

# Research Methodology and Design: Types, Methods, Tools, Tests and Analysis

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## Abstract

Research methodology is the systematic steps that research takes to solve a research question. Research methodology includes research methods covering all methods and techniques used to conduct research. The choice of both methodology and method is important as it determines the quality of the research process and its results. This narrative and theoretical review discusses the methodologies applied to a particular research project and the factors that determine the choice of methodology. It also covers sample sizing, sampling techniques, data collection, and analysis methods across a range of qualitative, quantitative, and mixed research methods.

**Keywords:** research methodology and methods; sampling procedures, sample size determination, data collection and analysis methods

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## 1. INTRODUCTION

This paper is a narrative review of literature on research methodologies and methods. It discusses factors that the researcher must consider when making choice of which research methodology, sample size, sampling techniques, and data collection and analysis techniques to apply in a given research project. These themes were explored across the qualitative, quantitative and mixed-methods research frameworks.

## 2. GENERAL RESEARCH OBJECTIVE

To explore research methodologies and methods and determinates for their selection.

## 3. SPECIFIC RESEARCH OBJECTIVES

The specific objectives of this narrative and theoretical literature review include:

- i. Discuss the determinants of selecting qualitative, quantitative, or/and multiple (mixed) methods research design;
- ii. Discuss qualitative and quantitative sample size determination
- iii. Discuss the qualitative and quantitative sampling procedures
- iv. Analyze the qualitative data collection methods
- v. Analyze the quantitative data collection methods
- vi. Examine the qualitative data analysis techniques, and
- vii. Examine the qualitative data analysis techniques

## 4. METHODOLOGY

The methodology used in this study was a combination of narrative, theoretical, and systematic literature reviews. The following key search terms were used in various scholarly databases such Google Scholar, EBSCO Host and JSTOR: 'qualitative research methods', and 'quantitative research methods', 'research methods' and 'research techniques', 'sample size determination', 'sampling techniques', 'data collection' and 'data analysis'. The review was limited to the relevant articles published Only articles published after 2004 are included for more accurate verification.

## **5. LITERATURE REVIEW AND DISCUSSION OF FINDINGS**

### **5.1. QUALITATIVE, QUANTITATIVE, AND MIXED-APPROACH METHODOLOGIES**

#### **5.1.1. Introduction**

Before discussing methods and methods available to researchers, it is important to first distinguish between research methods and research methodologies. Research methodology includes all methods and techniques used in conducting research. The first group of research methods deals with the collection of data, followed by methods of data analysis, and finally methods of assessing the accuracy of research results. Research methodology, on the other hand, is a systematic way of solving research problems. It is the science of how research is done (Kothari, 2004). From these definitions, research methods are included in research methodology.

Successful quality research requires planning the methodology to be used and subsequent implementation of the methodology. Many factors contribute to research success, but choosing the best research method is an important, difficult, and confusing decision. This is because the research method chosen underpins the process and documentation, the nature of the data, and the method of data collection and analysis. Much less methodology is established before the actual research is done. Qualitative, quantitative, and mixed research methods are available to researchers, and researchers should be aware of the rationale for choosing which one is most suitable for a particular research project. There are three types of survey methods. Studies based on qualitative, quantitative and mixed methods. Each of these options follows a different methodological approach.

#### **5.1.2. Quantitative Research Methodology**

Quantitative methodologies have dominated the research literature. It is based on the scientific method and relies on statistical methods for data analysis. Quantitative, like the word quantity, refers to the use of numerical data. This methodology uses numerical and statistical data, measures variables, and is used to test or confirm theories, assumptions, or hypotheses (Upagade, 2012).

#### **5.1.3. Qualitative Research Methodology**

On the other hand, qualitative methodology utilizes descriptive data that cannot be quantified numerically (Brink, 2006). It focuses on intangibles such as words, description, concepts, ideas and experiences. Qualitative research methodologies enable the researcher to understand and gain in-depth insights on topics, and are applicable to studies such as those that involve relationships and motives that drive individual behavior. Qualitative methods allow the researcher to analyze the whole rather than the parts (Brink, 2006).

Qualitative methodologies, on the other hand, use descriptive data that cannot be numerically quantified (Brink, 2006). It focuses on intangibles such as words, descriptions, concepts, ideas and experiences. Qualitative research methods allow researchers to understand problems and gain deeper insight, and can be applied, for example, to research into the relationships and motivations that drive individual behavior. Qualitative methods allow researchers to analyze the whole rather than the parts (Brink, 2006).

#### **5.1.4. Mixed-Methods Approach**

As an alternative to quantitative and qualitative approaches, a third approach has emerged that combines the two basic methods into a new methodology. Creswell (2007) defines a mixed methods approach as a research design with philosophical assumptions, combining qualitative and quantitative approaches at many stages of the research process. It is an increasingly accepted method of applying quantitative and qualitative data in the same research study to improve and validate research findings. For example, a mixed method approach allows you to explore the situation, develop a conceptual framework, and apply quantitative methods to test this model empirically. Mixed-method approaches are based on the assumption that combining quantitative and qualitative approaches provides a better understanding of the research question than either approach. Jackson (2009) argues that using only one method can provide a limited view of the big picture, especially when investigating complex phenomena.

## **5.2. CHOOSING THE BEST RESEARCH METHODOLOGY**

For most research topics, researchers can choose a qualitative, quantitative, or mixed method approach. Which methodology is chosen depends on many factors. Whether the researcher follows an inductive or deductive approach to research. Whether it is an experimental, relational, or descriptive study. It includes practical considerations such as time, money, data availability, and access to respondents.

#### **5.2.1. The Research Question**

The choice of research methodology is strongly influenced by the overarching research question that moves researchers from observational dilemmas to exploratory investigations. A good research question provides direction and focus in defining the types of data, how they are collected and analyzed.

#### **5.2.2. Nature of Research**

Regardless of its type, whether it is qualitative research, quantitative research, or mixed research, each research has a different purpose and approach to solving a particular kind of research problem. Therefore, one of the most important factors in determining which research method to use is the purpose of the research and the nature of the research question. Kothari (2012) identifies the following research categories:

1. *Inductive / Exploratory research* aims at obtaining a better understanding of an issue and potentially develops a theory regarding it. Thus, it tends to adopt qualitative research approach
2. *Deductive / Confirmatory research* seeks to confirm a potential theory or hypothesis by testing it empirically. Therefore, it tends to use quantitative research
3. *A mixture of exploratory and confirmatory research* that seeks to build a potential theory or hypothesis and then testing it.

Naturally then, research that combines a mix of both, or is seeking to develop a theory from the ground up and then test that theory, would utilize a mixed-methods approach.

### **5.2.3. Standard Practice**

A good choice of research methodology also involves questioning and considering the approach of other scientists in the field, or the approaches of research with similar problems and goals. Researchers in the same field share a common methodological approach, but that does not mean that researchers should follow the herd. Researchers should at least consider current practice and assess its usefulness for research..

### **5.2.4. Practicalities of the Methodology**

A given methodology can theoretically provide the most scientifically rigorous study design, but it lacks practicality. We have to weigh whether it is practical or not. Therefore, it is critical that researchers use methodologies that are practical under experimental conditions. Resource availability such as time, money, equipment, knowledge, and data access should be considered.

### **5.2.5. Conclusion**

When researchers take an inductive and subjective approach, they most often choose a qualitative research methodology because it takes an open and flexible approach. Use qualitative data analysis techniques such as analysis. Researchers, on the other hand, choose quantitative research methods when pursuing a deductive and objective research approach, as they employ a closed and highly planned approach. Quantitative research tests theories, relies on large samples, and uses statistical data analysis techniques. It is now common to combine qualitative and quantitative methods in a mixed method approach to get the best of both worlds.

## **5.3. SAMPLE SIZE DETERMINATION**

### **5.3.1. Introduction**

Sample size is a research term used to define the number of subjects included in a research study as representative of the population (Kaufman, 2005). Determining an appropriate sample size is one of the most important factors in statistical analysis, as the sample represents the population. Too small a sample size does not adequately reflect the reality of the population under study. The larger the sample size, the smaller the error bars and the more representative the population. However, too large a sample size can significantly increase the cost and time required to conduct the study. Therefore, researchers should consider the factors that determine sample size.

## **5.4. SAMPLE SIZE DETERMINATION IN QUALITATIVE RESEARCH DESIGN**

Researchers must first assess the degree of diversity or variability represented by the population in order to determine sample size. Qualitative research does not use techniques related to randomness, confidence intervals, and error bars that are standardized in quantitative research. Ultimately, sample size is often determined by intuition or past experience and not based on a known formula. This is another reason why qualitative researchers are often criticized for not justifying sample size decisions in their studies. There are factors to consider (Kaufman, 2005).

### **5.4.1. Matter of Quality over Quantity**

The main goal when conducting qualitative research is to ensure that the right topics are included in the research. Qualitative research is not just about the number of subjects, but about the quality of the subjects in terms of providing the data the researcher wants to collect (Steven, 2016). Therefore, one of the factors to consider when estimating the sample size of a qualitative research is finding subjects who meet all the criteria identified in the research design. For example, if the criteria include wealthy individuals, and she happens to be the only five people who meet those criteria, the 5 form the sample her size itself, rather than being recruited from the general population increase.

### **5.4.2. The Principle of Saturation**

The purpose of qualitative research is to reduce detection error and the purpose of quantitative research is to reduce estimation error. The goal of qualitative research is to have a sample size large enough to reveal diverse opinions while limiting the sample size at a saturation point (Kaufman, 2005). The sample size should be large enough to adequately answer the research question and not allow the researcher to learn more. begins to repeat and reaches a saturation point. When saturation occurs, adding participants to the study does not provide additional perspective or information. Therefore, there is a point where yield decreases with larger samples as it leads to more data but not necessarily more information. The goal of qualitative research is to have a sample

size large enough to reveal different opinions, but the sample size should be limited at a saturation point.

#### **5.4.3. The Limitation Approach**

Another method often used to estimate the required number of qualitative sample sizes is to consider project constraints such as finance, timing, audience availability, and intended scope to determine a feasible number. (Kothari, 2012). However, the final sample size should be representative. This ensures that survey limitations do not falsely skew results by not representing a significant portion of the population.

#### **5.4.4. The Mathematical Approach**

A mathematical alternative can be applied to determine a quantitative sample size if the researcher has given due consideration to the limitations of the study. According to the central limit theorem, a researcher can consider about 30 interviews before reaching a saturation point of discovery.

#### **5.4.5. Type of Research Design**

The nature of qualitative research design helps determine the optimal sample size for the study. Sample sizes vary depending on whether the study uses in-depth interviews, questionnaires, focus groups, or ethnography. Some studies combine all three, with each method of data collection yielding different results. Experienced researchers can quickly learn which study design best suits the type of research outcome.

#### **5.4.6. The Population Variation**

It is often assumed that sample size is related to population size, and that very large populations require larger sample sizes. This is not necessarily the case. If the citizens of a very large country were all exactly the same, researchers would only have to measure one of them. The more homogeneous the population, the smaller the sample size. However, as the degree of variability within a population increases, so should the sample size (Upagade, 2004). Therefore, variability is another important issue of sample size. The researcher's ability to explain this factor depends on knowledge of population parameters.

### **5.5. DETERMINATION IN QUANTITATIVE RESEARCH DESIGN**

#### **5.5.1. Introduction**

When determining the sample size for a qualitative research methodology, all the factors discussed in relation to qualitative research are often applied. However, there are additional factors inherent in quantitative research methods.

#### **5.5.2. The Population Size**

Researchers should give due consideration to the size of the population that must be represented by the sample. If the researcher conducts an employee survey, the population may be all employees. However, when the population increases beyond a certain point, the sample size doesn't change much.

#### **5.5.3. Confidence Interval / Margin of Error**

Confidence intervals measure the level of uncertainty or certainty in a sampling method and how much uncertainty there is in a particular statistic (Creswell, 2014). Simply put, a confidence interval conveys to researchers confidence that the findings reflect what they would expect if they were able to study the entire population. A confidence interval indicates the reliability of a statistical test calculated by the researcher. Before starting a research project, researchers can decide how much margin of error they are willing to tolerate between the mean of the sample and the mean of the population as a whole.

#### **5.5.4. Confidence Levels**

Confidence level refers to the percentage probability that the confidence interval will contain the true population parameter if the researchers randomly sample multiple times (Creswell, 2014). It is expressed as a percentage and indicates how often the population percentage falls within the confidence interval. Most research studies have 90%, 95%, or 99% confidence intervals. For example, a 99% confidence level means that if the researcher repeats the experiment many times, he will agree with the population's results 99% of the time. The larger the sample size, the more confident researchers are that the results are a true reflection of the population. The larger the sample for a given confidence level, the smaller the confidence interval.

#### **5.5.5. The Standard Deviation**

Another important measure in determining sample size is the standard deviation, which measures the distribution of the data set. The higher the distribution or variability, the larger the standard deviation. A high standard deviation indicates a wide range of responses to the research question, and a low standard deviation indicates that the responses are more similar and clustered around the mean (Creswell, 2014).

#### **5.5.6. Research Scope and Design**

Another important measure in determining sample size is the standard deviation, which measures the distribution of the data set. The higher the distribution or variability, the larger the standard deviation. A high standard deviation indicates a wide range of responses to the research question, and a low standard deviation indicates that the responses are more similar and clustered around the mean (Creswell, 2014).

#### **5.5.7. Cost of Sample Collection**

The cost of sampling determines how accurate a researcher's estimates should be. When choosing her sample

size, the researcher must determine the risk value. If the decisions you make as a result of sampling are of great value, you should have a low risk score and a large sample size.

#### **5.5.8. Prior Information**

If the phenomenon has been researched before, the researcher can use earlier facts to lessen pattern sizes. This may be achieved through stratifying the populace to lessen version inside groups, or through the usage of earlier estimates which include the suggest and general deviation.

#### **5.5.9. Practicality**

Researchers would like to make enough observations to obtain reasonably accurate estimates of the parameters of interest, but would like to do so within a viable resource budget. Therefore, there is a trade-off between sample size and cost of conducting a study that researchers must balance.

### **5.6. SAMPLE SIZE DETERMINATION IN MIXED RESEARCH DESIGN**

Determining the sample size in a mixed methods study design combines all factors considered in both qualitative and quantitative study designs. Researchers need to consider the size of the population and the variability present, quality over quantity, the principle of saturation, bounded approaches, mathematical approaches, confidence intervals (bars of error) and confidence levels, and standard deviations.

### **5.7. SAMPLING PROCEDURES**

#### **5.7.1. Introduction**

In research, it is virtually impossible to study an entire population. Sampling is a technique that allows researchers to make inferences about a population based on examining a sample. Sampling is a time-saving and cost-effective method that forms the basis of any study design. The main purpose of sampling is to create a representative sample in which the sample accurately reflects the characteristics of the population (Leavy, 2017). Whatever method you use to select your sample, it is important that the individuals you select are representative of the population as a whole. The techniques used depend on the context in which the research is being conducted, such as the purpose and objectives of the research. The method of sample extraction influences the quality of the study. There are several sampling techniques including probabilistic sampling and non-probabilistic sampling.

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### **5.8. SAMPLING PROCEDURES IN QUALITATIVE RESEARCH DESIGN**

#### **5.8.1. Introduction**

Qualitative research is more concerned with understanding a phenomenon than with generalizability, so the sample must produce a good informant for the investigation. Therefore, the respondent's characteristics are more important than her sample size. Qualitative research often uses non-probabilistic methods that involve feedback based on selection of a survey sample, rather than sequential selection methods. There are situations in which sampling is much less likely to be appropriate, such as in the early stages of research or when there are cost constraints in conducting the research (Patton, 1990).

Sarah (2013) mentions that non-probability sampling is used for the following:

- *Create a hypothesis:* to create an assumption when no prior information is available
- *Exploratory research:* use this sampling technique when conducting qualitative exploratory research
- *Budget and time constraints:* used when there are budget and time constraints

There are four types of non-probability sampling including convenience, quota, purposive, and snowball sampling.

#### **5.8.2. Convenience Sampling**

The method depends on whether the subject is accessible to the researcher, such as surveying customers at a shopping mall. A convenient sample for researchers to easily contact respondents. This type of sampling is therefore based on proximity rather than representativeness and is often used when the data collection process is time and cost constrained. Because those who volunteer may differ from those who choose not to volunteer, the results are likely to be highly biased. It is important to understand (Kaufman, 2005).



### 5.8.3. Quota Sampling

In quota sampling, member selection is based on pre-established criteria. This is an easy way to collect samples that are created based on specific attributes (Dawadi, 2021). The sample created has the same characteristics as the population as a whole. For example, the researchers chose 20 of her adult males, 20 of her adult females, 20 of her teenage girls, and 20 of her teenage boys and asked them about their Internet usage. can do. The rates chosen are proportionately representative of the underlying population characteristics. This method has the advantage of being relatively simple and representative. However, the sample selected may not be representative of other characteristics that the researchers did not consider.

### 5.8.4. Purposive or Judgment Sampling

Convenience sampling, also called selective, subjective, or judgmental sampling, is at the discretion of the researcher. You can set multiple-choice questions such as:

Interested in investing in government bonds? Respondents who answer "no" are excluded from the sample. This type of nonprobabilistic sampling has the advantage of being time and cost efficient and resulting in a wide variety of responses. However, it is subject to volunteer bias, is not always representative, and is prone to investigator error (Jackson, 2009).

### 5.8.5. Snowball Sampling

When research topics are difficult to identify and include, researchers can use what is called snowball sampling. This method, widely used in the social sciences, works by asking existing subjects to name other known subjects. In this way the sample size grows like a rolling snowball (Kothari, 2004). Snowball sampling is useful when it is difficult to determine the sampling frame. However, there is considerable risk of selection bias by selecting acquaintances of subjects who have already been tested. That is, to select a large sample with characteristics similar to the originally identified subjects.

## 5.9. SAMPLING PROCEDURES IN QUANTITATIVE RESEARCH DESIGN

### 5.9.1. Introduction

Qualitative techniques are usually quantified and classified. Because generalizability is important, quantitative research sampling should produce a representative sample. A particular goal of qualitative research is to obtain a general understanding of the characteristics of a population by examining a sample. Probabilistic sampling is a sampling technique in which researchers select samples from a larger population using methods based on probability theory. In probability sampling, a researcher begins with her pool of complete samples of all individuals eligible to select samples. In this way, all eligible subjects may be selected for the sample and the results of the study can be generalized. Therefore, probabilistic sampling tends to be more expensive and time-consuming than non-probabilistic sampling (Kumar, 2011).

Upagade (2005) identifies the following uses of probability sampling:

- *Reduce sample bias*: as the sample appropriately represents the population, the bias in the sample derived from a population is negligible to non-existent
- *Diverse population*: When the population is vast and diverse, it is essential to have adequate representation so that the data is normally distributed
- *Create an accurate sample*: it helps the researchers plan and create an accurate sample

There are four types of probability sampling techniques: simple random, systematic, stratified, clustered sampling.

### 5.9.2. Simple Random Sampling

In random sampling, each subject is selected purely at random, and each member of the population has an equal chance of being selected. One of her methods of obtaining a random sample is to assign a number to each subject in the population and then use a table of random numbers to determine which subjects to include. As with all probability sampling methods, simple random sampling allows us to calculate the sampling error, and this method reduces selection bias.

### 5.9.3. Systematic Sampling

This probabilistic sampling method selects subjects from a sample frame at regular intervals. Intervals are chosen to ensure adequate sample size. If a researcher needs a sample her size  $n$  from a population of size  $N$ , he (she) selects every  $N/n$ th subject of her for the sample. Systematic sampling is often more convenient and much easier to manage than simple random sampling. However, bias can also occur if there is an underlying pattern in the order of subjects within the sample frame. This occurs when the sampling technique matches the periodicity of the underlying pattern (Kothari, 2004).

### 5.9.4. Stratified Sampling

Stratified random sampling is a method by which researchers divide a population into smaller groups that represent the entire population but do not overlap. A population is divided into groups that share similar characteristics, and then each group is sampled separately (Brink, 2006). Stratified sampling improves the representativeness and accuracy of results by reducing sampling bias. However, it requires prior knowledge of

the basic characteristics of sampling frames.

#### **5.9.5. Clustered Sampling**

A clustered sample uses population subgroups rather than individuals as sampling units. The population is divided into subgroups called clusters and randomly selected for inclusion in the study. The cluster is usually already defined. For example, individual cities can be identified as clusters. A one-stage cluster sample includes all members of the selected cluster in the study. Two-level cluster sampling then randomly selects and includes a sample of individuals from each cluster.

### **5.10. SAMPLING PROCEDURES IN MIXED RESEARCH DESIGN**

A mixed methods approach to research aims to combine qualitative and quantitative methods to take advantage of the best of both worlds. Researchers therefore use a combination of these sampling methods. For example, non-probabilistic sampling can be applied first, followed by probabilistic sampling. Knowing how to combine the two approaches requires planning, experience, and consultation on the part of researchers.

### **5.11. QUALITATIVE DATA COLLECTION METHODS**

#### **5.11.1. Introduction**

Data are either qualitative or quantitative and are defined as facts, observations, and statistics collected for reference or analysis (Steven, 2016). Qualitative data is not numeric, it is descriptive in nature and focuses on the reasons behind the numbers. Quantitative data, on the other hand, is information that has a numerical value and can be quantified, counted, or measured. Data is meaningless and useless until it is collected, aggregated, and analyzed. Data collection is the process of gathering data about variables that allow researchers to answer research questions and test hypotheses. Once data are collected, researchers must determine the appropriate data analysis tools to apply to the data. Selection criteria for data analysis methods include data types and their purpose, costs and schedules, researcher experience and skills, and most importantly research questions and hypotheses.

#### **5.11.2. Primary and Secondary Data**

Data can be classified as either primary or secondary data based on its origin. Primary data, also called raw data, is data collected directly at the source. Therefore, researchers first manipulate the data and draw conclusions from it. Secondary data, on the other hand, is data that has already been collected, structured, and analyzed by another researcher (Creswell, 2014). Secondary data collection is much easier and faster than primary data collection, but finding secondary data that perfectly fits a researcher's needs is difficult. Primary data collection has an advantage in this regard as it is collected with a specific research need in mind.

#### **5.11.3. Qualitative Data Collection Methods**

Qualitative data analysis refers to the technique of analyzing words and terms used to describe certain traits and characteristics. Analyze data that cannot be measured or counted and attempt to answer why or how questions. Look for trends and meanings in your dataset. It is subjective and descriptive because it focuses on describing actions rather than measuring them. Compared to quantitative data analysis techniques, qualitative approaches are more open, informal, and unstructured or semi-structured. They will most likely consist of open-ended questions and descriptive answers with few figures. Data collection in this approach is flexible and relies heavily on interactive interviews, discussions, and in-depth conversations. Kaufman (2005) suggests the following data collection methods: Open questionnaires, interviews, focus groups, direct observations, case studies, literature reviews, oral tradition.

#### **5.11.4. Open-ended Questionnaires**

A survey is the systematic collection of data by means of a survey or survey containing open-ended questions that allow respondents greater freedom and flexibility in their responses.

#### **5.11.5. Interviews**

Perhaps the most common method of qualitative data collection is the interview, a face-to-face interaction between researchers and subjects. Interviews help explore opinions and attitudes about specific issues and can be spontaneous, informal, unstructured, and conversational. This data collection technique is ideal for collecting highly personalized data as it is a very personal approach.

#### **5.11.6. Focus Groups**

The focus group data collection method is a variation of the interview method, except when groups are included in the interview. Focus groups usually consist of 3 to 10 of her, including the facilitator. However, larger meetings and interviews are possible if necessary.

#### **5.11.7. Direct Observation**

It is one of the most passive methods of qualitative data collection, in which researchers employ a participatory attitude while making audio or video recordings and taking notes. It is an excellent technique for gathering data on behavioral activities and patterns, physical environments, and processes. Observation can get in the way. That is, when observations are made with the knowledge of the participants. Or obscured when observations are made

without the participant's knowledge.

#### **5.11.8. Case Studies**

It is an in-depth analysis of phenomena and is especially useful for assessing complex situations and examining their qualitative implications. Case studies can also be combined with other methods to illustrate findings and comparisons. They are usually presented in writing, but can also be presented as photographs, films, or videos.

#### **5.11.9. Literature and Document Review**

This qualitative data collection method is a review of secondary data to look for data relevant to the study. This technique can provide inexpensive and timely baseline information as well as a historical perspective of the phenomenon under investigation.

#### **5.11.10. Oral Tradition**

Oral law gathers historical information by interviewing people and using their past memories. It seeks to obtain interesting and provocative historical information from a variety of perspectives, most of which is not found in recorded sources.

### **5.12. QUANTITATIVE DATA COLLECTION METHODS**

#### **5.12.1. Introduction**

Quantitative data deals with variables that can be measured and expressed in numerical form. Because quantitative data collection methods often rely on mathematical calculations, these data are usually considered more objective and reliable than qualitative data. Quantitative techniques are usually cheaper and take less time to collect data than qualitative techniques. A high degree of standardization facilitates comparison and analysis of results using quantitative data collection methods. This approach relies heavily on random sampling and structured data collection tools, including surveys and closed-end questionnaires (Upagade, 2012).

#### **5.12.2. Closed-ended Questionnaires**

Hidden polls are based on questions that allow respondents to choose from predefined answer options. Mainly he has two types of closed-ended questions. One based on categories and one based on intervals or ratios. Categorical survey questions can include multiple choice questions, checkbox questions, or simple yes or no. Interval or ratio questions consist of rating scales and must be selected from a predefined set of values.

#### **5.12.3. Structured Closed-ended Interview**

This type of interview systematically follows carefully structured questions that only allow a limited range of answers, such as: B. Yes or No, expressed as a number on a rating or predefined scale. These quantitative interviews are effective when each question is asked the same way to each respondent, with little or no input from the researcher.

#### **5.12.4. Experimental Research**

When a hypothesis indicates an expected relationship between two or more variables, experiments are performed to confirm or disprove that hypothesis. Most experiments manipulate a set of variables and then compare them to a control group. This study is often used in the natural sciences.

#### **5.12.5. Correlational Research**

This study examines the relationship between two or more similar and interdependent variables and assesses their statistical relationship. Attempts to determine how one variable affects other variables and uses mathematical analysis such as regression analysis.

### **5.13. A MIXED-METHOD APPROACH FOR DATA COLLECTION**

There is a heated debate in the research community about whether quantitative or qualitative methods are best suited for research. Some researchers place the greatest emphasis on quantitative data, while others prefer qualitative data. However, the mixed method approach builds on the strengths of both methods and minimizes their relative weaknesses. Modern research is becoming increasingly complex and is best conducted using a combination of qualitative and quantitative data collection methods. We recommend using a variety of data collection techniques, combining qualitative and quantitative methods. This may add value to your research. This allows researchers to gain a more holistic understanding of the phenomenon under study.

Mixed methods allow you to capture a wider range of perspectives by using one method and another. Researchers can use quantitative data to measure what happened and qualitative data to find out how and why it happened. Qualitative methods can also help uncover problems in the early stages of research, after which quantitative methods can be used for further investigation (Kothari, 2004).

### **5.14. QUALITATIVE DATA ANALYSIS TECHNIQUES**

#### **5.14.1. Introduction**

Data is nothing unless it is properly organized, displayed and analyzed to inform decision making. Once researchers have collected data, the next step is to analyze the data to identify trends, patterns, connections, relationships, and meaning. Data analysis takes researchers from meaningless sets of data to information for



making informed decisions. Data analysis is an important part of research. This is because weak analysis leads to inaccurate results and inevitably leads to wrong and bad decisions. Choosing a data analysis method is important and necessary.

#### **5.14.2. An Exploration of Qualitative Data Analysis Techniques**

Here are some frequently asked questions: How do researchers measure and analyze non-quantifiable data? Analysis of qualitative data involves providing some understanding, description, and interpretation of patterns and themes in textual data. It includes processes and procedures aimed at There are many different types of qualitative data analysis, each serving a different purpose and having its own strengths and weaknesses. There are various methods of data analysis depending on the type of research, including content, topic, narrative, rationale, discourse, interpretative phenomenology, and frame analysis (Kaufman, 2005).

#### **5.14.3. Content Analysis**

One of the most widely used qualitative data analysis techniques for interpreting meaning from text data is content analysis. This data analysis technique is used to classify and summarize words, phrases, or images in text data to identify patterns and trends in content. Content analysis can be used to identify how often ideas are discussed and shared, with a focus on finding key aspects of content (Blaikie, 2010).

#### **5.14.4. Thematic Analysis**

Thematic analysis focuses on grouping data into themes so that researchers can derive meaning from the data. Although they may look similar, theme analysis is different from content analysis. Content analysis can be applied to both qualitative and quantitative data and focuses on identifying frequency and repeated words and themes. Thematic analysis, on the other hand, can only be applied to qualitative data and focuses on identifying themes and patterns.

#### **5.14.5. Narrative Analysis**

As the name suggests, narrative analysis uses different types of stories such as folk tales, life experiences, and autobiographies as units of analysis. Stories help researchers understand the world and can be used to gain insight into how people perceive reality. Narrative analysis is about paying attention to and making sense of the stories people tell and, more importantly, the way they tell them.

#### **5.14.6. Grounded Theory Analysis**

Grounded theory is one of the most popular qualitative data analysis techniques that derives a general abstract theory of a process or action based on the views of people participating in research. Develop theories by examining real-life data and develop theories and hypotheses through qualitative data collection and analysis. While other qualitative data analysis techniques generate data from hypotheses, this technique collects and analyzes data to generate hypotheses and theories (Brink, 2006).

#### **5.14.7. Discourse Analysis**

Discourse analysis examines text, audio, and video for relationships between information and its context. In contrast to content analysis, this method focuses on the contextual meaning of language, clarifying what listeners think and feel about a topic. Discourse analysis is the analysis of written or spoken language in its social context. Similar to narrative analysis, but used to analyze the social context in which communication between researchers and respondents took place.

#### **5.14.8. Interpretive Phenomenological Analysis (IPA)**

It is a qualitative data analysis technique that helps researchers understand a subject's personal experiences in relation to key life events and experiences. These are common or very rare events experienced by subjects. This is a good technique if the researcher is looking to analyze the subject's personal experience and therefore focuses on the experienter.

#### **5.14.9. Framework Analysis**

This data analysis technique integrates data into flexible and powerful matrices, enabling researchers to analyze data both by subject and by case. It provides a structure that allows researchers to systematically split and analyze data by case and code. Identify similarities and differences in qualitative data and analyze the data thematically to draw descriptive or explanatory conclusions (Kumar, 2011).

#### **5.14.10. Conclusion**

All of the qualitative data analysis techniques described above aim to process data and answer research questions, but differ in their intentions and the approaches used. Choosing the right analytical technique is not a matter of researcher preference, but of choosing a technique that fits the research question, goals, and objectives.

### **5.15. QUANTITATIVE DATA ANALYSIS TECHNIQUES**

#### **5.15.1. Introduction**

Qualitative data analysis techniques are the analysis of numerical data using statistical and numerical techniques. There are two main categories of statistical methods available. Descriptive and inferential statistics. In both differential and inferential statistics, researchers work with samples of populations. Descriptive statistics focus on explaining a sample, while inferential statistics aim to make predictions about the population based on

outcomes within the sample (Leavy, 2017).

### 5.15.2. Descriptive Statistics

As the name suggests, descriptive statistics are used to describe a dataset. Descriptive statistics, or analysis, is the first level of qualitative data analysis because it helps researchers summarize data and find patterns in specific data samples (Dawadi, 2021). Commonly used descriptive statistics include:

- *Mean* - the numerical average of a set of values
- *Median* - the midpoint of a set of values when the numbers are arranged in numerical order
- *Mode* - the most commonly occurring value in a dataset
- Percentage - expresses how a value within the data relates to a larger group of respondents.
- *Frequency* - the number of times a value is found
- Range - the highest and lowest value in a set of values
- *Standard Deviation* - used to indicate how dispersed a range of numbers is. It shows how close all the numbers are to the mean
- *Skewness* - how symmetrical a range of numbers is, showing if they cluster into a smooth bell curve shape in the middle of the graph or if they skew towards the left or right

Descriptive statistics provide absolute numbers and focus on describing the data set. First, it helps researchers get an overview of their data at the macro and micro level. It is then used to validate data and helps detect potential errors in data. Finally, these descriptive statistics can help you decide which inference statistics techniques can be used. These techniques depend on how the data are propagated (Patton, 1990).

### 5.15.3. Inferential Statistics

While descriptive statistics describes a data set, inferential statistics analyzes the sample to make predictions about the population. Jackson (2009) reveals that quantitative data analysis is generally used for three purposes:

1. *Predictions* about differences between groups; for instance, testing if there are significant differences in mean weight of two adult groups
2. *Relationships* between variables; for instance, the relationship between body weight and body height
3. *Testing* hypotheses in a scientifically rigorous way; for instance a hypothesis on the effect of certain vaccine

There are various statistical analysis tests and techniques within the inferential branch:

- *T-Tests* - compare the means of two populations to determine whether they are statistically significantly different. For instance, you might want to compare the mean height of two groups of people
- *ANOVA (analysis of variance)* - is similar to a T-test in that it compares the means of various groups, but ANOVA allows the researcher to analyze multiple groups instead of only two groups
- *Correlation analysis* - This type of analysis assesses the relationship between two variables. For instance, if one variable increases does the other variable also increase, decrease or stay the same
- *Regression analysis* – similar to correlation in that it assesses the relationship between variables, but goes a step further to investigate cause and effect between variables. Just because two variables correlate does not necessarily mean one causes the other
- *Cluster Analysis* - used to identify structures within a dataset. Data points within a cluster will look like each other and different from data points in other clusters. Cluster analysis aims to be able to sort different data points into groups that are internally similar and externally different
- *Time Series Analysis* - the measurement of the same variables at different points in time, used to identify trends and cycles over time. The researcher will be able to forecast how variables of interest may fluctuate in the future

The choice of the most appropriate statistical technique to apply will depend on the type of data and its distribution, as well as on the research questions and hypotheses (Vanderstoep, 2009).

## 6. CONCLUSION

For most research topics, researchers can choose between qualitative, quantitative, or mixed methods. Which type he/she chooses depends, among other things, on the research question, whether it is an inductive or deductive research approach, whether it is an experimental study, a correlation study, or a descriptive study. and time, money, data availability and access to respondents. Researchers need to be aware of these factors and how they influence the choice of methodology and methods.

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