is, it is a succinct text that deals with a completed or ongoing work (text). It should contain relevant information that gives the reader an overview of the original. Writing in this genre should include the subject of the work, the guiding question (hypothesis, if any), the objective or objectives of the work, the methodological procedures – theory, method, techniques, and instruments – used, as well as a succinct outline of the results obtained.

When referring to an article, monograph, TCC, dissertation, or thesis, the abstract should structurally be written in just one paragraph, written in the 3rd person singular, with verbs in the active voice. It should not contain abbreviations, graphs, illustrations, figures, tables, or bibliographical references. The number of words depends on the scientific genre to which the summary refers. When writing it, the author must record what is essential, following a hierarchy of ideas and the same sequence in which the facts appear in the original text. It is important to clarify that summarizing does not mean removing excerpts from the base text. A series of randomly linked excerpts does not necessarily constitute a logical sequence that we call text (statement). The writer must write the summary using his or her vocabulary in a way that remains true to the author's ideas. There should be no opinions or explanations. It is also important to note that whether it is for the summary of larger scientific texts or utilitarian purposes, such as those used in the classroom, to understand a text, several readings are essential to understand and synthetically record the ideas, information, and fundamental concepts of the original text. The expanded abstract differs from the simple abstract not only in length but also in structure, that is, the

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parts that compose it. In the expanded abstract, sections relating to each part of the original text may appear. In addition to the information cited in the simple abstract – the author may include tables, graphs, quotes, references, etc. Structurally, the following are parts of the expanded abstract: title of the original work; names of the authors; summary, which should include the subject, guiding question, hypothesis, objective, methodological procedures; keywords; introduction; methodology; results and discussion; conclusion or final considerations; acknowledgments and references.

**Report**

The Report is a narrative-descriptive textual genre in which information about the partial or total results of a given activity or event is recorded. This genre is based on what is relevant to be reported: experiences, investigations, processes, methods, and analyses, and therefore must be written faithfully to the facts.

Except for some that already have their forms, ABNT, through NBR 10719, states that a technical or scientific report must have the following structure: the external part that contains the cover and spine, as optional elements. On the internal part, the mandatory elements are the title page, the abstract, the summary, the introduction, the development, the final considerations, and references. The following optional elements stand out: acknowledgments, lists, attachments, and appendices.

The number of pages will depend on the depth required to address the subject at hand. Normally, the writer knows how much to write. Since it is a scientific genre, it should be written in the standard form of language.

**Research Project**

A research project is a text that outlines the objectives, methods, and actions of the research. Gil (2002, p. 19) explains that a research project is “the document that explains the actions to be developed throughout the research process”. This means that when the goal is to do something, it is necessary to plan. It is no different in scientific research. It is necessary to think and define the steps so that the result (or results) arise from a set of previously planned procedures. Further on, it teaches that “The project must, therefore, specify the objectives of the research, present the justification for its implementation, define the research modality and determine the procedures for collecting and analyzing data” (GIL, 2002, p. 19).

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The elaboration of a research project must start from an existing problem that needs to be known and solved or from an issue, still unknown in the scientific context, that needs to be investigated. In other words, defining what to investigate (subject) is an essential issue to start the construction of the project. In addition to this issue, there is the need to define the objectives, hypotheses, and reasons for investigating the defined object. It is important that what is going to be researched meets three fundamental factors: personally satisfactory, scientifically necessary, and socially relevant.

With the object, objectives, hypothesis, and justification established, it is necessary to define the locus, objects or people to be investigated, as well as the research to be carried out, the theoretical framework that underpins the problem, method, techniques and instruments for collecting or generating data. It is also necessary to define the method and techniques for analyzing the data collected and the schedule for each action/stage.

Scientific Article

A scientific article is an analytical report of updated information on a topic of interest for a specific purpose. It is the result of a study developed from research related to a Teaching, Research, or Extension project. Its objective is to disseminate the results of a study carried out, with the purpose of bringing new ideas and approaches to the knowledge of the interested public.

When writing an article, it is important to use clear, concise, and objective language. Adjectives, roundabouts, and unnecessary repetitions should be avoided. It is generally published in magazines, newspapers, or other specialized scientific journals. Dissemination of the results of work, and research in a specialized scientific journal. It may be from research that has already been carried out or from research that is in progress.

The structure of a scientific article consists of: a title, authors' names, abstract, keywords, introduction, development, conclusion or final considerations, and references. If desired, the writer may include annexes and appendices.

## CONSTRUCTION OF SCIENTIFIC KNOWLEDGE

All scientific research presupposes a methodological path used to obtain information that, when reflected upon, will become knowledge about a given subject. In order for the researcher to find the most reliable answers possible, it is essential that the process be planned, developed, and written in accordance with the methodological standards

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established by science. The construction of scientific knowledge about an object, situation, person, and their actions results from systematic methodological procedures that aim to find answers or solutions to the hypotheses in question.

## SCIENTIFIC WORK

It is common for the various branches of knowledge to cement different ways of producing scientific knowledge. In each of them, the objects and objectives to be investigated may change. In Natural, Exact, and Earth Sciences, for example, materials of natural origin, genetics, or products or objects that are materially present in reality are mainly investigated. Investigating a plant, mapping its characteristics and functions in nature; whether the soil is suitable for sowing or needs to be corrected for this purpose; or even the harm that certain viruses or bacteria cause to health are undeniably relevant and necessary for the understanding, maintenance and protection of human, animal and plant life. All of this is necessary to uncover what involves the subject in the external context, and what can bring benefits or be potentially harmful to life.

Other fields of knowledge, such as Humanities, Social Sciences, and Language, sometimes start from subjectivities, from immaterial issues that involve human beings. These are values, beliefs, thoughts, opinions, ideologies, dreams, desires, and speeches expressed orally or in writing. In this sense, scientific research has a beginning and an end, causes and consequences in the human being itself, so uncovering it is a sine qua addition for understanding actions, reactions, and intentions present in their daily interactions, exploring what is not apparent to the eye. Knowing the being in its human and social dimension is as necessary for Science as the act of breathing. These questions form the investigative field of these sciences, so they need to be unveiled in order to understand the human being in its entirety.

The investigative laboratory of these branches of knowledge is life itself to be unveiled. From this perspective, the discoveries of an investigation not only contribute to expanding knowledge on a subject but also renew all fields of knowledge and enable the human being to act on his vital universe. Ultimately, in this turn, research is understood as a prerequisite for human development (CHIZZOTTI, 2006). Whether to investigate the internal context, subjectivities, emotions, ideas, or thoughts, or to research the external context of the human being, with an emphasis on what is found in nature, for example, defining a scientific method is a condition of utmost importance for doing Science. The

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concrete realization of a well-planned investigation, developed and written in accordance with scientific methodological standards is essential and allows the researcher to find the most reliable answers possible to the questions in question, as explained by Gaio, Carvalho, and Simões (2008, p. 148):

> To research we need methods and techniques that lead us to judiciously solve problems. [...] it is pertinent that scientific research be based on the method, which means elucidating the capacity to observe, select, and scientifically organize the paths that must be followed for the investigation to be carried out.

It is true that there is no standardized methodology that covers the entire scientific scope, but there are different ways to do science. In each area of scientific production, there are principles or epistemologically divergent starting points, but this does not mean that scientific research is impossible. In other words, in all areas of knowledge, in order to carry out scientific research, it is necessary to establish and follow a method and everything that involves it in the effectiveness of the investigation to elucidate the subject and respond to the objectives that one wants to achieve. Whatever the chosen method, it cannot do without having in its essence the human being and all his acts and achievements, whether objective or subjective.

Finally, whether the research focuses on the entire range of values, material or immaterial, beliefs, ideologies, and discourses followed, constructed, and uttered in the experience of each subject, or whether the research has as objects and objectives external to the human being, language has a central function, because it is through language that subjects learn sociocultural and historically constructed knowledge over time, express themselves through it and, in this interaction, participate in the construction and expansion of scientific knowledge.

## TYPES OF RESEARCH

### Bibliographic research

Bibliographic research is not limited to writing down what others have written at other times. It enables us to learn about knowledge that has already been constructed and, based on this knowledge, not only expand it but also contribute to the production of other knowledge. In other words, using literature on a topic allows the researcher to “familiarize himself in depth with the subject that interests him” (TRIVIÑOS, 1987, p. 99). This type of

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research is not exclusive to a specific area; it can be developed in any branch of knowledge.

Except for possible original, unpublished, and already registered research, using bibliographic research means participating in the dialogic between authors and researchers, which makes it possible to recover what was recorded, which is clear proof that knowledge is not stagnant, but, on the contrary, is gradually constructed. It is, therefore, the reader/researcher's job to continue the apparently finite ends on a subject left by the researcher-authors. Knowledge, in this sense, is constructed both in the acceptance and expansion of what exists and in the contradiction that can result in scientific innovation. This issue is supported by the words of Lakatos and Marconi (2010, p. 166) when they state that “Bibliographic research is not the mere repetition of what has already been said and written on the subject, but rather allows the examination of a theme from a new perspective or approach, reaching innovative conclusions”. As stated, using bibliographic research is not merely reproducing what has already been written about the object investigated; but rather, expanding knowledge about it and seeking, at least minimally, to make considerations that result in significant contributions for future generations. Bibliographic research is constructed through books, theses, dissertations, course completion papers, scientific articles, and magazines that deal with the researched topic. From this, the researcher creates a framework of relevant information that serves both to expand knowledge on the subject and to ratify the analyses and discussions about what is being investigated. Without these bibliographic contributions, there is a risk that the considerations, even supported by the data generated in the field, will be at the very least rash, permeated by possible assumptions, inconsistent, and, at times, innocuous.

**Documentary research**

The fundamental characteristic of documentary research is to investigate documents, written or otherwise, with the purpose of uncovering what the object in question means. This type of research includes public or private documents, such as laws, contracts, letters, recordings, photographs, drawings, films, engravings, maps, statistics, etc.
Gil (2002, p. 45) states that,

> Documentary research is very similar to bibliographical research. The essential difference between the two is the nature of the sources/While bibliographical research fundamentally uses the contributions of various authors on a given

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> subject, documentary research uses materials that have not yet received analytical treatment, or that can still be reworked according to the research objectives.

The relevance of documentary research focuses, first and foremost, on the object under investigation itself, as well as on the researcher's ability to extract information from the document in question that contributes to scientific knowledge.

Finally, the researcher may, for example, opt for bibliographical or documentary research, if the objective is to learn about and discuss scientific or legally registered knowledge and parameters. If the object under investigation is outside that registered by Science, field research should be chosen.

**Field research**

As is known, field research is characterized by the researcher leaving his/her place and going to the locus where the investigation will be carried out. For Lakatos and Marconi (2010), it is used with the objective of generating information on a given subject and discovering new phenomena and the relationships between them. The locus, in field research, varies and should be defined according to the object and objectives to be investigated.

The human being and his/her space, where he/she acts, interacts and lives, can be considered as the locus where the research is carried out. In this place, the researcher's objectives focus on uncovering thoughts, ideologies, actions, expressions, ways of conceiving and experiencing reality, what people are, what they think, and how they act socially and professionally, a fact that will require prior contact with them. In this regard, Severino (2007, p. 123) clarifies that:

> Data collection is carried out under the natural conditions in which the phenomena occur and is therefore directly observed, without intervention or handling by the researcher. It ranges from surveys, which are more descriptive, to more analytical studies.

Since data is generated under natural conditions, in the subjects' environment, it requires the researcher, among other issues, to create favorable conditions for using the research techniques that will be used for the investigation, under penalty of compromising the research and its results. The difficulties that the researcher may face if he does not define exactly what he wants or disregards the characteristics of those being investigated are highlighted by Triviños (1987, p. 141 and 142) when he states that:

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> One of the most difficult situations that a researcher who wants to study the social reality that is being processed and occurring faces is that of clearly defining his or her role. He is a person who wants to know aspects of other people's lives. These people, like all human groups, have their own values that can be very different from the researchers' values. They have interests, enemies; social groups made up of friends, family, etc., or are united by the same desires. [...] the researcher must evaluate the circumstances and seek the best path.

In the author's words, it is necessary to establish a relationship of trust between the subjects of the investigation, to whom the researcher must show himself to be affable, truthful, without any attitude of superiority, so that the research participants consider themselves partners, contributors, to the point of providing data closer to the reality that surrounds them. In other words, in order to achieve this situation, it is up to the researcher to create the conditions for this, so he cannot show himself to be insensitive to the reality of people, nor place himself in a position superior to that of the investigated.

In some branches of knowledge, the locus is generally external to the human being, that is, where objects that are present in nature are found. For example, to conduct experimental research, which requires test tubes, slides, and other instruments, the locus is the physical laboratory.

## PROCEDURES FOR COLLECTING AND/OR GENERATION OF DATA

Procedures and instruments for scientific work may vary depending on the area of knowledge involved, as well as the focus, intention, and objectives of the investigation. However, although there is no absolute rule on what to use to conduct scientific research, the fact is that some procedures appear to be more appropriate depending on the nature of the branch of knowledge in question. Below, there are possibilities for collecting or generating data with a view to understanding the object or theme in question.

If the object to be investigated is material present in nature, the term data collection seems to be more appropriate, such as laboratory research, for example. If the investigation involves human beings, their actions, thoughts, values, ideologies, ways of life, etc., it is more logical to use the term data generation, as Bakhtin (2011, p. 329, 330) says:

> Thoughts about thoughts, an emotion about an emotion, words about words, texts about texts. This is the fundamental difference between our (human) sciences and the natural sciences (which deal with nature), although here too the separation is not watertight. In the field of human sciences, thought, as thought, is born in the thought of another who manifests his will, his presence, his expression, his signs, behind which are divine or human revelations [...].

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In this turn, the two terms, data collection, and data generation, appear below when the procedures necessary for scientific practice are applied.

**Didactic-formative experiment**

The didactic-formative experiment is theoretically linked to the general principles of Historical-Cultural Theory, as explained by Davidov (1988), as being a peculiar method for studying the relationships between learning and its relationship with the mental development of students. The development of this data generation procedure is more applicable when the objective of the investigation is to promote processes of construction, meaning, and resignification of some object in question, for example, a statement, whether oral or written, created by the subjects involved in the research.

The word experiment may refer to an understanding that it is an investigative approach of a positivist nature, but it is not. The experiment in question may be a didactic-investigative procedure that aims to carry out a research process to understand, for example, the development of subjects in a classroom, based on what they produce in the learning process. This understanding is in line with what Freitas (2010, p. 3) explains, for whom “the didactic-formative experiment is a way of researching the teacher’s teaching activity in dialectical relation with the student’s learning activity in the classroom context”.

According to Davidovian propositions, the didactic-formative experiment is a teaching method in which activities are planned and organized collectively among the subjects, with the purpose of producing developmental learning in which structures articulated with the educational action are created in the subject, which is capable of producing changes in this subject. These educational actions must have a specific purpose to solve problem situations and build appropriate theoretical-scientific knowledge (DAVIDOV, 1988).

Understood in this way, in addition to this research instrument serving to generate data, in a second plan or moment, it can be taken as a possibility of pedagogical practice, especially in work involving the oral or written creation of language, to be developed in the classroom when the objectives are also to enhance the training and development of students for the exercise of citizenship.

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**Dialogued Encounter**

Dialogued encounter is understood as a discursive genre capable of allowing the subjects involved in the investigation to establish interaction, through otherness, on a given object or subject. In this regard, Bakhtin (2016, p. 12) clarifies that,

> The richness and variety of discourse genres are infinite because the possibilities of multifaceted human activity are inexhaustible and because in each field of this activity, a whole repertoire of discourse genres has been developed, which grows and differentiates as such field develops and gains complexity.

According to Tamura (2018, p. 43), the dialogued encounter is "understood as a discourse genre, used as a methodological possibility for generating data in situations in which the researcher also constitutes himself as a subject of the research".

This data generation instrument is based on open interaction between the researcher, who proposes the meeting and the initial actions, and the subjects under investigation, who come together physically and dialogically and, together, generate data and information necessary to demonstrate the object of the investigation. The term object is used, but it does not refer exclusively to something materially solid. The object in question can be some aspect (or aspects) that form immaterial life: culture, knowledge, experiences, life experiences, ideologies, thoughts, emotions, sensations, opinions, in short, ways of living, acting, and relating. Investigating issues of this nature is as relevant or more relevant from a scientific point of view as measuring the distance between a stellar object X and planet Earth, for example. In this sense (the aspects that form immaterial life), the dialogic encounter brings the research subjects closer together and is better suited to this process. According to Bakhtin (2011, p. 400), "the subject as such cannot be perceived and studied as a thing because, as a subject and remaining subject, it cannot become mute; consequently, the knowledge that one has of it can only be dialogic".

The research that aims, specifically, to carry out a process to measure its result, for example, focusing on the content produced by the subjects, materialized in oral or written statements, the procedure of the Didactic-Formative Experiment, mentioned above, is more appropriate. On the other hand, if the focus is on knowing the process itself, from the subjects who execute it: who they are, how they live, what they think, and how they act in the actions they carry out, the dialogic encounter may prove to be the best procedure.

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In this procedure, as the dialogue flows, it is possible to instigate the subject or subjects to detail, in a detailed manner, actions, ideas, thoughts, opinions, and impressions, to know the object investigated broadly.

In addition to the above possibilities, the dialogued encounter (or dialogued encounters) can very well meet the objectives of investigating modes of expression, life, production, material or immaterial, of members of neighborhoods, farmers, ranchers, traditional communities, such as indigenous, quilombola, riverside communities, for example, or those who live in an agrarian settlement, in the undeniable materiality of life in society.

The scope of use of this procedure in scientific research is almost infinite. Knowing who and what they are, what they do, how they conceive and act in society, the meaning of what they create, and how the researched subjects express themselves: students, young people, teachers, women, politicians, and managers from the most diverse areas of activity, workers in the city and the countryside, Indigenous people, riverside communities, quilombolas, settlers, self-employed, unemployed, homeless people, prisoners, and a whole range of subjects not named here is possible through the dialogued encounter investigative procedure.

To preserve relevant information and data, the content of the dialogues can be recorded or audiotaped. It is recommended that this recording be done at the time or immediately after the end of the meetings, in order not only to record more accurately what the interlocutors are saying but also to preserve information and perceptions of the extraverbal context, which can greatly contribute to understanding reality.

It is interesting to note that the use of this procedure to generate data does not involve a subject or subjects who simply answer questions from a researcher, automatically, formally, or stuck to pre-established questions, as in a questionnaire or interview. The relevance of the dialogued meeting for generating data lies in the interaction between two or more people who talk, dialogue, and reflect on the subject in question, in a relaxed, sometimes informal manner, but the important thing is that this contact results in an understanding of what is intended to be known.

Finally, it is in this investigative dynamic that the researcher and the researcher are involved. With the object on which they are dialoguing and from this relationship arises reliable information that will be transformed into scientific knowledge. In the dialogic act, it is common for interlocutors to feel comfortable reporting other subjects that, in a certain

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way, help in the understanding of the original object, which reinforces the dynamic and constitutive nature of the procedure. Finally, language is recognized as the phenomenon that makes the dialogic encounter effective and places it as a resource for the generation of data in scientific research.

**Observation**

Another important procedure for collecting/generating data that is widely used is observation. One might think that the use of this technique is explained only to compare or ratify data obtained by another resource, such as a questionnaire or an interview, but it is much more than that. For Laville and Dionne (1999), this research procedure is not passive contemplation or a simple attentive look at an object, action, or subject, but an active look supported by a very well-founded objective and hypothesis. The action of observation, whose outcome aims to solidify the analyses and discussions of the research focus, not only allows us to capture certain aspects of reality that other means do not fully offer but also reveals itself as a privileged way of contacting reality. Observation cannot (because it is not) be considered a subordinate form of data generation, sometimes considered as a complement to other procedures. When well carried out, based on defined objectives and hypotheses, which support, guide and sharpen the perception of the researcher-observer, it imposes itself as a valuable means of revealing information that, often, the discourse given does not reveal. Lakatos and Marconi (2010, p. 174) state that: Observation helps the researcher to identify and obtain evidence regarding objectives of which individuals are not aware, but which guide their behavior. It plays an important role in observational processes, in the context of discovery, and forces the researcher to have more direct contact with reality. Observation enables the researcher to recognize relevant aspects from which analyses and discussions can certainly achieve a greater degree of reliability and allows the researcher to understand the subject or object under investigation in its observable scope.

Lakatos and Marconi (2010) cite several types of observation and highlight, among others, participant, non-participant, individual, and team observation. Regarding participant observation, even though the objective is not to intervene in the observed situation, maintain neutrality, to avoid potential changes that could occur at the time of observation, the presence of the researcher is already something that can influence the behavior of the subjects. Therefore, in the research setting, the researcher needs to position himself as

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someone present and not pretend that he is not there. It is essential to have common sense, when recording information, to note what is useful, considering the possible variables due to his presence. According to Laville and Dionne (1999), observation resources vary according to the structure, the degree of proximity between the observer and the subject or subjects being observed, and the objectives of the person performing the observation, who must stand back to select the maximum amount of information about the object of the research.

Another factor inherent to the observation procedure refers to the fact that the researcher becomes an analyst at the time of observation. He analyzes not the data that is being generated in itself, but what is important and what he must record from it as a result of what he observes. In this sense, the observation procedure is not simple. Its implementation requires maturity, discretion, ethical posture, and responsibility from the researcher. As the observation takes place, it is important to compile a detailed record of the most relevant actions, behavior, facial expressions, and body language, i.e., the impressions observed, so that, at the time of analysis, it may or may not respond to the objectives and hypothesis of the work.

**Questionnaire**

A questionnaire is an important resource for collecting or generating data, especially when the objective is to investigate the object being researched by sampling. It is characterized as a set of questions about the object, subject, or situation that one intends to investigate. Lakatos and Marconi (2010, p. 201) explain that “A questionnaire is a data collection instrument, consisting of an ordered series of questions, which must be answered in writing and without the presence of the interviewer”.

Although it seems easy to prepare a questionnaire, its construction requires great care and responsibility from the researcher. First, one must have some knowledge of the object or person one intends to investigate to create truly relevant questions whose answers respond to the research objective. Lakatos and Marconi (2010, p. 202, 203) state that:

> The process of elaboration is long and complex: it requires care in the selection of questions, taking into account their importance, that is, whether they offer conditions for obtaining valid information. The chosen topics must be by the general and specific objectives.

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The most common questionnaire in scientific research is the standardized one, in which, for the questions elaborated, Laville and Dionne (1999, p. 183), "offers the respondents a response option, defined from the indicators, asking them to indicate the one that best corresponds to their opinion". The response options vary but are generally formulated from expressions such as: disagree, disagree, no opinion, agree, or agree, and statements such as I do not agree, partially agree, unable to respond/evaluate, agree, totally agree, or groups of responses such as: yes, sometimes, no... and also, always, sometimes, rarely, never.

Structurally, the preparation of a questionnaire must follow established standards, as well as the indication of the entity to which the researcher is linked, and the objective and justification of the investigation. To know the object, subject, or situation to which the questionnaire is intended, the researcher can structure the questions in blocks and, in each of them, the answers according to the objectives of the research. An important structural indication is that made by Lakatos and Marconi (2010, p. 203), for whom "The questionnaire must be limited in length and purpose. If it is too long, it causes fatigue and disinterest; if it is too short, it runs the risk of not providing enough information".

One advantage of the questionnaire is the scope it can reach. The researcher can either deliver it in person, send it by mail, or by e-mail, thus being able to reach a large number of people in a larger geographic dimension. Unlike the procedures mentioned, the researcher who uses the questionnaire to collect/generate data does not need to know or have personal contact with the subjects investigated. In this case, distancing is characteristic of the use of the resource, since the subject answers the questions without the interference of the researcher. When the researcher formulates the questions, he does so alone, similar to the person who answers them.

**Interview**

The interview is also a valuable resource for collecting/generating data. It differs from the questionnaire in several aspects, among which is the proximity between the interviewer and the person being interviewed, as well as how the data is recorded. In a questionnaire, as already explained, there is a distance between the researcher and the person answering the questionnaire, whereas in the interview, direct contact is a fundamental characteristic. It also distances itself from the dialogic encounter. While the latter is based on a dialogic interaction between the researcher and the person being

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interviewed, without pre-defined questions, the former is based on the prior elaboration of a list of questions.

As a resource for collecting/generating data, for Lakatos and Marconi (2010, p. 195), the interview “is a meeting between two people, so that one of them can obtain information about a certain subject, through a conversation of a professional nature”.

In the questionnaire, the answers are already recorded (written or marked) by the respondent. In the interview, the interviewer needs to capture the answers, either through a logbook or a recording device. Even if he records them as he hears them, he will certainly only be able to write down a few questions that he considers most relevant. It is then necessary to rewrite the answers, if recorded, inserting details expressed by the interviewee, or transcribe them, if they have been recorded. Recording or transcribing an interview will require great responsibility from the researcher, as he must adhere exactly to what the interviewee said. He cannot, of his own volition, perhaps to achieve the research objectives, insert answers that are foreign to what was said.

Structurally, the interview can be structured, in which questions are asked for direct answers and without the possibility of the interviewer asking others that are not in the script, and semi-structured, in which, even if there is a defined script, the interviewer, depending on the interviewee's answers, can insert other questions that he considers relevant and necessary to achieve the research objective.

Gil (2002, p. 118) explains that:

> As can be seen, many of the precautions to be taken when preparing an interview are the same as those for a questionnaire. However, it is necessary to consider that the researcher is present in the interview and, in the same way, that he can help the interviewee, he can also inhibit him to the point of harming his objectives. That is why conducting an interview properly involves, in addition to strategy, a tactic, which fundamentally depends on the interviewer's skills.

When preparing the interview script, the researcher should focus on creating questions that are directly linked to the interviewee's object researched, with the purpose of the responses meeting the investigative objective.

## TYPE OF APPROACH AND METHODS OF DATA ANALYSIS

### Qualitative and quantitative approaches

After collecting/generating data about the object, situation, person, or group of people investigated, it is time for their presentation, analysis, and discussion. At this point,

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the researcher can use the qualitative or quantitative approach. The qualitative approach is mainly based on the presentation, description, and reflection of the data obtained, to understand them, without emphasizing showing them quantitatively. The quantitative approach, on the other hand, focuses on the rational and objective analysis of data and information. In this approach, the description, in numbers, graphs, and tables, of the data obtained stands out.

The qualitative approach allows the researcher to engage in a subjective dialogue with the information, as this is done in a constant dynamic manner, as can be seen in the words of Triviños (1987, p. 137): “The qualitative research process does not allow for isolated, fragmented, or stagnant views. It develops in dynamic interaction, constantly feeding back and reformulating itself”. In this sense, the researcher must consider the possible variables in the course of the investigation; he or she be attentive to the subjects investigated and the conditions in which the data were generated since the information obtained is not always exact or capable of being measured in numbers. This type of approach is characterized as subjective; therefore, it is necessary to consider nuances that are not quantitatively measurable, nor are they materially present, but that were perceived during their generation. This approach applies more to the inductive method, whose reasoning starts from the smallest to the largest or from a singular or particular premise to the general. This method starts from the “observation of facts or phenomena whose causes one wishes to know. Next, we try to compare them to discover the relationships between them. Finally, we proceed to generalization, based on the relationship verified between the facts or phenomena” (GIL, 2008, p. 28-29).

Quantitative is an important form of presenting scientific data. This approach focuses on presenting data, highlighting and emphasizing quantity, that is, something that can be measured as a percentage. In it, the results can be quantified. Research generally has a large sample, whether of people or the object of study, allowing the results to be understood as if they represented a real picture of the people or object studied. This approach focuses on objectivity. This approach to describing the causes of the phenomenon and/or object studied and the relationships between variables uses mathematical language, which is analyzed in the statistical model (KNECHTEL, 2014).

The quantitative approach generally starts from the deductive method, that is, it starts from the general to the particular, since it often has a larger sample, the use of the deductive method is better applied to it. According to Gil (2008), the deductive method is

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more applied in research in exact sciences, since the principles of exact sciences can be stated as laws. However, in the social sciences, this method is less used due to the difficulty of obtaining general arguments, whose veracity is not in doubt. It is worth noting, as Ferreira (2015, p. 117) asserts, “both the qualitative and quantitative approaches, within their specificities, serve as a support base for data analysis”. This will depend on the type of research, objective, and method that the researcher will choose to best respond to the problem to be researched. We emphasize that in addition to the inductive and deductive methods mentioned above, there are also other methods, among which we will highlight the hypothetical-deductive and the dialectical. In summary, it can be said that the hypothetical-deductive method consists of defining hypotheses to respond to a problem. The propositions undergo a falsifiability test, to prove or refute the hypotheses. For Gil (2008), the main difference between the deductive and hypothetical-deductive methods is that the former always seeks to confirm the hypothesis, while the latter seeks empirical evidence to overturn the hypothesis. The dialectical method, on the other hand, is widely used in qualitative approaches and postulates that facts cannot be analyzed outside of a social context; in which material and immaterial life is produced and from which contradictions arise that transcend each other, giving rise to new contradictions and possibilities for solutions. The dialectical method “provides the basis for a dynamic and totalizing interpretation of reality” (GIL, 2008, p. 32), since social facts cannot be understood and interpreted in isolation and outside of their historical, political, economic, social, and cultural context. This method is widely used in research in the humanities and social sciences.

## FINAL CONSIDERATIONS

Finally, as demonstrated, Science, to be effective, needs methods, techniques, and resources. The exposition and reflection undertaken in this text can guide the path to be followed to carry out scientific research, as well as to prepare a scientific paper. The methodological issues mentioned above can guide academics, especially at the beginning of their undergraduate studies, to carry out an investigation, since they provide support for understanding the issues and problems of scientific research. The methodological procedures used in a given investigation can raise new possibilities for investigation and analysis and, from this, enable other forms and understandings guided by systematic scientific criteria in search of the acquisition and construction of scientific knowledge.

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Finally, it is worth noting that there is no knowledge more important than another, but the construction of scientific knowledge requires the researcher to act ethically based on methods, techniques, and resources that are essential for the validation and recognition of the knowledge produced. ACKNOWLEDGMENTS

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