A Step-by-Step Guide TO CONDUCTING QUANTITATIVE RESEARCH

Dr. Bunnie L. Claxton
Dr. Michelle J. Barthlow

Kendall Hunt
publishing company

About the Authors

Dr. Bunnie L. Claxton, is the founder and CEO of Dr. Bunnie, LLC, a company that supports the implementation of doctoral programs in universities around the world. Formerly, she served as the Director of Applied Doctoral Research at Liberty University, a Subject Matter Expert, an Instructional Mentor, and Dissertation Chair. She is an adjunct professor at Liberty University and Colorado Christian University. Dr. Claxton has 31 years of experience in the field of education, including public, private, homeschool, and higher education. She has developed multiple doctorate-level courses and a research program and is a research methodologist. Dr. Claxton served as the Superintendent for Liberty University Online Academy, an online K-12 school with over 16,000 students, and currently serves on the Board of Directors. She is the author of 18 textbooks and is best known for her Step-By-Step textbook series. A few titles include *A Step-By-Step Guide to Conducting Applied Research, A Step-By-Step Guide to Conducting Qualitative Research, A Step-By-Step Guide to Conducting Quantitative Research, A Step-By-Step Guide to Writing a Literature Review for Doctoral Research, and A Step-By-Step Introduction to Research Methods: Qualitative, Quantitative, Mixed-Methods, and Applied.*

Michelle J. Barthlow, EdD, is an assistant professor at Liberty University and serves as Director of Quantitative Research in the School of Education. She also serves as an instructional mentor and subject matter expert. Her experience includes over 30 years in K-12 schools and higher education. She has won

several awards for excellence in education. Dr. Barthlow has taught doctoral-level courses, chaired dissertations, served as a quantitative methodologist, and as a dissertation reader. She has served on a local school council as a STEM education expert. Dr. Barthlow has authored a number of journal articles and enjoys publishing with her doctoral students and colleagues. She served as a consultant to local school systems, conducting qualitative and quantitative research.

Acknowledgments

I would like to personally thank and acknowledge Dr. Linda Eubanks for her incredible contribution to the artificial intelligence chapter. Her expertise and ability to write under pressure helped make this chapter possible. Thank you, Dr. Eubanks, for providing the foundation on which this chapter is built.

Thank you to Emi Rowland for contributing her editing expertise. I am grateful to you for supporting my writing endeavor and for helping me to make a positive impact in education! Thank you for being available at a moment's notice.

I also want to thank Dr. Benny Fong, Dr. Laura Mansfield, Dr. Rich Jensen, and Mr. Steven Barthlow for their support throughout this project.

Thank you to Curtis Ross, Noelle Henneman, Meghan Peterman, and Kendall Hunt Publishing for being such an amazing group of people to work with. I am forever grateful for your support and expertise in publishing.

Overview of Textbook Features

This book is designed to guide the novice researcher through the process of conducting quantitative research. The result is a quantitative dissertation manuscript that includes the research topic, a review of the scholarly literature, data collection, and data analysis procedures, findings, and a discussion regarding the outcome of the research. Details are provided to defend the research proposal and the defense of the final research manuscript, as well as how to transition a dissertation for potential publication in the scholarly literature. Basic guidelines for using artificial intelligence (AI) are also included.

Chapters include:

Table of Contents

Detailed Table of Contents

Chapter 1: Introduction to Quantitative Research guides the researcher in discovering key components needed to understand and conduct quantitative research. The deliverable, a quantitative dissertation, is described in detail. The chapter addresses the transition from novice researcher to independent researcher and scholar.

Chapter 2: How to Write the Front Matter describes how to write a formal abstract for a research study manuscript. The researcher will learn to write his or her credentials, background information, and connection to the proposed research as the investigator.

Chapter 3: How to Write Chapter 1: Introduction presents the methods needed to write the introduction to the research. Novice researchers learn how to identify a research topic and describe why the topic requires further investigation. The guidelines for determining and writing the purpose of the research and the research questions are established in this chapter.

Chapter 4: How to Write Chapter 2: Literature Review teaches the researcher how to conduct a methodological and systematic review of the current literature. Novice researchers learn about scholarly voice, which requires formal language and tone. The deliverable for this chapter is a well-written, thorough review of the current scholarly literature that demonstrates competence in the understanding and presentation of the current existing body of knowledge regarding the phenomenon.

Chapter 5: How to Write Chapter 3: Method provides a detailed description of the quantitative research method required to conduct research using quantitative data collection and analysis strategies. In this chapter, the methods are described, and instructions are provided to write the overview, the research design, research questions, null hypothesis, setting, participants, population, sample, groups, instrumentation, procedures, data analysis plan, and a summary for a quantitative research manuscript.

Chapter 6: How to Write Chapter 4: Results presents the results of the data analysis described in Chapter 3: Methods. In this chapter, information regarding the research question(s), results of the inferential statistic(s) conducted, and the summary are described. This chapter provides a guide for writing the results of common statistical analyses.

Chapter 7: How to Write Chapter 5: Discussion provides a discussion of the results presented in Chapter 4: Results. The discussion of the study includes the implications of the findings, the study's limitations, recommendations for future research, and the conclusion the researcher has reached based on the results of the quantitative research study.

Chapter 8: How to Defend Your Research This chapter provides the details regarding a proposal defense and a final defense for a quantitative research dissertation. Guidance regarding the focus of each defense is

provided, as well as an example slide show presentation.

Chapter 9: How to Publish Your Research provides the steps needed to transition a dissertation manuscript to a journal article. The result is a condensed version of the dissertation, which is intended to be submitted to a scholarly peer-reviewed journal for publication to narrow a gap in the literature regarding the quantitative research topic.

Chapter 10: How to Generate Content Using AI in Doctoral Research stipulates guidelines for using AI in doctoral research as well as possible ways to generate information for a dissertation utilizing ethical guidelines.

Chapter 11: Quantitative Research Dissertation Template is used as the structure for this quantitative research. This document provides the main headings required for all five chapters of the research study, as well as a checklist for each section to ensure accuracy. This is the foundational document for quantitative dissertation research.

CHAPTER 1

Introduction to Quantitative Research

Chapter Outline

Introduction
Quantitative Research Defined
Quantitative Research Designs
Reasons to Conduct Quantitative Research
Steps to Conduct Quantitative Research
Conclusion
Chapter Highlights

Objectives

By the end of this chapter, the reader will be able to:

- Define quantitative research
- Describe the types of quantitative research designs
- Explain reasons to conduct a quantitative research study
- Explicate the steps to complete a quantitative research study

Key Terms

- archival data
- assumptions
- bivariate linear regression
- causal-comparative design
- central tendency

- comparison group
- confounding variables
- construct
- construct validity
- content validity
- continuous variable
- control group
- correlational design
- covariate
- Cronbach alpha
- data set
- dependent variable
- descriptive statistics
- direction
- directly related
- distribution
- empirical evidence
- ex post facto
- experimental design
- experimental group
- experimental research
- feasibility
- independent samples *t* test
- independent variable
- inferential statistics
- instrument
- interval scale
- internal validity
- inverse relationship
- logistic regression
- logistics
- MANCOVA
- mean
- median
- mode
- multiple linear regression
- non-experimental research
- nonequivalent pretest-posttest control-group design
- one-way ANCOVA
- one-way ANOVA
- one-way MANOVA
- participants
- phenomenon
- predictive correlational design

- progressive discourse
- proposal
- quantitative research
- quasi-
- quasi-experimental posttest-only design
- quasi-experimental pretest-posttest design
- range
- ratio
- reliability
- research design
- science
- scientific method
- simple correlational design
- standard deviation
- statistic
- statistical test
- statistics
- strength
- theories
- two-way ANCOVA
- two-way ANOVA
- variability
- variable
- variance

Introduction

Quantitative research is "an inquiry into a social or human problem, based on testing a theory composed of variables, measured with numbers, and analyzed using statistical procedures, to determine whether the predictive generalizations of the theory hold true" (Creswell, 1994, p. 2). Quantitative research may also be described as numerical data collected to explain, predict, or control phenomena (Gay & Airasian, 2000). Further, quantitative research may be explained as empirical data in number format (Punch, 1998). For this textbook, **quantitative research** is delineated as a systematic approach to investigating phenomena by collecting quantifiable numerical data and analyzing it using statistical methods, which include descriptive and inferential statistics.

The purpose of quantitative research is to investigate and understand a particular moment in time and examine data sets over time to find trends and patterns. Researchers collect data to verify or falsify a hypothesis related to a research question. When quantitative data are collected, researchers aim to use a sample size that is representative of the total population of the participant population about which they are concerned.

Quantitative researchers are interested in investigating a natural phenomenon. A **phenomenon** is an event observed through the senses rather than by thought or intuition. Gall et al. (2007) define a phenomenon as something of interest to a researcher. Research comes about when there is no readily available answer to the "what," "why," or "how" of a phenomenon. To understand research, you must first understand the nature of science.

Science is the systematic investigation of the natural world using observation. Science uses a systematic approach to produce empirical evidence. **Empirical evidence** is information obtained through our senses and documented. Science, based on empirical evidence, aims for measurable results through testing and analysis, a process known as the **scientific method**. Science is based on fact, not opinion or preferences. The process of science is designed to challenge ideas through the research process. One important aspect of the scientific process is that it focuses only on the natural world. If a phenomenon cannot be measured, evaluated, or documented using our natural senses, then it is not science. In quantitative research, scientists try to understand and predict events and behaviors based on empirical evidence. Scientists look for patterns in the data to formulate conclusions and theories.

Theories are a set of principles agreed upon by a community of scholars within a discipline. Theories help unify a discipline and must be supported by a large body of empirical evidence that helps provide a broad framework for understanding related phenomena. Scientists and researchers should state that evidence agrees with the theory rather than proving a theory. Most scholars will not abandon a current theory even if they know it is flawed until a better theoretical explanation is presented. Because of the never-ending pursuit of scientific knowledge, theories can sometimes be shown to be incorrect. Thus, scientific theories can only be verified or falsified. Scientists only provide evidence that supports a claim until there is better evidence to discount a claim. For this reason, the scientific community embraces the practice of progressive discourse. **Progressive discourse** is the sharing of knowledge that encourages active debate and criticism of each other's research and results. To be a researcher, you would be wise not to take criticism of your work personally, as that is expected in scientific endeavors. Science demands that all evidence and facts be scrutinized.

Quantitative Research Defined

As noted previously, quantitative research is delineated as a systematic approach to investigating phenomena by collecting quantifiable numerical data and analyzing it using statistical methods, which include descriptive and inferential statistics. Quantitative research answers questions of "what," "why," or "how" for the purpose of adding to the body of knowledge on a topic. Adding to the body of knowledge is often referred to as narrowing the gap in the literature. This happens when a research study is published in a scholarly journal and thus shared in the body of current scholarly research. Quantitative research is intended to be generalized across a population; thus, scholarly journals share research results.

A defining feature of quantitative research is the use of statistics to analyze a data set. A **data set** is a collection of items that are related to the same topic. An example of a data set is a list of numbers created by recording the temperature every day at the same time for one month in a specific location. Using this data set, the average temperature for that time of day in that location could be calculated.

The words *statistics, statistic, and statistical test* have several meanings. Warner (2021) defines **statistics** as "techniques for analyzing numerical data" (p. 1). Examples are *t* tests and multiple linear regression. The word **statistic** is used to refer to the result of a statistical procedure. For example, if the mean of a data set is found to be 5.6 cm, the result, 5.6 cm, is a statistic. Further, the term **statistical test** is often shorted to "statistic" and refers to mathematical procedures used to analyze quantitative data. These statistical tests/statistics include analysis of variance (ANOVA), *t* test, Pearson product-moment correlation, and multiple linear regression, to name a few.

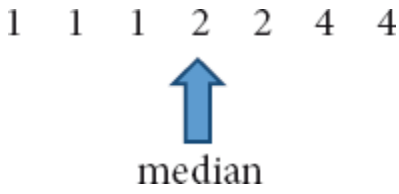
The ANOVA and the independent samples *t* test are examples of statistical tests that examine the differences between groups. An independent samples *t* test, often shortened to *t* test, compares the means of only two groups of an independent variable on one dependent variable that is measured on a continuous scale. An ANOVA is similar to the independent samples *t* test in that it compares means of groups of an independent variable on one continuous dependent variable. The difference is that the ANOVA can compare the means of two or more groups, whereas the independent samples *t* test can compare the means of only two groups.

The Pearson product-moment correlation and multiple linear regression are examples of statistical tests that examine the correlation between variables in a single group. The Pearson product-moment correlation is also called Pearson's correlation and Pearson's *r*. This statistical test determines the strength and direction of the correlation between two continuous variables. A multiple linear regression determines how well a continuous criterion variable is predicted by two or more predictor variables. The correlation of the variables is assessed. More details regarding statistical tests are provided in later chapters.

Descriptive Statistics

Statistics can be descriptive or inferential. **Descriptive statistics** summarize the characteristics of a numerical data set without drawing inferences about the population (Howell, 2008). Descriptive statistics include expressions of central tendency, variability, and distribution. **Central tendency** is defined as the most common or "typical" response that conveys the center value of a data set (Ary et al., 2008; Warner, 2021). Mean, mode, and median are all expressions of a data set's central tendency.

- The **mean** is the average of the data set. For example, using the data set 1, 1, 1, 2, 2, 4, 4 to calculate the mean, add the seven numbers together and divide by 7 since there are seven numbers in the data set. The mean of this data set is 2.1. It is calculated as an average: 1 + 1 + 1 + 2 + 2 + 4 + 4 = 15, and 15 divided by 7 = 2.1; thus, 2.1 is the mean.
- The **mode** is the value that is represented most often. For example, in this data set 1, 1, 1, 2, 2, 4, 4, the number 1 is listed three times, 2 is listed twice, and 4 is listed twice. Therefore, 1 is the mode since it is the value that is listed more times than the other values.
- The **median** of a data set is the numerical value that is in the middle of the data set if it is organized from the lowest value to the greatest value. In a list of seven numbers, the number in the middle is the number 2; therefore, 2 is the median.



Variability is the amount of dispersion in a data set and describes how far the individual data points are from the others and from the center of the distribution. Examples of variability include:

- The **range**, which is the highest and the lowest value in the data set
- The **standard deviation**, which is the average distance from the mean
- The **variance**, which is the squared value of the average distance from the mean

Distribution is defined as all values possible for a variable and how often each value occurs. A **variable** is a representation of a construct that can vary in quantity or quality in an observable phenomenon (Gall et al., 2007). A **construct** is a concept that is inferred from observed phenomena and is used to explain or interpret those observations to form the conceptual content of a theory (Ary et al., 2006; Gall et al., 2007).

Commonly used descriptive statistics in quantitative research are mean and standard deviation. Standard deviation is the average variability in a dataset. Said another way, the standard deviation is a number that expresses how spread out the data is around the mean. It is defined as the square root of the variance.

Inferential Statistics

Inferential statistics are used to make predictions, or inferences, about population characteristics from samples taken from the population. Inferential statistics are useful when examining all population members on a characteristic is impossible or impractical. For example, if we want to know if individuals between the ages of 30 and 50 who own a dog in a certain large city are more or less likely to engage in aerobic exercise three or more times a week when compared to individuals of the same age in the same city who do not own a dog, it is impossible, or at least impractical, to pose this question to every person in this age group in this large city. Instead, a representative sample of the population can be surveyed. Examples of inferential statistics include the following:

- independent samples *t* test
- analysis of covariance (ANCOVA)
- Pearson product-moment correlation
- multiple linear regression

Experimental Research

Quantitative research can be experimental or non-experimental. **Experimental research** is defined as an investigation in which the researcher manipulates the independent variable and observes the effect on the dependent variable while holding other variables constant. An **independent variable** is defined as the variable that is manipulated by the researcher, whereas the **dependent variable** is defined as the variable being tested. Thus, the dependent variable is always "dependent" on the independent variable. In a cause-and-effect relationship, the independent variable causes an effect on the dependent variable. An example of experimental research is a study in which participants are chosen by a random sample from the entire population of interest. Two groups are formed: an experimental group and a control group. The experimental group is given a

treatment, and the control group is not given the treatment. After the treatment has been administered, each group is tested to determine if the groups are different on their dependent variable. The treatment is assumed to be the cause of the difference between the groups. For example, suppose you want to determine if viewing a cell phone screen for 30 minutes before bedtime impacts the quality of sleep. Participants are randomly assigned to either the group who does not use their cell phones before bedtime or the group who does view their cell phones for 30 minutes before bedtime. An instrument that determines the quality of sleep is given to both groups after the experimental treatment has been run for an appropriate amount of time. Since the participants are randomly assigned to either the control group or the experimental group, the study is experimental.

Nonexperimental Research

Non-experimental research is defined as an investigation in which the researcher does not (or cannot) manipulate the independent variable, nor does the researcher control other variables that could alter the results of the study. For example, suppose a researcher is interested in determining if a student's end-of-course test score can be predicted by a combination of their homework quality and their average days present in the class. This research is non-experimental because there is no random sampling, and none of the variables are manipulated by the researcher.

As is typical in all research, quantitative research is subject to criticism. Procedures, theories, and results are always subject to alternative explanations. Science demands that all results be scrutinized. This is part of the learning process and why research and the analysis of it is important. The point of quantitative research is to investigate phenomena as they exist, free of researcher bias. Quantitative research has limitations that researchers consider as they evaluate, interpret, and report results. Using a systematic approach of scientific inquiry to investigate phenomena by collecting quantifiable data that can be mathematically analyzed, quantitative research seeks to examine the reality of phenomena for the purpose of adding to the body of knowledge.

Quantitative Research Designs

The **research design** of a study includes the methods and procedures used to collect, measure, and analyze data. The researcher determines the design of a study based on the method that will best answer the research questions. In other words, the research question determines the type of design needed to answer the research question. Five research designs are described in this chapter, they are:

1. causal-comparative design
2. correlational design
3. experimental posttest-only design
4. quasi-experimental posttest-only design
5. quasi-experimental pretest-posttest design

In the following sections, these five designs will be described, including the purpose, use, statistics used, and limitations of each. Let's look at each design in more detail.

Casual-Comparative Design

A **causal-comparative design** is a form of non-experimental quantitative research that seeks to explore possible cause-and-effect relationships between independent and dependent variables by comparing individuals who possess a particular trait or characteristic to individuals who do not possess the trait or possess it to a lesser extent. A defining feature of causal-comparative research is that the independent variable is categorical and present in the participants before the research begins. Causal-comparative research investigates the impact of naturally occurring variations in the independent variable in a population on one or more dependent variables. Since the trait or characteristic exists in the participants prior to the study, this type of research is referred to as **ex post facto,** a Latin term that means "operating retroactively" or after the fact. The data is gathered after the independent variable has presumedly exerted its effect on the dependent variable (Gall et al., 2007). Since the independent variable has already occurred, the researcher does not manipulate any variables.

Purpose

The purpose of causal-comparative research is to determine if a preexisting characteristic of participants, the independent variable, affects the value of the dependent variable. Causal-comparative research investigates a possible cause-and-effect relationship between the independent and dependent variables. The researcher will seek to determine if a difference exists due to the preexisting group membership.

Use

Causal-comparative research is used when:

- The researcher wants to determine if the independent variable affects the dependent variable.
- The researcher cannot manipulate any variable, which means that group membership is established prior to the study.
- There is no random assignment to groups.
- Group membership is determined by whether a participant possesses a particular trait or characteristic or whether a participant possesses the trait to a lesser extent.
- The independent variable is categorical.
- The grouping characteristic exists at two or more levels.

Statistics

Since the independent variable must be categorical and the dependent variable is continuous (either interval or ratio), there are several inferential statistics that are appropriate for data analysis. The most used are the independent samples *t* test, one-way ANOVA, two-way ANOVA, and one-way multivariate analysis of variance (MANOVA).

- **Independent samples *t* test** is used when there is *one* independent variable that is composed of *two* categorical groups and *one* dependent variable measured on a continuous scale.
- **One-way ANOVA** is used when there is *one* independent variable that is composed of *two or more* categorical groups and *one* dependent variable measured on a continuous scale.
- **Two-way ANOVA** is used when there are *two* independent variables, each composed of *two or more* categorical groups, and *one* dependent variable measured on a continuous scale.

- **One-way MANOVA** is used when there is *one* independent variable composed of *two or more* categorical groups and *more than one* dependent variable, each measured on a continuous scale.

More information on selecting the appropriate statistical test is provided in Chapter 5. Please see that chapter for further details.

Limitations

A causal-comparative design has limitations that the researcher should address when reporting the research. First, due to the non-experimental nature of a causal-comparative design, the researcher cannot make causal claims. Participants are not randomly assigned to groups, which means there could be extraneous variables present that impact the results. The researcher cannot know if the independent variable is responsible for variation in the dependent variable or if the variation was due to another unaccounted-for variable. The researcher will propose alternate explanations of the results based on variables not controlled for in the study. It is important to remember that a causal-comparative study can only determine possible cause-and-effect relationships. Further research is needed to establish cause-and-effect between the independent and dependent variables. Considering the limitations of causal-comparative studies, the design is used when it is impractical, impossible, or unethical to explore the variables in an experimental study.

Correlational Design

A **correlational design** is a form of non-experimental quantitative research that measures the strength and direction of the relationship between two or more variables. Correlational design can be a simple correlation that examines only the strength and direction of the relationship between two variables, or it can be a **predictive correlational design** that examines the ability of the independent variable to predict the dependent variable. How well the change in one variable indicates a change in the other is referred to as the **strength** of the relationship between the variables. The **direction** of the relationship refers to whether the variables are directly or inversely related. If the variables are **directly related,** then a positive change in one variable results in a positive change in the other variable. An example of a direct relationship would be the relationship between time worked on an hourly wage job and the amount of pay earned. When the number of hours worked increases, the worker's pay also increases. If the worker spends fewer hours on the job, the amount of pay earned decreases. An **inverse relationship** is one in which one variable increases while the other variable decreases. An example of an inverse relationship is the speed and time required to travel a certain distance. When speed increases, the time needed to travel a set distance decreases. When speed is decreased, the time needed to travel a set distance increases.

Purpose

A correlational design may be simple or predictive. The purpose of a **simple correlational design** is to identify variables that are related to each other in such a way that a change in one indicates that the other will change as well. The purpose of a predictive correlational design is to determine how well the independent variable(s) predict the dependent variable.

Use

A *simple* correlational design is used when:

- Two variables examined are from one group
- Each participant provides data on two variables
- The researcher wishes to determine if there is a relationship between the two variables
- The researcher wishes to determine the direction and strength of the relationship

A *predictive* correlational design is used when:

- Two or more variables are examined from one group
- Each participant provides information for the dependent variable (also called the criterion variable) and one or more independent variables (also called the predictor variable)
- The researcher wishes to determine how well the dependent variable is predicted by each independent variable. If there is more than one independent variable, how well the dependent variable is predicted by the combination of all independent variables
- The independent variable(s) must occur before the dependent variable

Statistics

For a simple correlational design, a Pearson product-moment correlation is appropriate. Pearson product-moment correlation is also referred to as Pearson's correlation. To run a Pearson product-moment correlation, the two variables must be continuous values, either interval or ratio. A **continuous variable** is a numerical variable that has an infinite number of possible values over some range of values. Continuous variables can be an interval scale or ratio values. An **interval scale** may have zero (0) as a possible numerical value, but it is not a true zero. For example, on the Fahrenheit scale, 0 degrees does not mean an absence of all heat. An interval scale can have negative values. For example, the temperature can be negative 5 degrees. A **ratio** scale has a true zero. For example, on the Kelvin scale, zero Kelvin (0 K) is absolute zero. There can be no lower temperature.

For a predictive correlational design, regression analysis is needed. There are several types of regression analyses; for this book, three commonly used regression analyses include bivariate linear regression, multiple linear regression, and logistic regression.

- **bivariate linear regression:** If two variables are examined and the dependent variable is continuous, a bivariate linear regression is used, which is also called simple linear regression. For example, if you want to know if the number of hours studying for an exam can predict the exam score, a bivariate linear regression is appropriate because both the dependent and independent variables are continuous.
- **multiple linear regression:** If the study has more than one independent variable and the dependent variable is continuous, a multiple linear regression is used. For example, if you want to know if the number of hours a participant spent studying for an exam and the number of hours a participant spent sleeping the week of the exam can predict the final exam score, multiple linear regression is appropriate because the dependent variable is continuous and there is more than one independent variable.
- **logistic regression:** If the dependent variable is dichotomous, a logistic regression is used (Warner, 2013). For example, if you want to know if earning a passing score (or not) on a registration exam can be predicted by course grades and the number of hours spent studying for the registration exam, logistic regression is appropriate. Logistic regression is appropriate because the dependent variable, earning a passing score on a registration exam or not, is dichotomous.

Limitations

A limitation of correlational studies is that they examine only one group, and there is no manipulation of variables. Since there is only one group, there can be no random assignment. Like causal-comparative studies, correlational designs do not allow the researcher to make a cause-and-effect claim, which is a limitation of simple and predictive designs. Correlation is not proof of causation. Another limitation of a correlational study is the presence of confounding or extraneous variables. More studies are needed to determine if other variables might have influenced the results.

Experimental Design Posttest Only

Experimental design is quantitative research conducted to determine cause-and-effect relationships between two or more variables and is the most accurate type of experimental research. The distinguishing characteristic of experimental design is the random assignment of participants to groups. Additionally, in experimental design, the independent variable is manipulated by the researcher and includes a control and experimental group (Gall et al., 2007).

The independent variable can be referred to as the treatment variable or intervention variable. The independent variable consists of an experimental group and a control group. The **experimental group** is the group of participants who receive the experimental treatment, whereas a **control group** is a group of participants who do not receive the treatment. The control group provides baseline data for comparison to the experimental results. If the control group receives a treatment different from the treatment group, it can be referred to as a **comparison group**. There can be several levels of experimental treatment, so more than two groups are possible for a single independent variable.

A goal of experimental designs is to keep the experiences of the treatment and control groups as similar as possible and to limit confounding variables. **Confounding variables** are any variables that have an unwanted effect on your dependent variable. By limiting confounding variables and making all groups similar, differences in the dependent variable can be attributed to the treatment. An example of a study with a confounding variable is if a researcher wanted to determine if taking a particular vitamin decreased the likelihood of catching a cold during a determined period. Participants were placed in the experimental group or the control group. The experimental group agreed to take this vitamin as prescribed. The control group did not take the vitamin. At the end of the study, it was found that the control group caught fewer colds. The researchers interviewed the participants and found that the control group was made up of individuals who all washed their hands frequently throughout the day, and the experimental group members did not. The researchers decided to rerun the study to determine if handwashing impacted their results. The result of the second study showed that frequent washing of hands did impact the results. Therefore, handwashing was a confounding variable in the original study.

Purpose

The purpose of an experimental design is to test a hypothesis by examining differences between groups using statistical analysis. The researcher manipulates the independent variable and seeks to determine a cause-and-effect relationship between the independent and dependent variables. An experimental design shows that the experimental treatment produced an effect and that this effect could not possibly have been due to any variable other than the treatment.

Use

Experimental design is used when:

- The researcher wishes to determine causality between the experimental treatment (independent variable) and the outcome (dependent variable)
- Participants who are determined to be similar are randomly assigned to the experimental and control groups
- There is a categorical independent variable with two or more groups
- The researcher manipulates the independent variable
- There is at least one experimental group and a control group
- The dependent variable is measured on a continuous scale
- The treatment is administered to the appropriate group or groups but not to the control group
- All groups take the same posttest at the same time

Statistics Used

Appropriate inferential statistical analysis for experimental designs includes an independent samples *t* test and one-way ANOVA and MANOVA. The number of independent variables, the number of groups that make up the independent variable(s), and the number of dependent variables determines which of these statistical methods is appropriate.

- **Independent samples *t* test** is used when there is *one* independent variable that is composed of *two* categorical groups and *one* dependent variable, measured on a continuous scale.
- **One-way ANOVA** is used when there is *one* independent variable that is composed of *two or more* categorical groups and *one* dependent variable, measured on a continuous scale.
- **One-way MANOVA** is used when there is *one* independent variable composed of *two or more* categorical groups and *more than one* dependent variable, each measured on a continuous scale.

Limitations

In the social sciences, random assignment to groups is often impossible or impractical; therefore, experimental design is uncommon in social science studies.

Quasi-Experimental Posttest Only Design

Quasi-experimental posttest only design is a form of quantitative research that examines the causal impact of an independent variable on a dependent variable using a posttest but not a pretest and lacks random assignment of participants to groups. This design is also called quasi-experimental, static design. The term **quasi-** means "resembling." Quasi-experimental research resembles experimental research except that it lacks random assignment of participants to groups. The independent variable is categorical, includes experimental (treatment) and control groups, and is manipulated by the researcher.

The independent variable can be referred to as the treatment variable or intervention. The independent variable consists of an experimental (or treatment) group and a control group. The experimental group is the group of participants who receive the experimental treatment, whereas a control group is a group of participants who do not receive the treatment. The control group provides baseline data for comparison to the experimental results. If the control group receives a treatment different from the treatment group, it can be

referred to as a comparison group. There can be several levels of experimental treatment, so more than two groups are possible for a single independent variable.

A goal of quasi-experimental posttest design is to keep the experiences of the treatment and control groups as similar as possible and to limit confounding variables. Confounding variables are any variables that have an unwanted effect on your dependent variable. By limiting confounding variables and making all groups similar, any differences in the dependent variable can be attributed to the treatment.

It is important to note that the quasi-experimental posttest only design is a weak design. Since no pretest is used, it is impossible to know if the groups were similar before the treatment was administered. For this reason, the researcher cannot make a strong case for cause-and-effect between the independent variable and the dependent variable.

Purpose

The purpose of a quasi-experimental posttest only design is to test a hypothesis by examining differences between groups using statistical analysis. The researcher manipulates the independent variable and seeks to determine a cause-and-effect relationship between the independent and dependent variables. A quasi-experimental posttest only design is used instead of an experimental design when random assignment is either impossible or impractical.

Use

Quasi-experimental posttest only design is used when:

- The researcher wishes to determine causality between the experimental treatment (independent variable) and the outcome (dependent variable)
- Participants cannot be randomly assigned to treatment and control groups
- Participants are determined to be similar
- There is a categorical independent variable with two or more groups
- The researcher manipulates the independent variable
- There is at least one experimental group and a control group
- The dependent variable is measured on a continuous scale
- The treatment is administered to the appropriate group or groups but not to the control group
- There is no pretest
- All groups take the same posttest at the same time

Statistical Analysis

Appropriate inferential statistical analysis for experimental designs includes independent samples *t* test, one-way ANOVA, two-way ANOVA, and MANOVA. The number of groups that make up the independent variable and the number of dependent variables determines which of these statistical methods is appropriate.

- **Independent samples *t* test** is used when there is *one* independent variable that is composed of *two* categorical groups and *one* dependent variable measured on a continuous scale.
- **One-way ANOVA** is used when there is *one* independent variable that is composed of *two or more* categorical groups and *one* dependent variable measured on a continuous scale.

- **Two-way ANOVA** is used when there are *two* independent variables, each composed of *two or more* categorical groups, and *one* dependent variable measured on a continuous scale.
- **One-way MANOVA** is used when there is *one* independent variable composed of *two or more* categorical groups and *more than one* dependent variable, each measured on a continuous scale.

Limitations

Internal validity is the extent to which results from a study can be used as evidence of a causal connection between variables and not the result of some other uncontrolled variable or variables (Ary et al., 2006; Warner, 2021). The lack of random assignment is a threat to internal validity. Participants are not randomly assigned to groups, so there is a possibility the groups are not similar. The researcher is limited in the ability to conclude a causal association between an intervention and an outcome. The researcher cannot be certain of the similarities and differences of the groups on the dependent variable before the intervention is applied; therefore, there is little evidence that the outcome is due to the treatment.

Quasi-Experimental Pretest-Posttest Design

Quasi-experimental, pretest-posttest design (also called **nonequivalent pretest-posttest control-group design**) is a form of quantitative research that examines the causal impact of an independent variable on a dependent variable using a pretest and a posttest. The pretest is also referred to as a covariate. Warner (2013) defines a **covariate** as a variable that is included in the statistical analysis so that its influence on the dependent variable can be statistically controlled. As noted previously, the term quasi- means "resembling." Quasi-experimental pretest-posttest design resembles experimental design, except that it lacks random assignment of participants to groups. All groups take the same pretest and posttest. The independent variable is categorical, includes experimental (treatment) and control groups, and is manipulated by the researcher.

The independent variable can be referred to as the treatment variable or intervention. The independent variable consists of an experimental (or treatment) group and a control group. The experimental group is the group of participants who receive the experimental treatment, whereas a control group is a group of participants who do not receive the treatment. The control group provides baseline data for comparison to the experimental results. If the control group receives a treatment different from the treatment group, it can be referred to as a comparison group. There can be several levels of experimental treatment, so more than two groups are possible for a single independent variable.

A goal of quasi-experimental, pretest-posttest design is to keep the experiences of the treatment and control groups as similar as possible and to limit confounding variables. Confounding variables are any variables that have an unwanted effect on the dependent variable. By limiting confounding variables and making all groups similar, any differences in the dependent variable can be attributed to the treatment. Gall et al. (2007) stated that when properly carried out, a pretest-posttest control group design effectively controls for several threats to internal validity. The pretest is referred to as the covariate and is used to equalize nonequivalent groups. In a pretest-posttest control group study, all groups take the pretest and the posttest. Statistical analysis can then use the pretest data to better measure the impact of the treatment.

Purpose

The purpose of a quasi-experimental pretest-posttest design is to test a null hypothesis using statistical analysis that controls for preexisting differences between the groups. The researcher manipulates the independent variable and seeks to determine a cause-and-effect relationship between the independent and

dependent variables while using a covariate to control for preexisting differences between the groups. A quasi-experimental pretest-posttest design is used instead of an experimental design when random assignment is either impossible or impractical.

Use

Quasi-experimental, pretest-posttest design is used when:

- The researcher wishes to determine causality between the experimental treatment (independent variable) and the outcome (dependent variable)
- Participants cannot be randomly assigned to treatment and control groups
- Participants are determined to be similar
- There is a categorical independent variable with two or more groups
- The researcher manipulates the independent variable
- There is at least one experimental group and a control group
- The dependent variable is measured on a continuous scale
- The treatment is administered to the appropriate group or groups but not to the control group
- A pretest is given to all groups before the treatment begins and is used as a covariate in analysis
- All groups take the same posttest at the same time

Statistical Analysis

Appropriate inferential statistical analysis for quasi-experimental, pretest-posttest design includes a covariate. They are one-way ANCOVA, two-way ANCOVA, and MANCOVA. The number of independent variables and the number of dependent variables determine which of these statistical methods is appropriate.

- **One-way ANCOVA** is used when there is *one* independent variable that is composed of *two or more* categorical groups, *one* dependent variable measured on a continuous scale, and a covariate measured on a continuous scale.
- **Two-way ANCOVA** is used when there are *two* independent variables, each composed of *two or more* categorical groups, *one* dependent variable measured on a continuous scale, and a covariate measured on a continuous scale.
- **MANCOVA** is used when there is *one* independent variable composed of *two or more* categorical groups, *more than one* dependent variable, each measured on a continuous scale, and a covariate measured on a continuous scale.

Limitations

The lack of random assignment is a threat to internal validity. The use of a covariate to statistically control for preexisting differences between the groups limits this threat to validity. The researcher must be sure the data meets all assumptions for the chosen statistic. **Assumptions** refer to conditions that must be true in order for a specific statistical test to be valid. Each type of parametric statistical analysis has certain conditions that must be met for the statistic to provide reliable information. For example, a common assumption is the assumption of normal distribution of data. The assumptions that must be met vary from one type of statistical test to another.

Reasons to Conduct Quantitative Research

For this book, the purpose of quantitative research is to conduct dissertation research and add to the body of knowledge on a specific topic and share that knowledge with a community of scholars. Adding to the body of knowledge can take many forms, such as presentations, scholarly journal articles, theses, and dissertations. This book focuses on the dissertation and scholarly journal articles; however, the elements and skills needed for quantitative research presented here are applicable to presentations and theses as well. See Chapter 9 to learn the steps to transition your manuscript from a dissertation to a journal article for publication.

A research study begins with a thorough review of the literature. If there is no readily available answer to the "what," "why," or "how" of a phenomenon, then a research study is justified. However, if the phenomenon has already been thoroughly explained in the literature, then there is little or no reason to conduct a study. Furthermore, the complete absence of a research topic does not necessarily constitute a gap in the literature. The absence of research may simply mean that no one in the community of scholars is interested enough to conduct research on the topic. Therefore, there are no studies on the topic. The purpose of scientific research is to build upon prior research and add to the body of scholarly knowledge. For example, after examining the current scholarly literature, you discover that there is a large body of empirical evidence regarding women's attitudes toward science. However, you discovered that there is little research regarding Hispanic females' attitudes toward science, and scholars are calling for research in this area; this could be considered a gap in the literature. The researcher may be encouraged to research this topic and add valuable information to the body of knowledge. Thus, research begets more research.

Steps to Conduct Quantitative Research

In this section, the steps typically followed when conducting quantitative research are presented. Note that in some instances, the process is cyclical and overlapping. These steps are intended to serve as a guide for the quantitative researcher to follow from commencement to culmination of a quantitative research study. The Nine Steps to Conduct Quantitative Research include the following:

Steps for Conducting Quantitative Research

Step 1. Find a gap in the literature

Step 2. Formulate a research question

Step 3. Consider feasibility

Step 4. Consider logistics

Step 5. Write the proposal

Step 6. Defend the proposal

Step 7. Collect and analyze data

Step 8. Write the final manuscript

Step 9. Defend the final manuscript

Using these nine steps, the researcher will conduct a quantitative research study. Let's look at each step in greater detail.

Step 1. Find a gap in the literature. The first step in quantitative research is to determine a gap in the literature. Begin by identifying a topic you are interested in and reading the current literature on that topic. This may require that you

read a large number of articles before you are able to determine a gap in the literature.

Step 2. Formulate a research question. The second step is to formulate a research question. Quantitative research questions take one of two approaches: examining differences between groups or relationships between variables within a single group.

An example of examining differences is a study that seeks to determine if teacher self-efficacy scores differ among three school settings: private, charter, and traditional public schools. The research question could be: Is there a difference in teacher self-efficacy scores among teachers who teach in private, charter, and traditional public schools? The independent variable is the school setting, and the dependent variable is teacher self-efficacy scores. An example of examining relationships between variables is a study that seeks to determine if the number of hours of remedial mathematics instruction in a school year is correlated to student's math growth scores. The research question could be: Is there a relationship between the number of hours of remedial mathematics instruction and mathematics growth scores for fifth-grade students?

Step 3. Consider feasibility. After formulating your research questions(s), consider the feasibility of the study. **Feasibility** is the likelihood of the research being accomplished in terms of the time, money, accessibility, participants, instruments, reliability, and expertise that are available to you. If you determine that the study is not feasible, then it would be wise not to proceed. Following are some items to consider when determining feasibility.

Time: When considering time, determine if the research can be conducted in a reasonable time frame. Since many quantitative research studies will be conducted in an educational setting or business, it is wise to consider breaks and holidays, such as summer and traditional holidays, as most educators and some business professionals will not be available for research during those times.

Money: Research often costs money. Money should be considered in terms of the cost of an instrument, supplies, special equipment needed for a treatment group, travel expenses, photocopy expenses, participant incentives, etc. While considering the study, estimate the total cost and make sure it fits into your budget.

Accessibility is the availability of a location and participants to the researcher who desires to conduct quantitative research. When considering accessibility, the setting of a quantitative research study may be determined by the accessibility that the researcher has to the location and the participants. **Archival data** is information that was previously collected for some reason other than the study being proposed by the researcher. Some quantitative researchers use archival data. In this case, accessibility refers to the ability of the researcher to gain access to the archived data. As with accessibility to a location, the researcher needs to secure permission from the gatekeeper(s) to access archival data that is not publicly available.

Participants are those persons who specifically participate in the research study by providing data. Determining participants for your study is exceptionally important to the research process since the participants must represent the population featured in the study. When considering participants, determine if participants are accessible and if there are any ethical considerations, such as minors or protected groups. Also, determine the number of participants available to you for data collection. The number of participants needed for a quantitative study is determined by the statistic used to analyze the data. Depending on the sample size needed for the statistical analysis planned, determine if the location chosen can provide the needed number of participants. Frequently, more than one location is needed to meet the minimum requirement for participants. More detail regarding participant selection and the number of participants needed is in a later chapter.

Instrumentation: An **instrument** is the tool used to measure the dependent variable and sometimes the independent variable during data collection. Common types of quantitative research instruments are academic assessments, tests, scales, and psychometric measurements that produce quantitative results. Instrumentation includes determining if the instrument does the following:

- measures the variables stated in the research question
- produces quantitative results
- is designed to be used with the population of the study (age-appropriate, reading level-appropriate, in a language spoken by the participants, etc.)
- is consistent with the theoretical framework of the study
- is valid and reliable

The instrument must be valid (appropriate) and reliable (consistent). Before using a particular instrument, the researcher must determine (1) what variable(s) does it claim to measure, (2) was the instrument determined to be valid for measuring the variable(s) it claims to measure, and (3) is the instrument valid for the research being proposed? Types of validity to consider include construct validity and content validity.

- **Construct validity** refers to how well an instrument measures the theoretical construct it claims to measure. The developers of instruments run correlation statistics to determine the performance of the instrument compared to an established (previously validated) instrument to establish construct validity.
- **Content validity** refers to whether the instrument measures an appropriate sample of the domains being measured. This can be accomplished by experts reviewing the instrument to determine that the items are appropriate for the construct it claims to measure.

Reliability refers to the quality of the instrument to produce accurate results. A reliable instrument will provide the same result over repeated trials. Notice that an instrument can be reliable but not valid. Reliability can be determined using statistical methods. The most common is **Cronbach alpha** (sometimes called coefficient alpha), which is a measure of internal consistency. If the correlation is found to be .80 or higher, the test is considered reliable (Gall et al., 2007).

Other instrumentation considerations include:

- Does the instrument produce the data needed to answer the research question?
- Does the researcher have permission to use the instrument from the developer?
- Is the use of this instrument practical in terms of cost, time needed for participants to complete it, ease of administration, and ease of scoring?

Expertise: As a researcher, you may be limited in your expertise regarding a topic area. For example, if you are considering a study of special education, without proper training and experience in special education, you may not understand the jargon used in the field. Thus, consider your expertise in dealing with highly technical issues, and make sure you have proper expertise on a topic before you select your topic and conduct the research.

Step 4. Consider logistics. Before conducting the research, make prior arrangements with leadership at the site and address any logistics for carrying out the research. **Logistics** are the requirements that pertain to managing people, securing facilities, and obtaining supplies. Before conducting the research study, ensure that all logistical requirements are addressed. Logistics are best discussed in terms of when and where data will be collected, from whom data will be collected, how data will be collected, how data will be recorded, etc. If a treatment is involved, training teachers to administer the treatment is critical to ensure the fidelity of the study. Have a clear plan to disseminate the instrument to the correct individuals and the means to collect it when complete.

Step 5. Write the proposal. A quantitative **proposal** is a document that describes a unique research study you plan to complete. It states what topic you plan to study, how you will conduct the research, and why it is worthy of investigation. The proposal is a well-organized and concisely written document. The proposal will guide the researcher through the process and is required by most school systems, businesses, and Institutional Review Boards (IRB) before any research can be conducted. As a minimum, the proposal should consist of an introduction to the topic being investigated, a problem statement, a purpose statement, the significance of the study, a review of the literature, a theoretical framework, instrumentation, participants, procedures, and data analysis.

Step 6. Defend the proposal. A proposal defense is intended to offer the novice researcher the opportunity to defend the first three chapters of their dissertation. This is typically accomplished with a Chair and research committee. This varies by institution, but the researcher should be prepared to present an introduction to their research, ethical considerations related to the treatment of human subjects, review of the scholarly literature, and present the proposed data collection and analysis procedures.

Step 7. Collect and analyze data. Before any data are collected, approval by an IRB is typically required. An IRB exists to review the methods proposed for research studies to be sure that appropriate steps are taken to ensure the research planned is ethical. The IRB can approve a study, deny a study, or require modifications to gain approval for a research study (**National Archives and Records Administration, n.d.**). The process for securing IRB approval is unique to each institution. It is important to determine from the institutions involved what information, forms, and permissions are required to grant IRB approval. After IRB approval is received, continue with the procedures of treatment (if applicable), data collection methods, and data analysis methods as presented in the proposal.

Step 8. Write the final manuscript. After the data collection and analysis is complete, it is time to report the results and draw conclusions based on your findings. When reporting the results, state specifically whether the null hypothesis was rejected or failed to be rejected. Address the results (reject or fail to reject the null hypothesis) in light of what the literature says about the topic. Conclusions must be supported by your results and the literature. Include suggestions for future research.

Step 9. Defend the final manuscript. A final defense is intended to offer the researcher the opportunity to defend their research. Like the proposal, this is typically accomplished with a Chair and research committee. The final defense varies by institution, but the researcher should be prepared to present details regarding their research results and conclusions considering the literature review and data collection and analysis strategies. More details are provided about this in a later chapter.

Quantitative research may be conducted using the nine steps described previously. The steps offer a systematic approach to quantitative research for investigating phenomena by collecting quantifiable data and analyzing it using statistical methods. These nine basic steps are designed to guide the researcher to conduct and implement quantitative research methodologies.

Conclusion

Quantitative research is a systematic approach for investigating phenomena by collecting quantifiable data and analyzing it using statistical methods that include descriptive and inferential statistics. The outcome of quantitative research answers questions of "what," "why," or "how" for the purpose of adding to the body of knowledge on a topic. Adding to the body of knowledge is often referred to as narrowing the gap in the literature. The product is a quantitative research study, such as a dissertation, that presents a clearly defined research process, including an introduction to the study, a problem statement, a purpose statement, research questions, procedures, instrumentation, data collection and analysis, results, conclusions drawn in light of the theoretical framework and literature, and recommendations for future research. This book will lead the novice researcher through the quantitative research process from commencement to culmination.

Chapter Highlights

For this textbook, **quantitative research** is delineated as a systematic approach to investigating phenomena by collecting quantifiable numerical data and analyzing it using statistical methods, which include descriptive and inferential statistics.

The purpose of quantitative research is to investigate and understand a particular moment in time and examine data sets over time to find trends and patterns.

A **phenomenon** is an event observed through the senses rather than by thought or intuition.

Science is the systematic investigation of the natural world using observation. Science uses a systematic approach to produce empirical evidence.

Empirical evidence is information obtained through our senses and documented.

In quantitative research, scientists try to understand and predict events and behaviors based on empirical evidence. Scientists look for patterns in the data to formulate conclusions and theories.

Theories are a set of principles agreed upon by a community of scholars within a discipline.

Progressive discourse is the sharing of knowledge that encourages active debate and criticism of each other's research and results.

Quantitative research answers questions of "why" or "how" for the purpose of adding to the body of knowledge on a topic.

A **data set** is a collection of items that are related to the same topic.

The term **statistical test** is often shorted to "statistic" and refers to mathematical procedures used to analyze quantitative data.

Descriptive statistics summarize the characteristics of a numerical data set without drawing inferences about the population (Howell, 2008).

Central tendency is defined as the most common or "typical" response that conveys the center value of a data set (Ary et al., 2008; Warner, 2021). Mean, mode, and median are all expressions of a data set's central tendency.

Variability is the amount of dispersion in a data set and describes how far the individual data points are from the others and from the center of the distribution.

Distribution is defined as all values possible for a variable and how often each value occurs.

A **variable** is a representation of a construct that can vary in quantity or quality in an observable phenomenon (Gall et al., 2007).

A **construct** is a concept that is inferred from observed phenomena and is used to explain or interpret those observations to form the conceptual content of a theory (Ary et al., 2006; Gall et al., 2007).

Inferential statistics are used to make predictions, or inferences, about population characteristics from samples taken from the population.

Experimental research is defined as an investigation in which the researcher manipulates the independent variable and observes the effect on the dependent variable while holding other variables constant.

An **independent variable** is defined as the variable that is manipulated by the researcher, whereas the **dependent variable** is defined as the variable being tested.

Non-experimental research is defined as an investigation in which the researcher does not (or cannot) manipulate the independent variable, nor does the researcher control other variables which could alter the results or the study.

The **research design** of a study includes the methods and procedures used to collect, measure, and analyze data.

A **causal-comparative** design is a form of non-experimental quantitative research that seeks to explore possible cause-and-effect relationships between independent and dependent variables by comparing individuals who possess a particular trait or characteristic to individuals who do not possess the trait or possess it to a lesser extent.

The purpose of causal-comparative research is to determine if a preexisting characteristic of participants, the independent variable, affects the value of the dependent variable.

A **correlational design** is a form of non-experimental quantitative research that measures the strength and direction of the relationship between two or more variables.

The purpose of a **simple correlational design** is to identify variables that are related to each other in such a way that a change in one indicates that the other will change as well.

The purpose of a predictive correlational design is to determine how well the independent variable(s) predict the dependent variable.

A **continuous variable** is a numerical variable that has an infinite number of possible values over some range of values.

Experimental design is quantitative research conducted to determine cause-and-effect relationships between two or more variables and is the most accurate type of experimental research.

A goal of experimental designs is to keep the experiences of the treatment and control groups as similar as possible and to limit confounding variables. The purpose of an experimental design is to test a hypothesis by examining differences between groups using statistical analysis.

Quasi-experimental posttest-only design is a form of quantitative research that examines the causal impact of an independent variable on a dependent variable using a posttest but not a pretest.

A goal of quasi-experimental posttest design is to keep the experiences of the treatment and control groups as similar as possible and to limit confounding variables. The purpose of a quasi-experimental posttest only design is to test a hypothesis by examining differences between groups using statistical analysis.

Internal validity is the extent to which results from a study can be used as evidence of a causal connection between variables and not the result of some other uncontrolled variable or variables (Ary et al., 2006; Warner, 2021).

Quasi-experimental, pretest-posttest design (also called **nonequivalent pretest-posttest control-group design**) is a form of quantitative research that examines the causal impact of an independent variable on a dependent variable using a pretest and a posttest. The pretest is also referred to as a covariate.

A goal of quasi-experimental, pretest-posttest design is to keep the experiences of the treatment and control groups as similar as possible and to limit confounding variables. The purpose of a quasi-experimental pretestposttest design is to test a null hypothesis using statistical analysis that controls for preexisting differences between the groups.

The purpose of quantitative research is to add to the body of knowledge on a specific topic and share that knowledge with a community of scholars.

Reliability refers to the quality of the instrument to produce accurate results.

Steps for Conducting Quantitative Research

Step 1. Find a gap in the literature

Step 2. Formulate a research question

Step 3. Consider feasibility

Step 4. Consider logistics

Step 5. Write the proposal

Step 6. Defend the proposal

Step 7. Collect and analyze data

Step 8. Write the final manuscript

Step 9. Defend the final manuscript

CHAPTER 2

How to Write the Front Matter

Chapter Outline

Objectives

By the end of this chapter, the reader will be able to:

- Write the front matter of a quantitative research manuscript
- Explain what should be included on the Title Page
- Explain what should be included on the Signature Page
- Differentiate between the Title Page and the Signature Page
- Write an Abstract

- Write the Table of Contents
- Prepare a Copyright page
- Dedicate the research to specific people on the Dedication page
- Acknowledge specific people who impacted the researcher on the Acknowledgments page
- Write a List of Tables
- Write a List of Figures
- Write a List of Abbreviations

Key Terms

- Abstract
- Acknowledgments
- Copyright
- Dedication
- List of Abbreviations
- List of Figures
- List of Tables
- Signature Page
- Table of Contents
- Title Page

Introduction

A quantitative research manuscript includes many sections that must be completed thoroughly using scholarly writing and the current writing style manual. This chapter begins with an outline for a quantitative research manuscript. The purpose of this book is to guide the novice researcher through the process of writing a quantitative research manuscript by investigating phenomena, collecting quantifiable data, and analyzing the data using statistical methods, which include descriptive and inferential statistics. Quantitative research answers questions of "what," "why," or "how" for the purpose of adding to the body of knowledge on a topic.

A quantitative research manuscript begins with the front matter. The front matter includes the following sections: Title Page, Signature Page, Abstract, Table of Contents, Copyright (optional), Dedication (optional), Acknowledgments (optional), List of Tables, List of Figures, and a List of Abbreviations. Throughout this book, you will use this quantitative research manuscript outline as a guide for your research. Your institution may use a slightly different version. If so, you should follow the guidelines specific to your institution, which are likely presented in a research handbook provided by your institution. This manuscript is intended to be compliant with the American Psychological Association (APA) requirements. The basic outline for a quantitative research manuscript follows.

0:00 / 1:21

Outline of a Quantitative Research Manuscript

Front Matter

Title Page

Signature Page

Abstract

Table of Contents

Copyright Page (optional)

Dedication (optional)

Acknowledgments (optional)

List of Tables

List of Figures

List of Abbreviations

Chapter 1: Introduction

Overview

Background

Problem Statement

Purpose Statement

Significance of the Study

Research Question(s)

Identification of the Variables

Definitions

Summary

Chapter 2: Literature Review

Overview

Theoretical Framework

Related Literature

Summary

Chapter 3: Method

Overview

Research Design

Research Question(s) and Null Hypothesis(es)

Setting and Participants

Instrumentation

Procedures

Data Analysis Plan

Summary

Chapter 4: Results

Overview

Research Question(s) and Null Hypothesis(es)

Results

Summary

Chapter 5: Discussion

Overview

Discussion

Limitations

Recommendations for Future Research

Conclusion

Summary

References Appendix

How to Write the Front Matter

The front matter of a quantitative research manuscript includes the following: Title Page, Signature Page, Abstract, Table of Contents, Copyright (optional), Dedication (optional), Acknowledgments (optional), List of Tables, List of Figures, and a List of Abbreviations. The first page of the quantitative research manuscript is the Title Page.

How to Write the Title Page

The Title Page of a quantitative research manuscript offers a first impression of the study and indicates the subject of the manuscript. A quantitative manuscript is a scholarly document based on the latest research and data available about the research topic. Thus, it should be presented in a professional manner. The **Title Page** reveals the study's title, the researcher's name, a statement of the partial fulfillment of the requirements for the degree, the degree title, the college or university name, and the year the research was completed.

Title of the Study: The title of the study should be written in title case, should be derived from the research question, and should include the design. For the title of the research, the research question should be converted from a question to a statement. For example, if the research question was "Is there a difference in overall teacher efficacy between charter public-school teachers and traditional public-school teachers?" then the title would be "A Causal-Comparative Study of Teacher Efficacy in Charter Public-School Teachers and Traditional Public-School Teachers."

Researcher's Name: The researcher's name should be written as the researcher's first and last name. A middle initial or middle name is also appropriate. There should not be any indication of a degree earned. For example, do not write "Dr. Student Name," or "Student Name, EdD" or "Student Name, PhD."

Partial Fulfillment of the Requirements for the Degree: This section of the Title Page indicates to the reader the purpose for conducting this research in terms of a degree earned. This section should be written as follows:

A Dissertation Presented in Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy (or other)

College or University: This section should include the full name of the college or university issuing the degree. This is not the site or location where the research is being conducted.

Date: Include the year the research was concluded. Do not include the month and day unless it is required by your institution. See the Title Page example that follows.

A Causal-Comparative Study of Teacher Efficacy in Charter Public-School

Teachers and Traditional Public-School Teachers

by

Sara Capwell

A Dissertation Presented in Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy

University Name

2019

Checklist: Title Page

- ☐ is derived from the research question and includes the research design
- ☐ is written in bold, title case, size 12, Times New Roman font
- ☐ includes the researcher's first and last name
- ☐ includes the Partial Fulfillment of the Requirements for the Degree information in the format provided
- ☐ includes the college or university where the degree was issued
- ☐ includes the year the research was completed or presented
- ☐ excludes a running head
- ☐ excludes a page number

How to Write the Signature Page

The Signature Page of a quantitative research manuscript is exactly the same as the Title Page with one addition. The Signature Page includes all the information on the Title Page with the addition of the committee members' name(s) and degree earned. The **Signature Page** of a quantitative research reveals the title of the study, the researcher's name, the partial fulfillment of the requirements for the degree section, the degree title, the college or university name, the year the research was completed, and the committee members name(s) and degree. Do not put Dr. in front of the committee members' names; only the degree after each name. Duplicate the title page and add the committee members' names to the signature page.

Committee Members: This section includes the names of the committee members who approved the research. The name(s) of the committee members should be written to include the first name, last name, and degree earned. For example:

Approved by:

Michelle J. Barthlow, EdD, Committee Chair

Bunnie Claxton, EdD, Committee Member

See the Signature Page example that follows.

A Causal-Comparative Study of Teacher Efficacy in Charter Public-School Teachers and Traditional Public-School Teachers

by

Sara Capwell

A Dissertation Presented in Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

University Name
2019

Approved by:
Michelle Barthlow, EdD, Committee Chair
Bunnie Claxton, EdD, Committee Member

Checklist: Signature Page

- ☐ title is derived from the research question and includes the research design
- ☐ is written in bold, title case, size 12, Times New Roman font
- ☐ includes the researcher's first and last name
- ☐ includes the Partial Fulfillment of the Requirements for the Degree information in the format provided
- ☐ includes the institution where the degree was issued
- ☐ includes the year the research was completed
- ☐ includes the first and last name of the committee chair, followed by their earned degree
- ☐ includes first and last name of committee member(s) followed by their earned degree
- ☐ includes the Roman numeral ii in the upper right corner

How to Write the Abstract

The **Abstract** is a summary of the quantitative research manuscript and is provided for readers to quickly understand the nature of the research and provides the first impressions of your study. The Abstract will not be fully developed until the research has concluded since the results, conclusions, and recommendations for further research are not known until the research has concluded.

The word "Abstract" should be a level 1 heading, written in title case, and centered at the top of the page. At the culmination of the research, the Abstract should include the purpose statement (including method and design), the importance of the study, a brief description of the sample, its size and setting, instrumentation, data collection procedures, statistical analysis procedures, results, conclusions, and recommendations for further research. Results, conclusions, and recommendations for further research are included at the culmination of the research and are based on the completed study. The Abstract should be approximately 250

words, as brevity makes the summary more appealing to readers (APA, 2020). The first sentence of the abstract should not be indented. The abstract should not include citations or direct quotes. Keywords should follow the last line of the Abstract. Indent and italicize the word *Keywords*, followed by a colon and a list of the keywords written in lower case, non-italicized font, and separated by commas. The abstract should be written using the format that follows.

Abstract

> The purpose of this quantitative [insert research design] study was to [state the purpose]. This study is important because [insert importance of the study]. The sample was composed of [insert a brief description of participants, the sample size, and the setting]. Data were collected using [insert name of instrument]. [Indicate how data from the instrument were collected, such as an electronic survey platform or a paper-pencil format]. The results of the [insert statistic used] [select one: did/did not] find a significant difference/relationship/predictive correlation in/between [insert dependent variable] between [insert independent variable groups]. [State the conclusion]. [State recommendations for further research].
>
> *Keywords:* word 1, word 2, word 3, word 4, word 5.

The Abstract should begin by specifically stating the *purpose* of the research in a concise sentence. The purpose statement should include the word "quantitative" and the design (causal-comparative, correlational, experimental posttest only, or quasi-experimental posttest only, for example). If there is more than one design, state both. The purpose statement will remain constant throughout the entire manuscript since the purpose of the study remains the same throughout the research process. The abstract should specifically begin by stating, "The purpose of this quantitative [insert design] study was to…" The purpose of the research is followed in the next sentence, which is the *importance of the research*. The importance of the research stems from the gap in the literature, which is the problem the study will address. This statement about the problem being studied will remain constant throughout the research manuscript since the problem will not change throughout the research process. This should specifically state, "The study is important because [insert the problem statement addressing the gap in the literature] …" This should be done in approximately two sentences. The importance of the study should be followed by information about the sample. Provide a brief description of the participants, the sample size, and the setting. Again, this should specifically state, "The sample of (insert a brief description of participants, the sample size, and setting) …" After the information about the sample is presented, address the data collection methods. Specifically, you should state data were collected using (insert name of instrument). Then, indicate how data were collected. Next, state the statistical analysis planned. For example, you may state, "Data will be analyzed using an independent samples *t* test." For the Abstract of a quantitative research proposal, this is the information needed.

For a completed, final quantitative research study, the Abstract continues as one paragraph. The next sentence should state the results of the data analysis. State the statistic used and whether a significant difference was found on the dependent variable between or among the groups of the independent variable. For example, you would write, "The results of the (insert statistic used such as an independent samples *t* test) did/did not (choose one) find a significant difference in (insert dependent variable) between/among (insert independent variable groups)." Use the term "between" if the independent variable is composed of two groups and the word "among" if the independent variable consists of three or more groups. In the next sentence, state the conclusion based on these findings. State recommendations for further research in the last sentence of the Abstract. See the Abstract example that follows.

Abstract

The purpose of this quantitative causal-comparative study was to determine if a significant difference exists between overall classroom teacher efficacy in charter public-school teachers and traditional public-school teachers. This study is important because teacher efficacy has a direct impact on student engagement, productivity, and achievement in the classroom; therefore, this study adds to the literature regarding teacher efficacy by examining the differences between teachers in charter public schools and traditional public schools. The sample was composed of 100 teachers from charter schools and 102 teachers from traditional public schools from accredited school districts in central Florida. Data were collected using the Teacher Self-Efficacy Scale by surveys sent via email using Survey Monkey. The results of the independent samples *t* tests indicate that there is no significant difference in overall teacher efficacy between charter-school teachers and traditional public-school teachers. These results indicate that the school setting does not impact overall teacher self-efficacy. It is recommended that further research examine targeted populations such as various school sizes, demographics of teachers, demographics of students, and types of charter schools to investigate possible trends.

Keywords: charter public school, traditional public school, teacher self-efficacy, classroom management, student achievement

Checklist: Abstract

Abstract is presented in this order:

- ☐ uses a level-one heading to cue the reader
- ☐ purpose of the study includes the word "quantitative" and the design
- ☐ importance of the study
- ☐ brief description of the sample, size, and setting
- ☐ instrumentation
- ☐ data collection and procedures
- ☐ statistical analysis
- ☐ results of the study (at the culmination of the research)
- ☐ conclusion (at the culmination of the research)
- ☐ recommendation for further research (at the culmination of the research)
- ☐ four to seven keywords not italicized, separated by commas, that are central to the study The Abstract
- ☐ is approximately 250 words
- ☐ does not include references or quotes
- ☐ is written as one paragraph
- ☐ is not indented
- ☐ is written in accurate tense
- ☐ includes Roman numeral page number iii

How to Write the Table of Contents

The **Table of Contents** is a list, including page numbers, of the major sections of the quantitative research manuscript; it should be simple with a professional appearance. The Table of Contents should contain no more than two levels of headings in addition to chapter titles. It should appear in outline format.

The Table of Contents should be left justified. The subsections in each chapter will include APA Level 1 and Level 2 headings. The major headings should include the ones in the figure that follows, but these headings may vary slightly based on the specific quantitative research study. Level 1 headings should be indented one-half inch, and Level 2 headings should be indented one inch. According to APA 7th edition, chapter titles are not considered Level 1 headings. Entries should be double-spaced.

When you initially set up the Table of Contents, use the Table of Contents tool in Word that can be found under the References tab in the Table of Contents group. Then, format your Chapter, Level 1, and Level 2 headings to link to the Table of Contents by using the heading formatting in the Home tab in the Styles group. See the Table of Contents example that follows.

Table of Contents

Checklist: Table of Contents

- ☐ uses a level-one heading to cue the reader
- ☐ each heading is linked to the correct page
- ☐ page numbers are correct
- ☐ all chapter titles and Level 1 and Level 2 headings are included
- ☐ includes the correct page numbers Includes the following headings in this order:
- ☐ Abstract
- ☐ Copyright Page (optional)
- ☐ Dedication (optional)
- ☐ Acknowledgments (optional)
- ☐ List of Tables
- ☐ List of Figures
- ☐ List of Abbreviations
- ☐ Chapter 1: Introduction
  - ☐ Overview
  - ☐ Background
    - ☐ Historical Overview
    - ☐ Societal Impact
    - ☐ Theoretical Framework
  - ☐ Problem Statement
  - ☐ Purpose Statement
  - ☐ Significance of the Study
  - ☐ Research Question(s)
  - ☐ Identification of the Variables
  - ☐ Definitions
  - ☐ Summary
- ☐ Chapter 2: Literature Review
  - ☐ Overview
  - ☐ Theoretical Framework
  - ☐ Related Literature
  - ☐ Summary
- ☐ Chapter 3: Method
  - ☐ Overview
  - ☐ Research Design
  - ☐ Research Question(s) and Null Hypothesis(es)
  - ☐ Setting and Participants
    - ☐ Setting
    - ☐ Participants
  - ☐ Instrumentation
  - ☐ Procedures

- ☐ Data Analysis Plan
- ☐ Summary

- ☐ Chapter 4: Results
  - ☐ Overview
  - ☐ Research Question(s) and Null Hypothesis(es)
  - ☐ Results
  - ☐ Summary
- ☐ Chapter 5: Discussion
  - ☐ Overview
  - ☐ Discussion
  - ☐ Limitations
  - ☐ Recommendations for Future Research
  - ☐ Conclusion
  - ☐ Summary
- ☐ References
- ☐ Appendix

How to Write the Copyright Page

A **copyright** is an exclusive right to publish, print, or otherwise reproduce a work, such as certain types of literary or artistic productions. A copyright may be held by the author, originator, or an assignee. Whether or not a researcher registers for a copyright with the US Copyright Office, including a copyright page in the dissertation helps establish that the author is the owner of the work. This page is optional. If including the copyright page, center the copyright symbol followed by the year with no space. For example, ©2019. Double space to the next line and write the student's first name and last name. Double space to the next line and center these words: All Rights Reserved. See the Copyright Page example that follows.

Copyright Page

©2019

Student's First and Last Names

All Rights Reserved

Checklist: Copyright Page

- ☐ uses a level-one heading to cue the reader
- ☐ text is double-spaced
- ☐ includes the copyright symbol immediately followed by the year, centered on the page below the title of the page: Copyright Page
- ☐ student's first and last name, centered

- ☐ includes the words: All Rights Reserved, centered
- ☐ includes the correct Roman numeral page number

How to Write the Dedication Page

The **dedication** page is a page in which the candidate dedicates the manuscript to a specific person or persons. The decision to dedicate the manuscript to someone is a personal matter. Dedications are typically given to close family members such as a spouse, parents, children, and even community groups. This page is optional. If included, the dedication page is written in first person, double-spaced, in paragraph format, and left justified. It is approximately one-half to one full page but should not exceed one page. The title, Dedication, is centered and bold, with the first letter capitalized. Include a double-spaced line between the heading and the body of the text. See the Dedication example that follows.

Dedication

This manuscript is dedicated to my husband and children. To my husband, Steve, thank you for the many times you took on my responsibilities so that I could conduct research and write this dissertation. To my children, Elizabeth and Lee, thank you for understanding when I had to spend time writing instead of spending time with you. This work is dedicated to you.

This manuscript is also dedicated to my parents, Frank and Martha. Thank you for teaching me to follow my dreams and to never give up. Your influence helped me achieve this goal.

Checklist: Dedication (optional)

- ☐ uses a level-one heading to cue the reader
- ☐ text is double-spaced
- ☐ includes a specific person or persons and may include community groups.
- ☐ is written in paragraph format
- ☐ is left justified
- ☐ is approximately one-half page and does not exceed one page
- ☐ is written in first person
- ☐ includes the correct Roman numeral page number

How to Write the Acknowledgments Page

The **Acknowledgments** page provides the opportunity for the candidate to specifically acknowledge the various people who influenced the writing and completion of the research. The decision to acknowledge someone is a personal matter. Acknowledgments are usually faculty members and committee members who guided the research process and others who offered support. This page is optional. If included, the title is centered, bold font, and in title case. Include a double-spaced line between the heading and the body of the text. The body of the Acknowledgments is written in paragraph form, double-spaced, and left justified. See the Acknowledgments example that follows.

Acknowledgments

I would like to acknowledge the following people for helping me accomplish this research. To my Chair, Dr. Michelle Barthlow, who guided me through the research process, challenged my thinking, and served as my intellectual cheerleader! Thank you for helping me to persevere when the going got tough. Thank you to my committee member, Dr. Bunnie Claxton. Thank you to Sarah Smith for helping me with technology. I could not have accomplished this without your technological expertise. To my colleagues, thank you for supporting me when I felt overwhelmed. I am grateful for your help and for reminding me to take one step at a time.

Checklist: Acknowledgments (optional)

- ☐ uses a level-one heading to cue the reader
- ☐ text is double-spaced
- ☐ includes a specific person or persons and may include community groups
- ☐ is written in paragraph format
- ☐ is left justified
- ☐ is approximately one-half page and does not exceed one page
- ☐ is written in first person
- ☐ includes the correct Roman numeral page number

How to Write the List of Tables

The **List of Tables** is a list of the tables found in the manuscript, along with the corresponding page number where each table is located. The List of Tables is listed in the order the tables are presented in the manuscript. This list will enable the reader to easily locate the tables. The List of Tables is set up in a similar fashion to the Table of Contents. In Word, under the References tab, in the Captions group, select Insert Table of Figures. Use this tool to develop the List of Tables. The title of this page should be a level 1 heading, centered, bold, and in title case. The title should be located one (1) inch from the top of the page. Entries should be double-spaced. Include a double-spaced line between the heading and the first entry. See the List of Tables example that follows.

List of Tables

Checklist: List of Tables

- ☐ uses a level-one heading to cue the reader
- ☐ title is formatted correctly
- ☐ each table of the manuscript is listed and linked to the List of Tables
- ☐ page numbers are correct
- ☐ tables are listed in the order presented in the document
- ☐ includes the correct Roman numeral page number

How to Write the List of Figures

The **List of Figures** is a list of the figures contained in the manuscript and the corresponding page of each figure. The List of Figures is listed in the order presented in the document. This list will enable the reader to easily locate the figures in the manuscript. The List of Figures is set up in a similar fashion to the Table of Contents. In Word, under the References tab, in the Captions group, select Insert Table of Figures. Use this tool to develop the List of Figures. The title of this page should be a level 1 heading, centered, bold, and in title case. The title should be located one (1) inch from the top of the page. Entries should be double-spaced. Include a double-spaced line between the heading and the first entry. See the List of Figures example that follows.

List of Figures

Box and Whisker Plot for Overall Teacher Efficacy 62

Normal Q-Q Plot of Overall Teacher Sense of Efficacy 64

Checklist: List of Figures

- ☐ uses a level-one heading to cue the reader
- ☐ title is formatted correctly
- ☐ each figure of the manuscript is listed and linked to the List of Figures
- ☐ page numbers are correct
- ☐ figures are listed in the order presented in the document
- ☐ includes the correct Roman numeral page number

How to Write the List of Abbreviations

The **List of Abbreviations** lists all the abbreviations and acronyms that are found in the manuscript. This list will enable the reader to easily check the meaning of each abbreviation or acronym. The title of this page should be a level 1 heading, centered, located one (1) inch from the top of the page. Include a double-spaced line between the heading and the first entry. Entries should be double-spaced, listed in alphabetical order, and left justified. Each term is listed on a separate line with the term listed and followed by the abbreviation in parentheses. See the List of Abbreviations example that follows.

List of Abbreviations

National Center for Education Statistics (NCES)

Teacher Sense of Efficacy Scale (TSES)

Overall Teacher Efficacy (OTE)

Continue with other relevant abbreviations.

Checklist: List of Abbreviations

- ☐ uses a level-one heading to cue the reader
- ☐ all abbreviations found in the manuscript are listed
- ☐ are presented in alphabetical order
- ☐ is left justified and double-spaced
- ☐ one term per line is listed with the abbreviation in parentheses
- ☐ includes the correct Roman numeral page number

Conclusion

The front matter of a quantitative research manuscript provides a lot of information in relatively few pages. The information needs to be written professionally and concisely to communicate in as few words as possible. The front matter begins with a professionally presented Title Page. The Title Page is followed by the Signature Page, which is followed by the Abstract. The Abstract will include a brief synopsis of the study and will be completed after the research concludes. Next is the Table of Contents with two levels of headings that include the names of the chapters, the titles of certain pages, and the major sections in each chapter. If included, optional pages, including the Copyright, Dedication, and Acknowledgments pages, will follow. Next is the List of Tables, List of Figures, and List of Abbreviations. The front matter offers a first impression; thus, it must be presented professionally and concisely.