Quantitative Methods in Scientific Research

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Abstract
The description of quantitative research is an essential part of a study that uses research methods based on numbers and statistics to obtain, analyze, and explain data. This research aims to gain a deeper understanding of the quantitative research methods, types of research in quantitative research, procedures, and data measurement in quantitative research. The data was collected through a literature review. The results of this study are expected to provide a strong understanding of quantitative research methods and to make a significant contribution to the development of scientific knowledge and decision-making in various fields.

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INTRODUCTION

Research systematically gathers new information or tests a hypothesis (Herdayati & Syahrial, 2019; Stephenson & Slesinger, 2018; Syahrum & Salim, 2012). Research systematically collects, analyzes, and presents new information or knowledge about a specific topic (Syahrizal & Jailani, 2023). The essence of research is to seek truth or answer to a question posed through a systematic and structured process (Raihan, 2017). Research aims to gain further knowledge about a phenomenon or solve an unresolved problem. Research can be conducted in various fields, such as science, society, economics, and health. In research, the methods used must be objective and replicable by others to ensure the validity and reliability of research findings.

Research is necessary because it can help develop new understanding and knowledge about a topic or phenomenon, discover innovations, solve various problems in various fields, provide a strong basis for decision-making in public policy planning, and improve the quality of life of communities. Research also helps develop science and technology and positively contributes to a nation's and the world's progress. All these benefits are obtained through investigating and analyzing data systematically and structured.

Creswell generally explains that the research process begins with formulating the research question or hypothesis to be investigated. Then, the researcher gathers data through observation, experimentation, or interviews. The collected data is then analyzed using statistical or qualitative methods, depending on the data collection type. The results of the data analysis are stated in the form of conclusions or findings that can be used to answer the research question or test the hypothesis (Fahmi et al., 2022).

Creswell also divides research into qualitative, quantitative, and mixed methods (Chu, PH. and Chang, 2017; Ishtiaq, 2019). Qualitative research focuses on gaining in-depth understanding of a phenomenon and uses data in the form of words, images, or sound in its analysis (Fadli, 2021). On the other hand, quantitative research uses data from numbers or statistics to test hypotheses. Mixed methods research is a combination of qualitative and quantitative research, which combines the strengths of both in producing more comprehensive knowledge.

This paper is conducted to provide a comprehensive understanding of the approach used in quantitative research. The explanation describes the steps in the quantitative research process, including problem formulation, sample selection, data collection, data analysis, and interpretation of findings. With a clear and detailed explanation, readers will be able to understand the usefulness and benefits of quantitative research methods and how to apply them in producing measurable data that can be statistically processed and carefully analyzed.

METHODS

This research employs a literature review method. The literature review approach collects, evaluates, and analyzes various reading sources relevant to the research topic without collecting primary data. This method involves searching, selecting, and comprehending theories, concepts, findings, and opinions in the related literature.

The data sources in this study utilized a literature review, where data is gathered by identifying, selecting, and analyzing relevant reading sources related to the research topic. In the data collection phase, the researcher searched databases, libraries, and other sources of information to find relevant journal articles, books, papers, and documents related to the
research topic. The data from these reading sources are then systematically analyzed to identify key findings, recent research developments, utilized concepts, and existing approaches in the related literature.

Data analysis is performed using techniques involving reducing data collected from relevant literature to obtain more focused and specific information. Data reduction aims to simplify the data and summarize the collected information. Based on the presented data analysis, the researcher concludes the findings from the literature review.

RESULTS AND DISCUSSION

Definition of Quantitative Research

Before conducting research, a prospective researcher must distinguish between research methodology and methods. By understanding the difference between research methodology and research methods, researchers can design studies that are systematic and aligned with their research objectives. Research methodology and research methods are two different yet interrelated concepts in research. In contrast, research methods are the specific techniques or instruments used in that research's data collection and analysis process.

Quantitative research is an approach or method used to obtain data or information that can be measured using objectively operationalized measuring tools. According to Creswell (2014), the quantitative research method can be defined as testing theory by examining the relationship between variables measured using research instruments, and the data obtained is analyzed using statistical procedures. Priadana & Sunarsi (2021) define the quantitative research method as a research method that focuses on collecting and analyzing data that can be measured numerically. Furthermore, according to Abdullah (2015), the quantitative research method is a research approach that uses objective measurement and mathematical analysis (statistics) to data obtained from questionnaires, opinions, tests, or other research instruments. The quantitative research method aims to find relationships, patterns, or trends in the data and generalize those findings to a larger population. The quantitative research method also aims to provide valid and reliable data to explain, predict, or control a phenomenon being studied (Hayati, 2019; Sugiyono, 2019).

Studying quantitative research methods is essential for every researcher, whether they are still learning or already experienced. Firstly, by studying quantitative research methods, researchers can design valid and reliable studies in data collection and analysis to answer research questions or test hypotheses. In quantitative research methods, researchers will gain competence and skills in data collection, data analysis, and interpretation of research findings in numbers or statistics, which are highly necessary in many fields of science, such as medicine, engineering, and economics.

In addition, understanding quantitative research methods will also develop researchers' critical thinking and analytical skills. Researchers need to understand how to design appropriate research questions and collect and analyze data suitable for those types of questions. Strong statistical techniques are used for data analysis in quantitative research methods, allowing researchers to make robust and accountable conclusions. Thus, researchers can ensure that their research is consistent with academic standards and reliable as a basis for decision-making and scientific development. Therefore, understanding quantitative research methods becomes important for every researcher to enhance the quality of their research and strengthen their contribution to the field of science.
Types of Quantitative Research Methods

The type of quantitative research method used depends on the research objectives and questions to be answered. Using the appropriate method will help obtain significant and relevant data to answer research questions objectively. Sugiyono (2017) and Abdullah (2015) classify quantitative research methods into two types: survey and experimental. On the other hand, Abdullah et al. (2022) divide quantitative research methods into correlation research methods, descriptive research methods, causal-comparative research methods, experimental research methods, survey research methods, and inferential research methods. Likewise, Priyono (2008) also mentions similar types of quantitative research, such as survey research method, experimental research method, and content analysis. Furthermore, Fahmi et al. (2022) categorize quantitative research methods into experimental and non-experimental research methods. The researchers will then discuss several commonly used research methods, such as the survey research method, experimental research method, descriptive research method, and correlational research method.

The survey method is one of the most commonly used methods. According to Singarimbun and Effendi (1989), the survey method in quantitative research is a data collection method that typically uses questionnaires to gather information (Sutiyono, 2013). This method aims to generate numerical data that can be measured and processed statistically. Surveys can involve large samples and produce representative data from a larger population.

Additionally, the experimental method is also commonly used in quantitative research. This method divides research participants into control and treatment groups, where the treatment group is given a specific treatment or intervention (Akbar et al., 2023). This method helps evaluate the effects of the treatment on the variables being studied.

Furthermore, correlational research is also used to study the relationship between variables. This method involves collecting data on the variables being studied and analyzing the correlational relationship among them. This method assists in identifying cause-and-effect relationships between variables (Sutiyono, 2013).

Lastly, the descriptive research method is also used to describe the level, characteristics, or distribution of a phenomenon or variable (Sahir, 2022). This method helps provide a more detailed portrayal of the phenomenon under study.

The procedure for conducting quantitative research

The procedure for conducting quantitative research involves several steps that need to be followed in order to obtain valid and reliable data. This procedure helps researchers pursue structured and systematic steps to answer research questions with strong and objective data. Implementing quantitative research methods begins with designing a research framework consisting of a research problem formulation, hypotheses, and observed variables. Designing a quantitative research framework requires structured and systematic steps. The first step in research is to identify and formulate the research problem to be answered. The research problem formulation must be clear, specific, and able to be answered using quantitative methods. Next, the researcher formulates hypotheses that describe the relationship between the variables to be studied. Hypotheses must be based on an initial understanding of the research topic and focus on quantitatively testable predictions. Hypotheses in research are
statements about the relationship between two or more variables in a study. Hypotheses can provide the basis for researchers to define and design a study.

Research variables are characteristics, attributes, or aspects observed and measured by researchers in a study or research. These variables play a key role in understanding the relationship between the phenomena studied and answering research questions. In a study, variables can be independent or dependent depending on the relationship being investigated. Next, the researcher collects data through instruments such as questionnaires or structured observations based on predetermined variables. The data obtained are then processed using appropriate statistical techniques. After the data is collected, the next step is data analysis. Researchers use statistical techniques such as validity and reliability tests, descriptive analysis, and hypothesis testing to interpret and conclude the research findings. This data analysis aims to test the proposed hypotheses and draw conclusions based on the collected data. Furthermore, a structured research report interprets and communicates the research findings. Quantitative research reports usually include an introduction, literature review, research methods used, results of data analysis, and research conclusions. This report will help researchers share research findings objectively and transparently with stakeholders and enrich knowledge in relevant research fields.

**Measurement Scale in Quantitative Research Methods**

Measurement scale is a tool used in quantitative research to measure the variables that are being studied. Measurement scales are used to produce numerical or numeric data that can be analyzed statistically. There are four types of measurement scales commonly used in quantitative research: nominal scale, ordinal scale, interval scale, and ratio scale (Rahayu, 2021).

1. Nominal scale is used to classify objects or individuals into different groups without any order or hierarchy among them. This scale is the simplest and most basic type of measurement scale. It categorizes data into distinct categories or groups without any specific order or value. Examples of variables measured on a nominal scale include gender, ethnicity, or marital status.

2. Ordinal scale has an order or hierarchy among the measured variables, but it does not indicate the distance between each level. This scale introduces a certain level of order or ranking among the categories. While the differences and intervals between categories may not be equal, variables measured on an ordinal scale can be ranked based on their relative position. Examples include survey response options like "strongly agree," "agree," "neutral," "disagree," and "strongly disagree."

3. Interval scale has an ordered level and equal distance between each level, but it does not have an absolute zero point. The interval scale not only ranks the categories but also measures the equal intervals between them. It has a fixed measurement unit and a zero point that doesn't necessarily represent an absence of the variable. Temperature measured in degrees Celsius or Fahrenheit is an example of an interval scale.

4. Ratio scale has an ordered level, equal distance between each level, and an absolute zero point for measuring true magnitude (Priadana & Sunarsi, 2021). The ratio scale is similar to the interval scale, but it has a true zero point that represents the absence of the variable. It allows for meaningful ratios and comparisons between values. Examples of variables measured on a ratio scale include age, weight, or income.
The selection of the appropriate measurement scale is crucial to obtain quality data and enable more accurate statistical analysis. The measurement scale used in quantitative research should be consistent with the concept of the variables being studied and meet the principles of validity and reliability. When selecting a measurement scale, researchers should consider the research objectives, the type of variables to be measured, and the expected data quality. By using the appropriate measurement scale, quantitative research can produce high-quality data and provide a deeper understanding of the phenomena being studied.

CONCLUSION

Quantitative research is a research method that uses numbers and statistics to obtain data and explain the relationship between variables. Quantitative research is beneficial for exploring phenomena and theories and empirically testing hypotheses. In conducting quantitative research, the appropriate research design is needed by determining the dependent, independent, and control variables for data analysis. Therefore, quantitative research is instrumental in decision-making, such as in the business, marketing, health, and education fields, and can contribute to the development of knowledge and present results in a format that is easily understood and measurable.

REFERENCES


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