Scientific Methods of Quantitative Research: Epistemological Foundations, Methodological Strategies, and Applications for the Study of Social Phenomena

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ABSTRACT:

Quantitative research represents one of the most robust methodological approaches for the production of scientific knowledge, as it provides systematic procedures for measuring, analyzing, and objectively explaining social phenomena through the use of numerical data and statistical techniques. The objective of this study was to analyze the scientific foundations, methodological characteristics, and fields of application of the experimental, correlational, and descriptive quantitative methods, highlighting their contribution to the production of objective knowledge within the Social Sciences. Methodologically, the study was conducted within the interpretive paradigm using a qualitative approach, employing a literature review, the development of a theoretical framework, and the hermeneutic method to critically examine the principal contributions of the specialized literature. The findings indicate that each method serves a distinct research purpose: the experimental method establishes cause-and-effect relationships; the correlational method identifies statistical associations among variables; and the descriptive quantitative method characterizes populations and phenomena through quantifiable information. It is concluded that these methods possess distinct yet complementary scientific foundations and that their appropriate selection depends on the nature of the research problem, the objectives of the study, and the type of evidence required. As a contribution to knowledge, this study integrates the epistemological foundations, methodological strategies, and applications of the principal quantitative research methods into a single analytical framework, offering a comprehensive perspective that strengthens research training and promotes their rigorous application in the study of social phenomena.

Keywords: quantitative research; experimental method; correlational method; descriptive method; social sciences.

1. Introduction

Quantitative research has occupied a central position in the development of modern science by providing systematic procedures for observing, measuring, and explaining reality through the collection and analysis of numerical data. Its consolidation responds to the need to generate objective, verifiable, and empirically testable knowledge, enabling researchers to identify regularities, establish relationships among variables, and formulate scientifically grounded inferences about the phenomena under investigation. Within the Social Sciences, this approach has made significant contributions to the study of issues related to education, poverty, health, employment, civic participation, and human behavior, thereby strengthening evidence-based decision-making and the development of public policies supported by reliable empirical information (Kerlinger & Lee, 2002; Hernández et al., 2014).

Within this framework, the experimental, correlational, and descriptive quantitative methods represent three fundamental methodological strategies that, although designed to address different research purposes, share the common objective of understanding reality through rigorous measurement procedures and statistical analysis. The experimental method is intended to establish cause-and-effect relationships through the manipulation and control of variables; the correlational method identifies the degree of association between variables without manipulating them; and the descriptive quantitative method focuses on characterizing populations and contexts through the systematic organization and objective interpretation of quantifiable information. The appropriate selection of these methods depends on the nature of the research problem, the objectives of the study, and the type of empirical evidence required, factors that ultimately determine the coherence, validity, and methodological rigor of the research process.

The literature review indicates that these methods should not be regarded as isolated or mutually exclusive procedures, but rather as complementary methodological approaches that broaden the possibilities for understanding social phenomena from different analytical perspectives. Their combined application enhances the explanation, description, and empirical examination of complex social processes, thereby strengthening both the methodological quality of research and the production of scientific knowledge. Within this context, the present study aims to analyze the scientific foundations, methodological characteristics, and fields of application of the experimental, correlational, and descriptive quantitative methods in order to explain their contribution to the production of objective knowledge, the measurement of social phenomena, and the formulation of empirically grounded inferences within Social Science research.

2. Methodology

This study was conducted within the interpretive paradigm, understood as an epistemological perspective that conceives scientific knowledge as a construct aimed at understanding the meanings, foundations, and scope of the phenomena under investigation within their theoretical and methodological contexts (Martínez, 2026). Consistent with this paradigm, a qualitative approach was adopted, emphasizing the critical, reflective, and interpretive analysis of the specialized literature on the experimental, correlational, and descriptive quantitative methods in order to identify their scientific foundations, methodological characteristics, and principal areas of application in the Social Sciences (Martinez, 2010; Hernández et al., 2018; Martínez et al., 2025).

The methodological strategy was based on a literature review, complemented by the development of a theoretical framework grounded in both classical and contemporary academic sources. This procedure made it possible to identify, organize, compare, and interpret the principal conceptual and methodological contributions related to

quantitative research, thereby fostering a comprehensive understanding of its evolution and its applications within the scientific field (Salcedo et al., 2022). The information was analyzed through the hermeneutic method, conceived as a process of critical and systematic interpretation of texts aimed at understanding the meaning of theoretical propositions, establishing relationships among the various contributions found in the literature, and assessing their contribution to the production of scientific knowledge in accordance with the hermeneutic principles proposed by Gadamer (1993). Collectively, this methodological strategy enabled an analysis of the scientific foundations, methodological characteristics, and fields of application of the experimental, correlational, and descriptive quantitative methods, explaining their contribution to the production of objective knowledge, the measurement of social phenomena, and the formulation of empirically grounded inferences within Social Science research.

3. Results

Scientific methods in quantitative research constitute one of the fundamental pillars for the production of empirical knowledge in the Social Sciences, as they provide systematic procedures for measuring, analyzing, and interpreting phenomena through numerical data and statistical techniques. Their application makes it possible to identify relationships among variables, describe the characteristics of populations, and formulate explanations supported by verifiable empirical evidence, thereby strengthening the objectivity, reliability, and methodological rigor of the research process. Within this framework, the experimental, correlational, and descriptive quantitative methods represent widely used methodological strategies for addressing research questions related to social, educational, and cultural issues, providing scientific evidence that contributes to the understanding and explanation of social reality. The following section analyzes their scientific foundations, methodological characteristics, and principal fields of application, highlighting their contribution to the objective measurement of social phenomena and to the formulation of empirically grounded inferences within Social Science research.

3.1. Scientific Methods of Quantitative Research

Scientific methods in quantitative research are designed to analyze social phenomena through the collection, organization, and interpretation of numerical data using statistical procedures that enable the identification of relationships, trends, and patterns within a given population. This approach is characterized by methodological objectivity, the systematic measurement of variables, and the testing of hypotheses, thereby supporting the rigorous investigation of social, educational, and cultural issues. In this context, methods such as the experimental, correlational, and descriptive quantitative approaches facilitate the understanding of social behavior through surveys, measurement techniques, and statistical analyses. Within the Social Sciences, these methods contribute to the production of empirically grounded and verifiable knowledge, strengthening the scientific interpretation of social reality and enhancing the rigor of the research process.

3.1.1. Experimental Method

The experimental method is one of the most representative approaches in quantitative research because it enables the analysis of causal relationships between variables through the deliberate manipulation of an independent variable and the systematic control of the conditions under which the study is conducted. Its primary purpose is to determine whether the application of a stimulus, treatment, or intervention produces significant changes in a dependent variable, thereby allowing researchers to obtain objective results supported by empirical evidence.

From a methodological perspective, Campbell and Stanley (1963) argue that the experimental method provides a rigorous strategy for establishing causal inferences by combining variable manipulation with the control of external factors that could threaten the validity of the findings. Similarly, Hernández et al. (2014)

explain that an experiment consists of applying a treatment to a specific group and subsequently observing its effects through systematic measurement and comparison procedures. These characteristics make the experimental method a fundamental tool for testing hypotheses and assessing the influence of one variable on another under controlled conditions.

Although its application has traditionally been more common in the natural and health sciences, the experimental method has also gained relevance in the Social Sciences, particularly in Sociology. It is used to examine phenomena related to education, social behavior, social interaction, civic participation, group dynamics, and other social processes that can be evaluated through controlled interventions. In such studies, researchers seek to maintain constant external conditions in order to compare outcomes across groups and establish explanations based on quantitative evidence.

Characteristics of the Experimental Method

Characteristic	Description
Variable manipulation	The researcher introduces a stimulus or treatment to evaluate its effects.
Experimental and control groups	One group receives the intervention, while the other does not, allowing for comparison.
Objective measurement	Results are analyzed using quantitative data and statistical techniques.
Control of conditions	External factors that may influence the findings are minimized.
Cause-and-effect relationship	Determines whether one variable produces significant changes in another.

Application Example

In the city of Valledupar, university instructors have identified low levels of student participation during face-to-face classes, a situation that may negatively affect academic interaction and collaborative learning. Consequently, the research problem focuses on the limited classroom participation of university students.

The research hypothesis states that the implementation of participatory group activities significantly increases classroom participation among university students in Valledupar.

To test this hypothesis, the researcher would select two groups of students with similar characteristics. The experimental group would participate in collaborative learning strategies, including debates, group workshops, and case-study discussions over several weeks. In contrast, the control group would continue receiving traditional instruction without methodological modifications.

At the end of the intervention, indicators such as the number of classroom contributions, oral participation, attendance, and student interaction would be measured. The results obtained from both groups would then be compared using statistical analyses to determine whether the participatory teaching strategies produced a significant increase in student participation. In this way, the experimental method would make it possible to establish, on the basis of empirical evidence, the existence of a cause-and-effect relationship between the pedagogical intervention and the observed changes in student participation.

3.1.2. Correlational Method

The correlational method is one of the most widely used approaches in quantitative research

for examining the statistical relationship between two or more variables without directly manipulating or intervening in them. Its primary purpose is to determine the degree of association among the phenomena under investigation, making it possible to identify patterns, trends, and behaviors that contribute to explaining the dynamics of a particular social reality. Unlike the experimental method, the correlational approach does not seek to establish cause-and-effect relationships; rather, it aims to determine the strength and direction of the associations between the variables being analyzed.

From a methodological perspective, Hernández et al. (2014) argue that correlational studies make it possible to determine the degree of relationship between two or more variables within a research process, providing empirical evidence of their joint behavior. Similarly, Kerlinger and Lee (2002) maintain that this method is particularly useful for investigating complex social phenomena in which variables cannot be experimentally controlled, making it a widely adopted strategy in the Social Sciences. Through the application of statistical procedures, the correlational method enables the identification of significant associations that may subsequently serve as the basis for further research or for the formulation of explanatory hypotheses.

Within the field of Sociology, this method is frequently employed to examine relationships among phenomena such as poverty, education, violence, social media use, youth participation, unemployment, and academic performance, providing objective evidence regarding how these variables are associated within a given population.

Characteristics of the Correlational Method

Characteristic	Description
Relationship between variables	Examines the association between two or more social phenomena.
Use of statistics	Employs quantitative data and statistical analysis procedures.
No manipulation of variables	Observes phenomena as they naturally occur within their context.
Identification of trends	Identifies patterns and associations among variables.
Social application	Widely used in educational, cultural, and social research.

Application Example

In the city of Valledupar, many university professors believe that excessive use of social media may be associated with students' academic performance. The increasing amount of time devoted to digital platforms may influence study habits, concentration, and academic achievement, making it a relevant phenomenon for social research.

Research Problem

Frequent use of social media may be associated with low levels of academic performance among university students in Valledupar.

Hypothesis

The greater the amount of time university students in Valledupar spend using social media, the lower their academic performance.

Application Procedure

To conduct this correlational study, the researcher would administer surveys to university students in Valledupar in order to collect information on the number of hours spent daily using social media, the amount of time devoted to studying, grade point average, and reading and concentration habits. Subsequently, the data

collected would be organized into tables and analyzed using statistical procedures to determine the degree of association between the variables under study. Finally, the researcher would interpret the findings to determine whether a positive or negative relationship exists between social media use and students' academic performance, thereby providing empirical evidence for understanding this phenomenon within the context of higher education in Valledupar.

2.3. Descriptive Quantitative Method

The descriptive quantitative method is one of the most widely used approaches in quantitative research for identifying, measuring, and characterizing the properties of a population or phenomenon through the collection and analysis of numerical data. Its primary purpose is to objectively describe behaviors, trends, conditions, and characteristics present within specific social groups without manipulating or intervening in the variables under study. In this way, it provides a systematic representation of reality, enabling the construction of population profiles and the generation of empirical information that serves as a foundation for decision-making and the development of subsequent research.

From a methodological perspective, Kerlinger and Lee (2002) argue that descriptive research makes it possible to identify observable patterns within a population through systematic procedures of measurement and analysis. Similarly, Hernández et al. (2014) state that the purpose of this method is to specify the properties, characteristics, and profiles of individuals, groups, communities, or social phenomena by describing how they manifest themselves within a particular context. Consequently, the descriptive quantitative method does not seek to establish causal relationships but rather to provide an accurate characterization of reality based on quantifiable and verifiable information.

Within the Social Sciences, and particularly in Sociology, this method is widely employed to conduct population diagnoses and characterize issues related to education, poverty, employment, youth, family, socioeconomic conditions, health, and quality of life. To achieve this objective, it frequently relies on surveys, structured questionnaires, censuses, and databases, whose information is subsequently organized and interpreted through tables, graphs, percentages, and statistical indicators that facilitate an objective description of the population under study.

Characteristics of the Descriptive Quantitative Method

Characteristic	Description
Numerical data	Uses quantifiable information obtained through standardized instruments.
Use of surveys	Collects information through structured questionnaires and other measurement techniques.
Statistical application	Analyzes results using percentages, frequencies, tables, and statistical graphs.
Population description	Characterizes the properties and conditions of specific social groups.
Organization of information	Presents findings systematically to facilitate interpretation.

Application Example

In the city of Valledupar, higher education institutions enroll students from diverse neighborhoods, municipalities, and socioeconomic backgrounds. However, statistical information on the social and economic characteristics of this student population is often

limited, making it difficult to design institutional strategies that effectively address their needs.

Research Problem

There is insufficient statistical knowledge regarding the social and economic conditions of university students in Valledupar.

Hypothesis

The majority of university students in Valledupar belong to low- and middle-income socioeconomic strata.

Application Procedure

To conduct this descriptive quantitative study, the researcher would administer structured surveys to university students in Valledupar in order to collect information on age, gender, socioeconomic status, place of residence, employment status, internet access, and parents' educational level. Subsequently, the collected data would be organized and processed using tables, graphs, and statistical percentages to characterize the social and economic profile of the student population. Finally, the researcher would interpret the findings to identify the principal social conditions affecting university students and examine how these conditions may influence their academic trajectory and performance, thereby providing objective information to support the formulation of institutional policies and student support strategies.

4. Discussion

The literature analysis demonstrates that the experimental, correlational, and descriptive quantitative methods constitute complementary methodological strategies for the production of scientific knowledge in the Social Sciences, as each addresses different research purposes while providing empirical evidence from distinct analytical perspectives. Whereas the experimental method establishes cause-and-effect relationships through the manipulation and control of variables (Campbell & Stanley, 1963; Hernández et al., 2014), the correlational method facilitates the identification of statistical associations among social phenomena without intervening in them (Kerlinger & Lee, 2002), and the descriptive quantitative method focuses on characterizing populations and objectively describing their properties and conditions (Kerlinger & Lee, 2002; Hernández et al., 2014). This methodological differentiation demonstrates that the selection of a research method should be guided by the nature of the research problem, the objectives of the study, and the type of knowledge to be generated, rather than by the researcher's methodological preference.

Furthermore, the literature review confirms that quantitative research continues to play a fundamental role in the study of social phenomena by providing systematic procedures for variable measurement, hypothesis testing, and the formulation of empirically grounded inferences. Nevertheless, its scientific rigor depends not only on the application of statistical techniques but also on the appropriate formulation of the research problem, the conceptual and operational definition of variables, the coherence of the research design, and the quality of the data collection instruments. Consequently, the scientific value of these methods lies in the consistency between the research problem, the methodological strategy adopted, and the objective interpretation of the findings.

The application examples developed within the university context of Valledupar demonstrate the practical usefulness of these methods for investigating contemporary social issues. The experimental method makes it possible to assess the impact of pedagogical strategies on student participation; the correlational method enables the examination of the association between social media use and academic performance; and the descriptive quantitative method facilitates the characterization of the socioeconomic conditions of the university student population. These examples illustrate that the three methods should not be regarded as mutually exclusive but rather as complementary approaches whose combined application provides a broader and more rigorous understanding of social reality, thereby strengthening evidence-based decision-making and promoting the development of research with greater scientific impact.

5. Conclusion

The literature review established that the experimental, correlational, and descriptive quantitative methods constitute methodological approaches with clearly differentiated yet complementary scientific foundations, whose application strengthens the production of empirical knowledge in the Social Sciences. The findings indicate that the experimental method is designed to examine cause-and-effect relationships through the manipulation and control of variables; the correlational method facilitates the identification of statistical associations among phenomena without intervening in them; and the descriptive quantitative method enables the objective characterization of populations and social contexts based on quantifiable information. These findings confirm that the selection of a research method should be determined by the nature of the research problem, the objectives of the study, and the type of evidence to be generated, thereby ensuring coherence between the methodological design and the production of scientific knowledge.

Furthermore, the analysis demonstrated that the rigor of quantitative research depends not exclusively on the application of statistical techniques, but also on the appropriate articulation of the research problem, the conceptual and operational definition of variables, the selection of the methodological approach, the design of data collection instruments, and the critical interpretation of the findings. Consequently, quantitative methods represent essential scientific tools for measuring social phenomena, testing hypotheses, and generating empirically grounded inferences that contribute to explaining reality from an objective and systematic perspective.

As a contribution to knowledge, this study integrates into a single analytical framework the scientific foundations, methodological characteristics, conceptual distinctions, and fields of application of the three principal quantitative research methods, highlighting their complementary nature and their relevance for the study of contemporary social issues. Furthermore, the inclusion of application examples contextualized within the university setting of Valledupar facilitates understanding of their practical implementation and provides a methodological reference for students and researchers in the Social Sciences. In this way, the study contributes to strengthening research training by offering an integrated perspective that supports the critical and appropriate selection of quantitative methods according to the objectives and specific needs of each research project.

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