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SCIENTIFIC INTERPRETATIONS FOR FUTURE RESEARCH QUESTIONS AND POSSIBLE SOLUTIONS

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ABSTRACT

Various methods of interpretation exist in medicine, engineering, social sciences, art, archaeology, and many other disciplines. Interpretation is meaningless without understanding its philosophical and logical prerequisites, following audio-visualization, observation, reading, experimentation, and systematization. It also means personal understanding and reframing something based on common sense, following effective communication between people with components of cultural, regional, and social understanding. In any interpretive process, language plays a crucial role in understanding, enabling seamless transitions between sequential knowledge processes such as visualization, auralization, and doubt. The doubt stage requires scientific philosophical fields such as epistemology, metaphysics, aesthetics, and rhetoric, combined with logical rules. Interpretation supports the conscious and unconscious acquisition of language during an individual's learning, education, training, and experience. While qualitative interpretations (ontology and epistemology) form the backbone of every discipline, quantitative interpretations (methodology) gain importance in scientific research. This article aims to reveal the stages of scientific interpretation, as well as the successive stages of knowledge evolution and explanation in historical, present and future directions.

KEYWORDS: Interpretation, Future, Research, Questions, Science, Solutions.

1. INTRODUCTION

In general, interpretive scientific approaches are crucial, especially before the numerical application of any methodology, because interpretation is considered a qualitative (linguistic) investigation without the quantitative numerical application that leads to interpretive thinking (Boland and Lyytinen, 2004; Remenyi and Pather, 2004). It is well known that even in established mathematical equations, uncertainty always remains due to a series of assumptions, idealizations, hypotheses, and simplifications, and this uncertainty was therefore termed as falsification (Popper, 1963). In any research activity, there are highly subjective and biased human characteristics that cannot be assessed through quantitative observations or measurements, so access to reality is only achieved through shared interpretive language discussions and consciousness.

While the basic definition of interpretation, according to Webster's Dictionary, is "the act of explaining the meaning of something; the way something is explained or understood," this definition does not reflect the true meaning of interpretation in science, as there are endless interpretations to arrive at scientific factual assessments. However, in ideological, regional, or cultural beliefs, a product can be reached, even if it does not encompass all worldviews. Interpretation means an explanation or view of what something means at a time. However, there is a constant persistence in scientific interpretations because everything agreed upon is quite vague, ambiguous, incomplete, and uncertain.

The open literature contains numerous research contributions from different authors and different perspectives on the interpretive meaning of an effective research procedure (Boland, 1985; Checkland and Holwell, 1998; Gichuru, 2017). In contrast to the interpretive paradigm of qualitative research, it defines a broad methodological commitment to understanding the world from the subjective experiences and perspectives of individuals (Denzin and Lincoln, 2011). Understanding should lead to meaningful evaluations of every philosophical and logical aspect of a research topic. Evaluation is a specific type of interpretive stance. Conceptual understanding is crucial for evaluating the interpretive implications and content of a research proposal (Pines and West, 1986). A detailed overview of quantitative research approaches is presented by (Ghanad, 2023). According to Popp (2013), the term "research" should not be used to equate, at least not, with quality research. On the other hand, (Gabriel, 2013) has suggested that there are basic concepts and rules for distinguishing between multiple predictions and scenarios for future scientific research investigations. Myllyoja et al. (2022) presented a foresight methodology approach with a predictive mindset and practical tools, keeping in mind that an ecosystem evolves. They presented a foresight model consisting of three interrelated elements as "Thinking beyond immediate collaboration," "Enabling continuous future dialogue," and building "Ecosystem future" capabilities.

The primary goal of this article is to distinguish the differences and supporting actions between two types of interpretation: qualitative (verbal) and quantitative (numerical). Qualitative interpretation types are overwhelmingly discussed in detail, as they are prerequisites for successful qualitative interpretations before and after modeling procedures. There is no faith in science, but for the future of scientific research, such quality criteria require scientific interpretations that have the approval of the reviews proposed in this article.

2. QUALITATIVE INTERPRETATION TYPE

Wherever human thought exists, there are interpretive activities to achieve greater meaningful understanding, and social, verbal (qualitative), or quantitative means of communication for mutual understanding and collective problem-solving. It is well known that human intelligences cannot be aggregated, but lower-level intelligences can be raised to higher levels through critical questioning and interpretation. As explained in the introduction, although there are various types of formal interpretation that are not widely known, everyone searches for better interpretive alternatives to arrive at the final solution. This does not mean that the solutions reached are not subject to interpretation; in fact, they are, and therefore the activity of interpretation appears to be an endless process. This point is clear when considering the evolution of knowledge and informative enlightenment since the beginning of human history. All early interpretations, from the era of wandering and hunting, were based on verbal thoughts as humans encountered the

myriad events occurring in their environment to meet their needs for food, clothing, and shelter. This stage can be said to seek knowledge through visualization and interpretation, as illustrated by the successive intertwined stages and cycles in Figure 1.

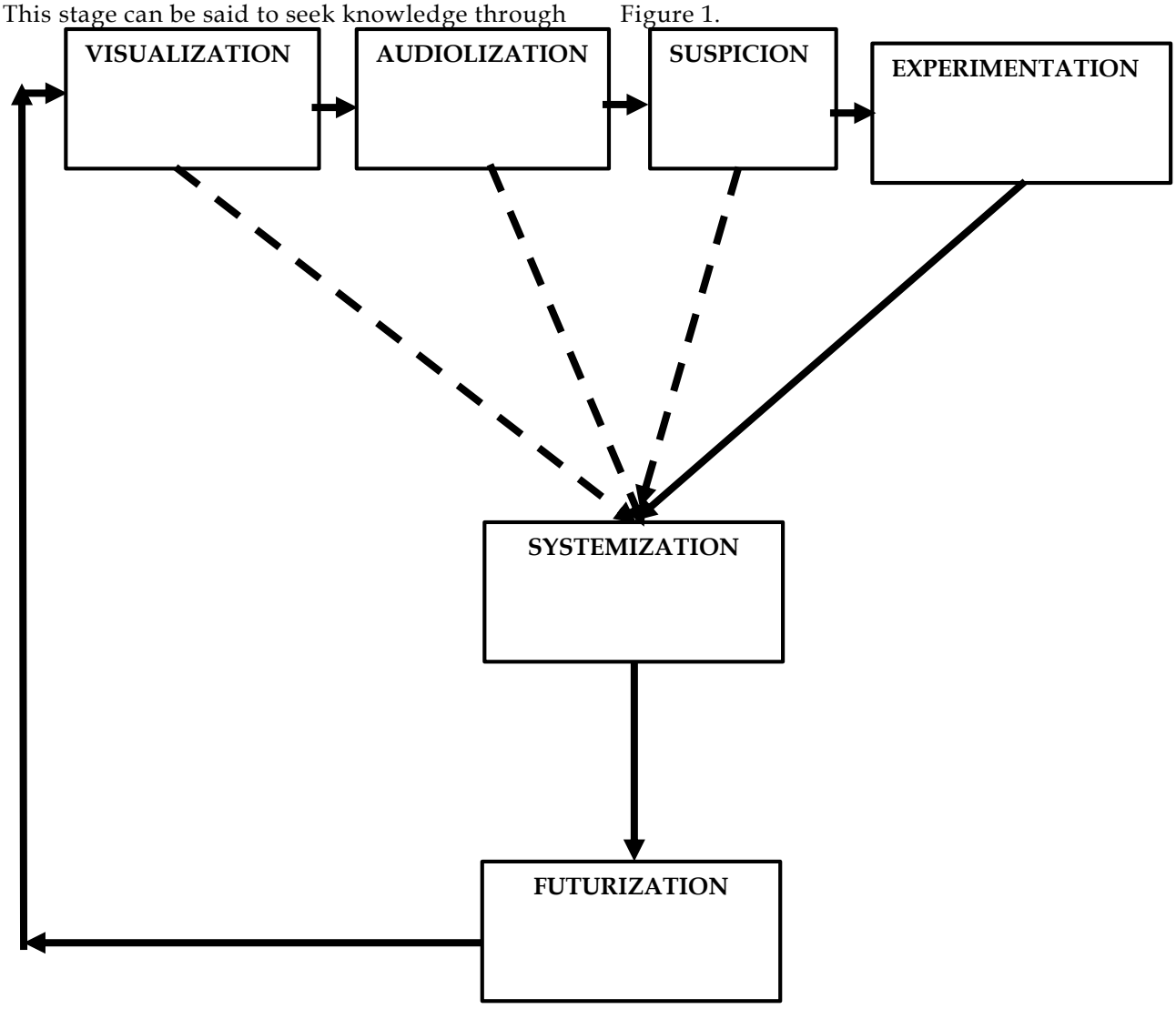

Figure 1: Knowledge Evolution and Interpretation.

While systematization may seem like a present-day outcome, it should also guide meaningful interpretations that will be modified or innovative in the future. All such stages are part of a qualitative interpretative process based on ontology and epistemology, rather than a scientific methodological quantitative process based on mathematics and numerical data. In this flowchart futurization implies advancement of existing methodologies and proposal of innovative procedures better than available approaches.

3. QUANTITATIVE INTERPRETATION TYPE

Interpretation generally refers to social communication, and particularly in science, primarily to self-interpretation, and consequently, is disseminated through the media for universal communication. Sometimes, misinterpretations arise as misunderstandings, and therefore, further interpretative clarification is necessary. Language is the primary means of communication and interpretation in the absence of interactive communication, leading to better and clearer understanding between people, or to confidence and credibility. There are different versions of interpretative methods in open literature (Boland and Lyytinen, 2004). While the type of interpretation varies by discipline, in quantitative scientific interpretation, the steps in Figure 2 become crucial after each stage is

completed to reach the final goal. Thus, the stages of interpretation in a scientific research process differ significantly from those in qualitative interpretation.

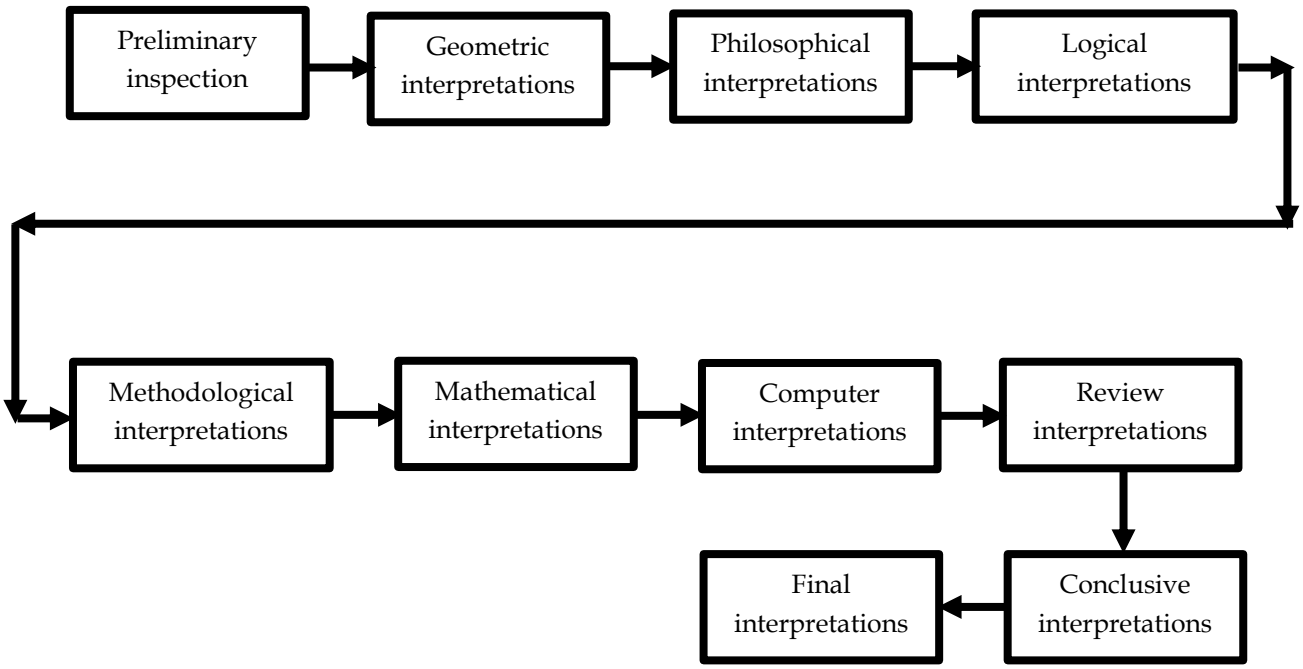

Figure 2: Quantitative Interpretation Steps.

The preliminary examination provides the first contact of the eye, ear, memory, and mind with the question on the research agenda. The researcher attempts to grasp the fundamental keywords about the phenomenon of study. Further interpretations can be obtained by imagining the geometry (shape) of the phenomenon, which offers implicit and explicit visual perspectives. In fact, geometric imagination also refers to interpretations made with existing design structures, modifications, or innovative design procedures. Detailed information on this subject is available in a book by the author (Şen, 2014).

The previous paragraph reflects visual, imaginary, and design conceptualizations embedded in verbal sentences without being checked by appropriate approaches. To this end, prior imaginary concepts can be questioned, and thus, elements of philosophical thought begin to play a role in developing interpretations. Philosophy of science plays a significant role in interpreting verbal information, even if it does not align with pure rationality (Bhaskar, 1991).

The next stage of interpretation enters the framework of logical rule(s) that provide nearly rational interpretations. At this point, three different logical systems are available to the researcher, depending on their thinking: determinism, indeterminism, or vagueness. The first alternative, called Aristotelian (384-323 BC) crisp, two-valued logic, is the most common type of logic, based on two extremes: absolute truth, represented by 1, or falsehood, represented by 0. The second type of logical interpretation considers numerical binding (data) based on measurements of input-output variables that describe a phenomenological event. The final version of interpretation is based on the fuzzy logic inference system, which is verbal rather than numerical (Zadeh, 1965, 1968). Any of these logical interpretation procedures can be used in any interpretation, but this does not mean that they should be applied exclusively individually. Mixtures and combinations can also be used to achieve better interpretation results.

Following the completion of the previous interpretation stages, the researcher should transfer all this information to a quantitative methodological interpretation procedure to digest the information content together. For the methodology, the researcher must possess verbal and qualitative interpretative knowledge and accordingly select the most appropriate alternative from among the possibilities. Nevertheless, the interpretative field remains

within the realm of verbal, i.e., qualitative, assessment.

All previous types of interpretation are referred to as interpretative, qualitative, or phenomenological research [7, 8]. These steps do not rely on any mathematically based analytical, probabilistic, or statistical analysis. Unfortunately, many recent scientific articles, due to their qualitative nature, ignore these steps, relying instead on readily available numerical methodologies and readily available software in the form of application articles or reports. However, innovative scientific articles must either modify established methodologies or propose innovative approaches. Mathematical interpretative knowledge is equivalent to translating all previous verbal knowledge into symbolic logic in the form of equations. Mathematical equations are of primary importance in numerically dependent disciplines such as engineering, but social interpretation does not require them. The significance of mathematical equations is for the communication with the computer through convenient software for numerical calculations and numerical output values for interpretations either about the validity and if available to compare with the available output data to compare the computer outputs with them. If the match between the numerical computer outputs and the output measurement data has less than $\pm 5\%$ or $\pm 10\%$ relative error then all the interpretation types in Figure 2 are acceptable as conclusion of the study for the present time but they can be improved after more relevant and constructive interpretations.

Of course, after all the interpretation types whether qualitative or quantitative, it is necessary to write a report about the project concerned or a scientific paper according to scientific format to provide opportunity for readers, who can make further interpretative discussion.

4. QUESTION GENERATION

There is no general rule for question formation, other than doubting the plausibility of existing knowledge or information one is interested in or has encountered, intentionally or unintentionally. Question implications form the basis for productive research, whether for further interpretative modifications, improvements to existing methodologies, or, if possible, innovative alternatives. Questions arise from potentially meaningful concerns about the content of research already available in the literature, thereby guiding the researcher toward new research horizons. The art of questioning existing theories, methods, and evidence is cultivated through curiosity and humility (Alford, 1998; Stern and Powell, 2022). It is recommended that the falsifiability of any scientific theory or methodology (Popper, 1963) be kept in mind, along with skepticism about underlying assumptions, the possibility of false or incomplete hypotheses, and the structure of the generating mechanism, because the answers to the research questions are neither complete nor valid. Detailed and relevant research questions are described in (Stern and Powell, 2024). The researcher should not forget the potential ignorance of the phenomenon of interest. Therefore, since any research has the potential for qualitative and quantitative verification, linguistic ambiguities can be minimized as much as possible. For numerical (quantitative) interpretation and validation, the researcher will need to apply valid mathematical equations to the problem at hand, of course, after achieving reliable data interpretation. To this end, after determining the interpretative meaning of the input and output variables and their interrelationships in Aristotelian (384-323 BC) two-valued logic, the numerical data values of the inputs must be converted into output variables with acceptable relative error percentages, as outlined in many practical studies in the literature. There is no way to have zero error; this means that every scientific methodology can be improved by minimizing the error percentage lower than existing methodologies. This point is further explained in critical theory and methodology (Morrow and Brown, 1994). Scientifically acceptable, useful, productive, and valid results can be achieved by recognizing the researcher's own curiosity and shame; otherwise, the researcher cannot contribute new findings about the phenomenon of interest.

Finally, there are three types of questions: ontological, epistemological, and methodological; these relate, respectively, to reality and its form, to concepts about knowledge, and to finding solutions. The ontological question, that is, what is the form and nature of reality?

a) The epistemological question, that is, what is the fundamental concept about knowledge (i.e., what can be known),
b) The methodological question, that is, how can the researcher find what they think can be known?

5. SOLUTION PATHS

Following the explanations in the previous sections, the researcher must then proceed to find solutions to the problem at hand. This solution can only be undertaken after a thorough understanding and

meaningful conceptualization of the theory of knowledge, that is, epistemology, and the relevant set of logical rules have been developed. Figure 3 illustrates three different ways of interpreting quantitative research activities. Thus, there are three avenues of research activity that require rational interpretations of achievements. The middle part is a classical study that requires no interpretation or meaningful thought for an improved study; however, this is the classical path, which is open to those who can publish a paper by applying existing methodologies applicable to their numerical data; however, the interpretations are local and almost subjective, as personal inferences in local studies. According to Kuhn (1962), there is normal science, in which researchers focus on consolidation, verification, and application as they emerge from well-known methodologies in the literature. They are content with the assimilation of quantitative numerical data but disregard the qualitative aspects (ontology, epistemology, and rationality).

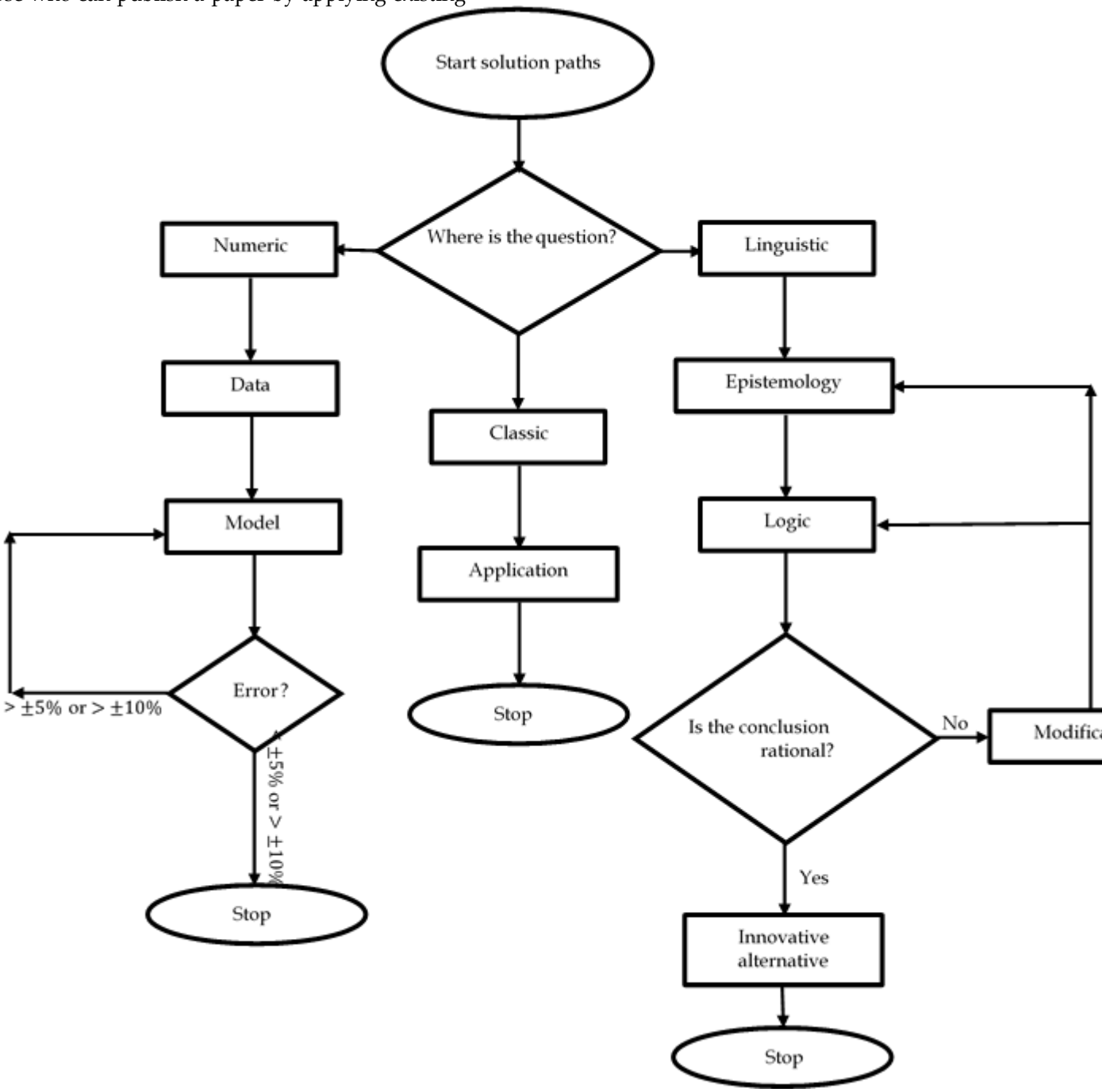

Figure 3: Quantitative Scientific Research Activities.

In general, scientific modeling studies cannot achieve 100% agreement with natural event

measurements, and therefore, many methodological approaches are best suited to estimate measured data values within ±5% or a maximum of ±10% error. However, if a new methodology is proposed, its results should have better error limits than existing methodologies. Another branch of normal science deals with the development of existing scientific paradigms in better directions through minor changes such as refinements of assumptions and changes in hypotheses. This is illustrated as the path of numerical research in Figure 3. A revival from normal science is possible when the desired results cannot be achieved with classical methodologies and researchers seek to improve existing methodologies. Kuhn proposed another dimension of research, revolutionary science (the right-hand path in Figure 3). On this path, once the flaws of existing scientific methodologies become apparent, they are virtually abandoned by the advent of a new way of understanding the problem at hand. In such a situation, virtually all problematic concepts and methods must be regenerated with better interpretations and meanings. In addition to all these facts, attention should also be paid to the general history of science and past literature. Science also develops in a society with cultural views that value products of scientific rational thought with universal interpretations. Figure 4 illustrates the interpretative components in a research process. This figure illustrates the interpretative stages necessary for the qualitative rational foundation of any relevant problem, considering various questions related to the relevant phenomenon. First, the characteristics of the phenomenon's existence—that is, ontology, the first triggering key to philosophy—must be defined to match the questions. To investigate the most appropriate one, there may be multiple realities for the phenomenon at hand. This can be achieved through human interaction with the phenomenon and its subsequent description and interpretation using meaningful words and sentences. To this end, the researcher can draw on existing literature and discuss the problem with experts and even non-experts (human knowledge, opinions, interpretations, and experiences) who are interested in the same problem. At this stage, the researcher is advised to conceptualize the internal formation mechanism of the phenomenon through sketches, drawings, and, in other words, geometry.

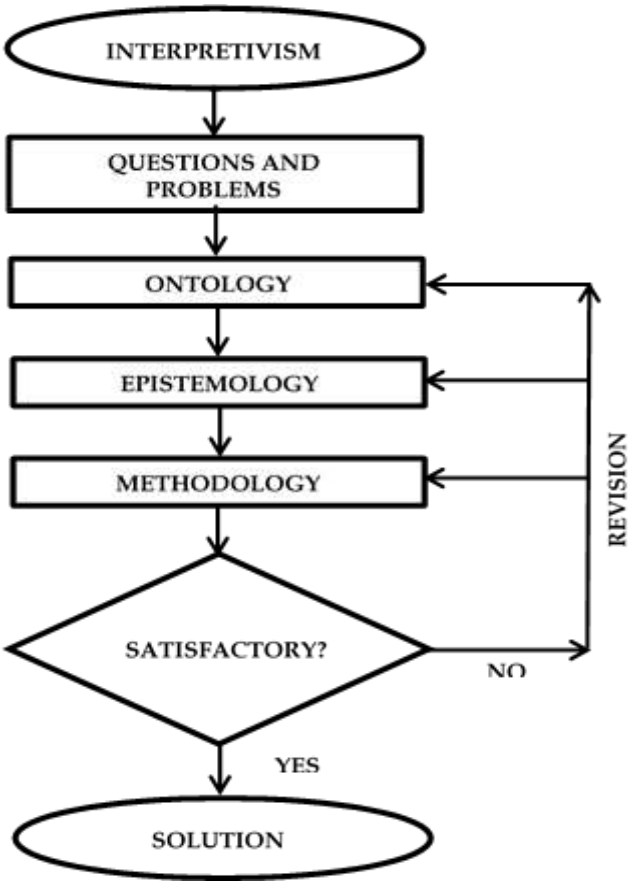

Figure 4: Interpretivist Cycles.

The next stage, after ontology, also relates to the epistemology branch of philosophy, which enables meaningful thought and understanding of concepts. The phenomenon must be understood through

interpretations based on mental processes. Necessary consultations can be conducted with experts and individuals who have previously experienced similar questions and problems in a rational, interpretive manner. Of course, while etymology is not among the explicit branches of philosophy, it implies that keywords must possess meaningful informational content. Epistemology, as the theory of knowledge, is successful when it relies on meaningful etymological content. This flowchart contains hidden logical rules in the form of bivalent or fuzzy logic forms. Without logical rules that imply rationality, mathematical equations cannot be obtained to describe the work under consideration.

Before proceeding to the methodology phase and its application, the researcher must complete all the previous qualitative steps and then seek numerical data for quantitative analysis. In methodology, mathematical equations related to the phenomenon of interest play a primary role. Methodological applications require the collection of numerical data as the most crucial part, but the researcher must also consider assumptions and possible false hypotheses and gather qualitative linguistic information and data analysis to develop their methodology (Miles and Hubermann, 199). Reliability verification of the collected data, particularly through computer software, should be conducted before using it in methods.

After all these stages, the researcher should ask themselves whether their thoughts and processes are rationally satisfactory. If so, a solution to the problem has been reached and can be reported or published for others to appreciate or critique with constructive comments. If the final form is not satisfactory after all these stages, a revision process is repeated between the ontological, epistemological and methodological triads.

6. DISCUSSION

The interpretive research process proposed in this article overlaps with previous publications, but the explanation has some different interpretive content. The general research proposal is discussed in two parts: qualitative interpretation and quantitative interpretation. The first part deals with all types of research activities in social, economic, physical, medical, engineering, and all other disciplines, based on aspects of ontology and epistemology, while the quantitative part is quite specific to disciplines that are numerically related only through methodological approaches. What distinguishes this article from others is the flowcharts that provide the reader with visual examination and interpretation to understand the meaning of scientific research. This could lead to the modification of existing methodologies or to the possibility of completely revolutionary research based on a three-pronged research approach that includes ontology, epistemology, and methodology.

Qualitative research is a valid approach in the social sciences, as suggested by Kelley (Kelley, 1999), but this article argues that it was very important before qualitative research and, therefore, that the possibilities of qualitative research cannot be limited to the social sciences alone. On the other hand, Gergen (2014) noted that epistemologically based qualitative research is becoming more widely accepted, particularly in the social sciences. Regardless of the topic, social or scientific researchers prepare a dissertation to reach the doctoral philosophy level. Unfortunately, especially in scientific research, researchers often lack knowledge of the philosophy of their research thesis, as in science, only quantitative and non-epistemological aspects are addressed. This demonstrates that doctoral dissertations in science are often based on quantitative studies, ignoring the qualitative aspects that are the foundation of acceptable scientific research. This article emphasizes that, before quantitative studies, the originality of scientific research must be relied upon in qualitative research content. Otherwise, there are people worldwide who pursue doctorates without considering the epistemological meaning of philosophy. It should be kept in mind that scientific philosophy has evolved over time, leading to improved developments, and therefore, the scientific knowledge content of any given topic tends to increase, even if the trend is sometimes very small.

7. CONCLUSION

The literature contains numerous articles explaining how research should be conducted through an interpretive process, including several recommendations useful for further research. This article's bias is toward more ontological, epistemological, and methodological aspects, prioritizing qualitative research over quantitative research, which must be based on numerical data. However, the most crucial aspect of research concerns the qualitative phases, which are often overlooked by many researchers who fail to offer even a modified and improved version of existing approaches or to offer innovative methodological solutions. The article provides insights into both types of research, but it emphasizes that qualitative research is lacking in many scientific studies because most doctoral dissertations worldwide lack the

ontological and epistemological foundations of qualitative research. The literature often claims that quantitative research addresses only social issues, but this article disagrees completely on this point. For effective research, it is recommended that innovative or modified research should include philosophical and logical foundations to reach rational results, and that the qualitative dimension should be emphasized before the quantitative content, not only in doctoral theses but in all subsequent research.

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Availability of Data and Material/ Data Availability: The data will be provided to anyone who requests

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