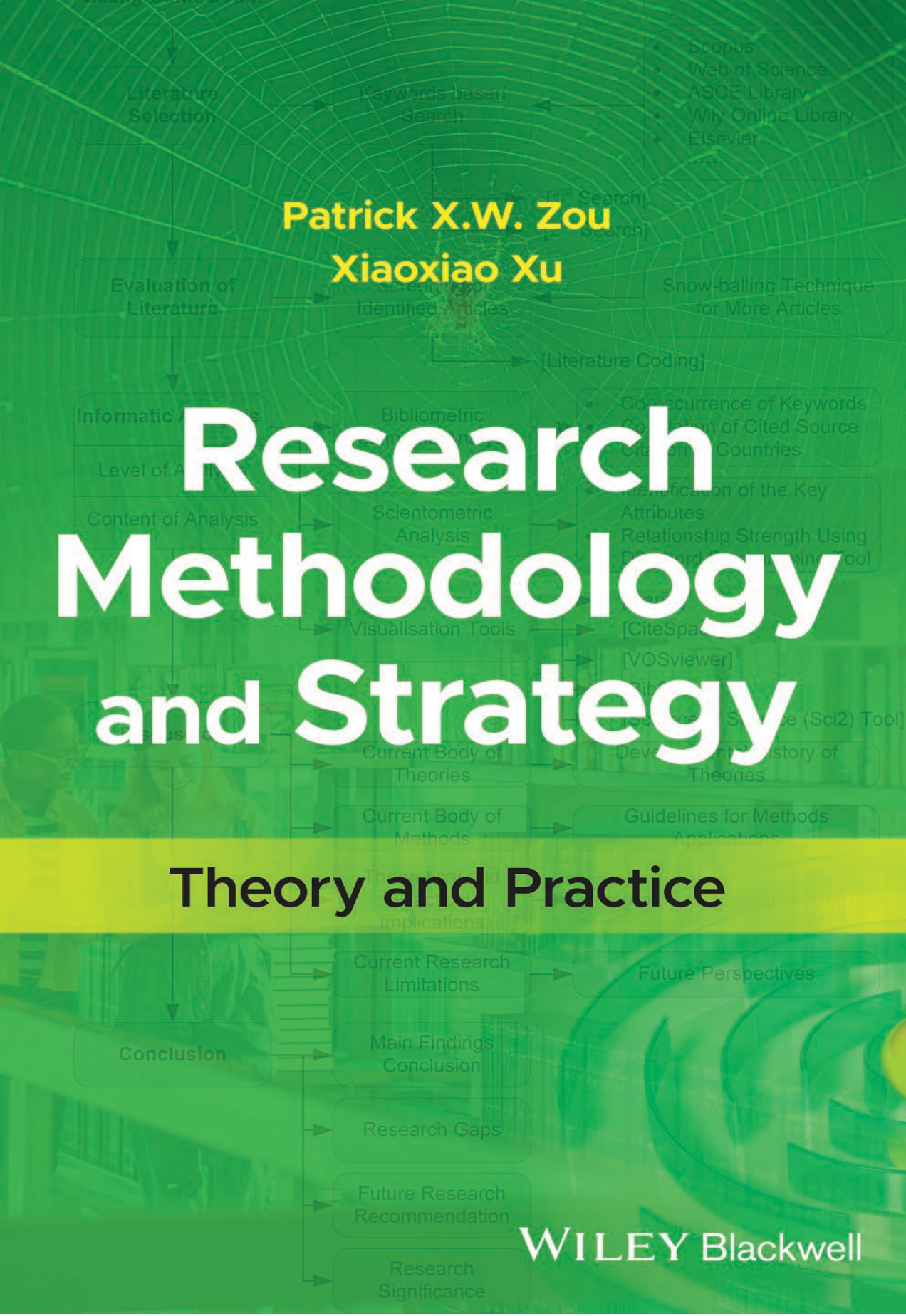

Patrick X.W. Zou
Xiaoxiao Xu

Research Methodology and Strategy

Theory and Practice

WILEY Blackwell

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Contents

Foreword

Professor Andrew Dainty

Developing a research design and methodology for any study is one of the most fundamental decisions any researcher can make, and one which challenges many, particularly at the outset of their careers. Questions such as how to identify appropriate research problems and define research aims, what are the differences between various research methodologies and paradigms, what factors inform the choice of methods and how to publish impactful research outcomes are common questions that concern most researchers, and are those that this book sets out to answer.

Researcher Methodology and Strategy: Theory and Practice is different from many other books as it contains research methodology and strategy in one single volume. This book comprehensively describes research methodologies and approaches including qualitative research, quantitative research, and mixed methods approaches. It also discusses new emerging research methods such as technology-enabled experimental research methods and data-driven research methods. In addition, it explains emerging ideas such as the fifth research paradigm: hybrid natural-social sciences methods research, an exciting development in methodological thinking.

This book also provides comprehensive strategies for implementing research, including journal article writing and publishing, thesis writing, operating at the research–practice nexus and knowledge coproduction. It therefore provides practical guidelines for improving research theoretical and its impact.

I have known Professor Patrick X.W. Zou for many years, having collaborated in research that has achieved significant outcomes, including award-winning papers. He has developed a book suitable for students to improve the depth and breadth of research knowledge and skills, for researchers to improve research thinking and strategies, and for practitioners to improve knowledge coproduction and practical performance and I commend it to you.

Good luck with your research!

Andy Dainty

Professor Andrew Dainty, PhD
Pro-Vice-Chancellor
Manchester Metropolitan University, UK

Foreword

Professor Chimay J. Anumba

The need for appropriate use of research methods has been growing in importance over the years. In fact, many universities now have compulsory research methods courses that all postgraduate students have to take as part of their advanced studies and research. These students rely on a wide range of books to find the most relevant for their research.

Professor Patrick Zou and his colleague, Xiaoxiao Xu, have written a comprehensive book on *Research Methodology and Strategy: Theory and Practice*, as their contribution to enhancing understanding of research methods and strategies. It is different from other similar texts in the way that it goes from basic definitions of research to traditional and modern research approaches and then to thesis and journal article writing, and the importance of impact and citation of research outcomes. It also addresses the gap between research and practice, and includes review questions and exercises at the end of each chapter.

The book provides a very good introduction to the fundamentals of research and the key topics covered within the book. It fully describes qualitative, quantitative, and hybrid research methods, and provides guidance on their use and how to avoid the main criticisms associated with them. It also provides appropriate examples, as needed, to illustrate and/or emphasize the key points. Case studies, which are now very widely used are also well covered. A new topic that is not covered by many current books on this subject is 'Technology-Enabled Experimental Methods', which discusses electroencephalography (EEG) and eye tracking, and the context for their experimental use. The book also discusses the importance of data, data quality, and data analytics – all of which are now of considerable interest to the research community. The authors also introduce the Fifth Research Paradigm, which involves hybrid natural and social sciences research.

An important feature of this book is the coverage of research writing – both thesis and journal papers – and some of the issues involved in getting published. This is a welcome addition and will be of tremendous benefit to young researchers. The discussion of the gap between research and practice is also a novel feature that will enable researchers and practitioners to understand how best to bridge the gap, and enhance our collective knowledge.

Overall, this is a much-needed and timely book that will be invaluable to both researchers and practitioners. It would be a great text for the numerous research methods courses that I mentioned at the outset. I commend it to all those interested in improving their research and research outcomes, and making an impact.

Professor Chimay J. Anumba, BSc, PhD, DSc, Dr. h.c.,
FREng, CEng, FICE, FIStructE, FASCE, NAC
Dean, College of Design, Construction, and Planning
University of Florida, USA

Foreword

Professor Lieyun Ding

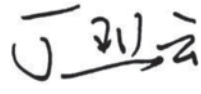
The world we live in is complex, as are the natural and social problems we face. This is coupled with rapid development and constant change, and the increasing application of emerging information and communication technologies and data science. Traditional research methods have become insufficient in decision making, and in identifying, analysing, and solving complex problems. A series of questions continue to beset researchers: What methodologies should I apply? What methods do I use? What strategies should I take?

This book, *Research Methodology and Strategy: Theory and Practice*, focuses on not only research methodologies but also research strategies. It includes key aspects of scientific research and provides contemporary research methods and strategies to improve the efficiency, quality, and impact. There are several unique features: the development of the fifth research paradigm framework, technology-enabled research methods, data-driven research methods, and emphasis on the research–practice nexus and knowledge coproduction as well as a longitudinal perspective of research from conceptualization to long-term impact.

This book is easy to understand, learn from, and then apply the theories and techniques and practice them in different research contexts. It provides numerous contemporary theories and practical guides and examples. It will be of great value for higher degree research students to learn research methods and thesis writing, for researchers to improve research quality, outcomes, and impact, and for practitioners to improve the theoretical underpinning of their practice.

This book is a condensed reflection of Professor Patrick X.W. Zou's over 20 years of rich experience and knowledge in researching, teaching, and supervising from the frontline of research and practice.

I highly recommend this book to researchers, students and practitioners.



Professor Lieyun Ding, PhD
Academician, Chinese Academy of Engineering
Former President, Huazhong University of Science and Technology, China

Foreword

Professor Dongping Fang

Research mainly aims at fulfilling humankind's curiosity, solving problems, and developing strategies for the advancement of society and improvement of the natural environment. How to define research problems and aims? How to select research methods? How to publish research outcomes and improve research impact? These are common but key issues that require answers when undertaking a research project.

This book provides the answers to these questions. Not only so, the book also helps readers improve the depth and breadth of their research thinking and capability. This book explicitly discusses the fundamental concepts, theories, and techniques as well as practical processes, and uses numerous examples to explain different research methods in a simple and straightforward manner. Readers will also gain an in-depth understanding of research process, from problem formulation to outcomes publication and improving research impact.

Out of the many unique features, I am particularly impressed with the technologies-enabled and data-driven research methods as well as research strategies that cover thesis writing, journal article writing, submission, responses to reviewer comments, and monitoring publication impact. I am also impressed with the chapters discussing strategies on improving the research–practice nexus and knowledge coproduction. There are many worked examples and diagrams to explain the complex concepts and techniques.

I have known the lead author Professor Patrick X.W. Zou for more than 20 years, and I have also had the honour of collaborating with him. This book draws from Professor Zou's rich experience and knowledge of research, practice, and student supervision, in methodology and strategy.

I strongly recommend this easy-to-read book to anyone who wishes to learn research methodology and strategy, and improve research productivity, quality, and impact.

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Dean, School of Civil Engineering
Tsinghua University, China

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Last but not least, we express our deepest gratitude to our families for their enduring and selfless love and support.

Professor Patrick X.W. Zou, *PhD*
Associate Professor Xiaoxiao Xu, *PhD*
Xi'an, China

1

Fundamentals of Research

1.1 Introduction

The advancement of human society is dependent on creating and applying new theory and new knowledge. This is achieved through research, which in turn requires the application of methodology and strategy.

Research is defined as the detailed study of a subject, especially in order to discover information or reach an understanding (Cambridge Dictionary), or an endeavour to discover new or collate old facts by the scientific study of a subject or by a course of critical investigation (The Oxford Encyclopaedic English Dictionary). It is a systematic process of collecting, analysing, and interpreting data to increase understanding of a phenomenon. Specifically, it is the systematic, controlled, empirical, and critical investigation of hypothetical propositions about presumed relations among natural or social phenomena. Research is a combination of experience and reasoning and is regarded as an approach to the discovery of truth, where experience leads to knowledge and understanding through day-to-day living and reasoning is a method of coming to a conclusion by the use of logical argument.

The main objectives of engaging in research are to develop new theory or support existing theory, and to create new knowledge. Theory is a statement about a phenomenon or a set of statements describing the interrelationships of the elements within a phenomenon, while knowledge is the understanding of or information about a subject that researchers get by experience or study.

Quality research can bring a range of social, cultural, and economic benefits locally and globally, leading to social development and productivity and economic improvement. At an individual personal level, successfully undertaking research could be a major development and achievement. It is an opportunity to master different research methods and methodologies, develop decision-making and problem-solving capabilities, and develop personal attitude, skills, and knowledge (ASK), which leads to a more professional approach and career opportunities.

This chapter introduces the characteristics and cornerstones of research, philosophical assumptions, general research process, different research paradigms and methods, theory development methods, research ethics, and an overview of the book's contents and its unique features.

Research Methodology and Strategy: Theory and Practice, First Edition. Patrick X.W. Zou and Xiaoxiao Xu.

1.2 Characteristics of Research and the General Research Process

Research should have the following characteristics, as stated by Leedy and Ormrod (2013):

1) Originates with a research question or a problem; in other words, it is guided by a specific research problem, question, or hypothesis.
2) Divides the principal problem into more manageable subproblems.
3) Requires clear articulation of a research goal (i.e., the aim of the research).
4) Rests on certain critical theories.
5) Requires a specific plan to proceed.
6) Requires collection, analysis, and interpretation of data in an attempt to resolve the problem that initiated the research.
7) Is cyclical; there is no obvious end point because research encourages follow-up studies.

The term 'research' implies several elements: (i) the methodology, which includes the basic and critical theories, hypothesis, principles, and the logic of the research being undertaken; (ii) the research process and operational procedure; and (iii) detailed operational technique and tools for collecting and analysing data. The general research processes and steps are visualized in Figure 1.1. This diagram outlines a cyclical process of research, informed by literature and theories. With the problem being addressed through research, there is room for new research thinking to arise.

1.3 Cornerstones of Research

For research to be convincing and understandable to readers, it must follow certain research rules. In general, successful research has clearly defined and discussed elements.

1) Concept

A research concept is a set of meanings or characteristics associated with specific events, objects, conditions, situations, and behaviours in general, such as building energy consumption, organizational behaviour, corporate culture, and stakeholders. The success of research arguably depends first and foremost on the clarity of the concept and how

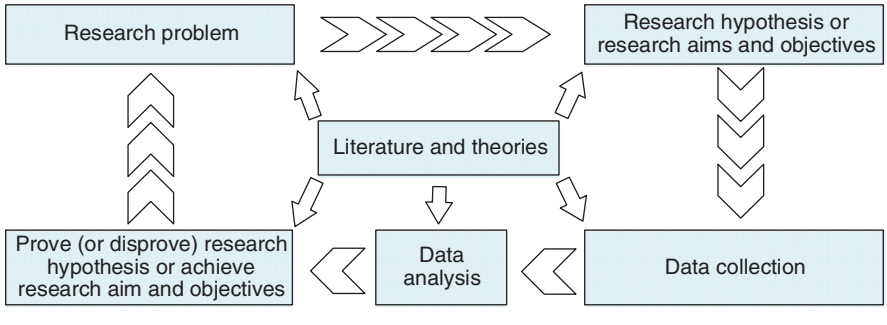

Figure 1.1 General research process.

others understand the concepts used. In some cases, the researcher may come up with a new concept, but this requires the researcher to define the concept clearly so that the reader understands the concept, and to maintain the strength and validity of the study.

2) **Theory**
   The Cambridge Dictionary defines theory is a formal statement of the rules on which a subject of study is based or of ideas that are suggested to explain a fact or event or, more generally, an opinion or explanation; this definition applies directly to research theory.
3) **Model**
   A research model is a formal representation of a practical problem or an object or law after abstraction. The difference between a model and a theory is that the role of a theory is to explain, whereas the role of a model is to demonstrate. A model is an important means of testing a theory.
4) **Construct**
   A research construct is an idea invented specifically for the purpose of a particular research or theory construction.
5) **Variable**
   In research, the variable is a specific value used to measure concepts or constructs.
6) **Proposition**
   A research proposition is a statement of concepts (variables) and relations between concepts (variables), used at the beginning of research design.
7) **Hypothesis**
   Hypothesis is a statement that attempts to explain phenomena or facts but has not yet been proven. Chapter 3, Section 3.1.1 expands upon this.

Apart from the above-mentioned cornerstones and elements, there are also other cornerstones of research, as shown in Figure 1.2. These elements and cornerstones are located in one of the three different phases of a research: conceptualization, operationalization, and measurement. Figure 1.2 also shows relevant components and methods which may be required to implement the research.

1.4 Philosophical Understanding of Research Methodology

It is important for researchers to clearly explain the philosophical assumptions that provide a foundation for the chosen research topic or problem before selecting a research methodology (Creswell and Clark 2017; Zou et al. 2014). Researchers' worldview (also known as paradigm) is the core of philosophical assumption. Thus, researchers need to be aware of the implicit worldviews they bring to their research (Creswell and Clark 2017). Worldviews directly affect assumptions the researcher makes about reality and the way to obtain knowledge (Creswell and Clark 2017).

There are four main types of worldviews applicable in research: positivism, postpositivism, constructivism, and pragmatism. Positivism believes that knowledge is based on natural phenomena, which is unbiased and cannot be affected by researchers' subjective view (Macionis and Gerber 1999). Positivism is associated with quantitative methods. As an amendment to positivism, postpositivism states that the subjective view of the researcher can influence

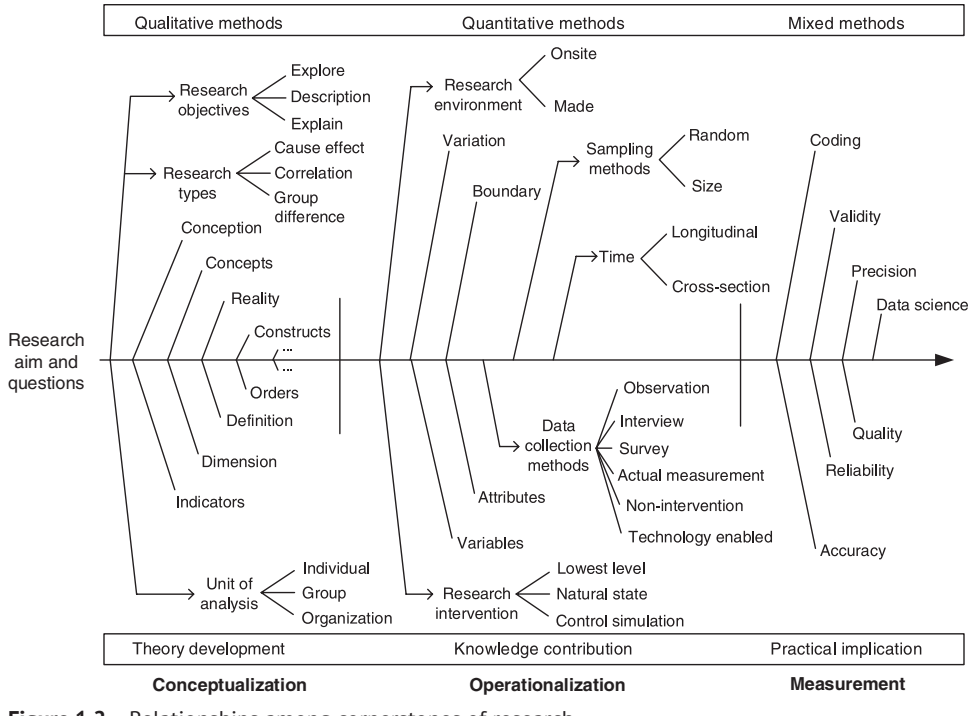

Figure 1.2 Relationships among cornerstones of research.

what is observed (Seaman 1995). To pursue objectivity, postpositivists use checks to recognize the possible effects of biases and eliminate them. Similar to positivism, postpositivism is also associated with quantitative methods. Contrary to positivism and postpositivism, constructivism is a worldview that is made up of the understanding and meaning of phenomena formed through the person being researched and their subjective view. It is believed that researchers and persons being researched are dependent on each other. Creswell and Clark (2017) pointed out that, in constructivism, researchers start with views of the persons being researched and build 'up' to patterns, theories, and generalizations. Constructivism is associated with qualitative methods. Due to the opposition of the worldview, there is a protracted debate between positivism (and postpositivism) and constructivism, which in turn has evolved into a conflict between qualitative and quantitative research methodologies. Under this background, pragmatism was born. Pragmatism is problem-oriented, believing that any method that can solve the research problem is a good method. With the support of pragmatism, mixed methods approaches have been developing rapidly in recent years.

To help readers gain an in-depth understanding of worldviews, five main philosophical considerations in research are discussed (Creswell and Clark 2017; Tashakkori and Teddlie 1998) below.

1) **Ontology** studies the nature of reality; researchers with different philosophical assumptions could have different views on the nature of reality. For example, positivism believes singular reality while constructivism believes multiple realities.
2) **Epistemology** explores the nature of knowledge, justification, and the relationship between cognition and reality.

3) **Axiology** examines whether researchers include biased perspective or not.
4) **Logical inference** focuses on the way to acquire knowledge, including induction and deduction.
5) **Rhetoric** concentrates on the language of research. For positivism, a formal style with clear definition of variables is used. In contrast, constructivism adopts an informal style, e.g. description.

Based on the above five philosophical considerations, researchers can recognize the philosophical assumptions that might underpin their particular research task, and use this to select a methodology, as proposed in Figure 1.3.

According to different worldviews, there are three common research methodologies: quantitative, qualitative and mixed methods, detail information is present in the following sections.

1.5 Qualitative Research Methods

Qualitative research emphasizes words and meanings rather than quantification in the collection and analysis of data (Bryman 2016). It develops interpretive narratives from the data in an effort to capture the complexity of those phenomena. Qualitative research tends to be subjective, where researchers begin with open minds and immerse themselves in the complexity of a situation before interacting with research participants. Data might be collected from a small number of participants, who are able to speak about the investigation topic. After sufficient data are collected, variables and theories are then drawn from the data, explaining the phenomenon in that particular context, which may or may not be generalizable (Leedy and Ormrod 2013). There are different qualitative research methods, such as ethnography, grounded theory, case study, phenomenology, narrative inquiry, and content analysis. Qualitative research is classified as a first research paradigm aiming at understanding a phenomenon. Readers who are interested in learning and applying these methods are encouraged to undertake further reading.

Chapter 2 discusses the definitions, steps, and methods for data collection and analysis in qualitative research. Particular emphasis is given to interviews as a method for data collection, including criteria for data sampling, because it is still a commonly used method. Emphasis is also given to data analysis methods, such as grounded theory, content analysis, and artificial intelligence (AI)-based qualitative analytical methods.

1.6 Quantitative Research Methods

Quantitative research typically tries to measure variables in a numerical way by using standardized instruments with the purpose to establish relationships among variables. This is the dominant methodology in natural science research and social science research. The process involves determination of concepts, variables, and hypotheses at the beginning of the research, which are tested after data have been collected. The data are collected from a population or from samples that represent the population so that research findings may be generalizable (Leedy and Ormrod 2013). The general process of quantitative research is shown in Figure 1.4.

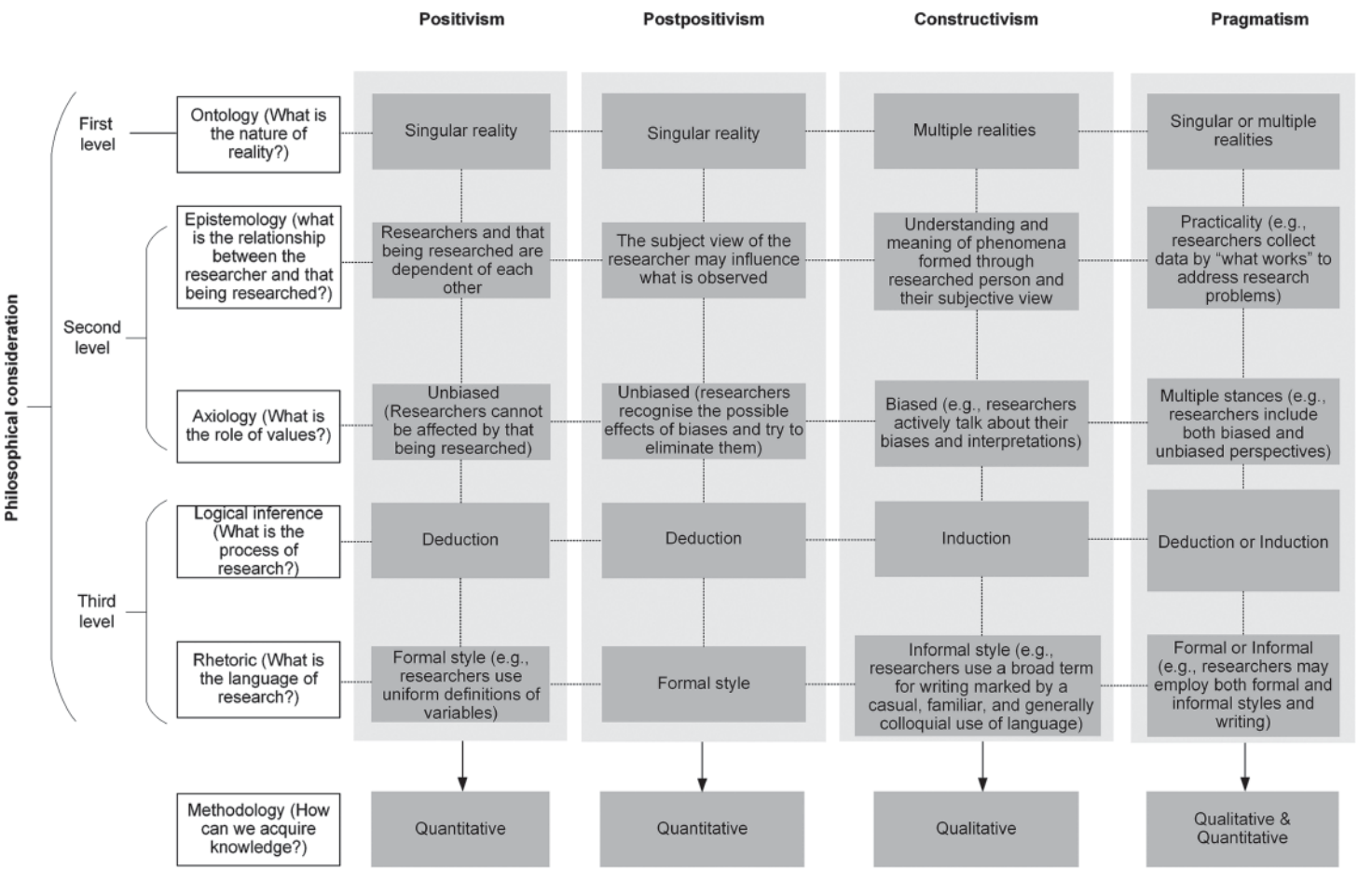

Figure 1.3 Methodology selection based on philosophical considerations.

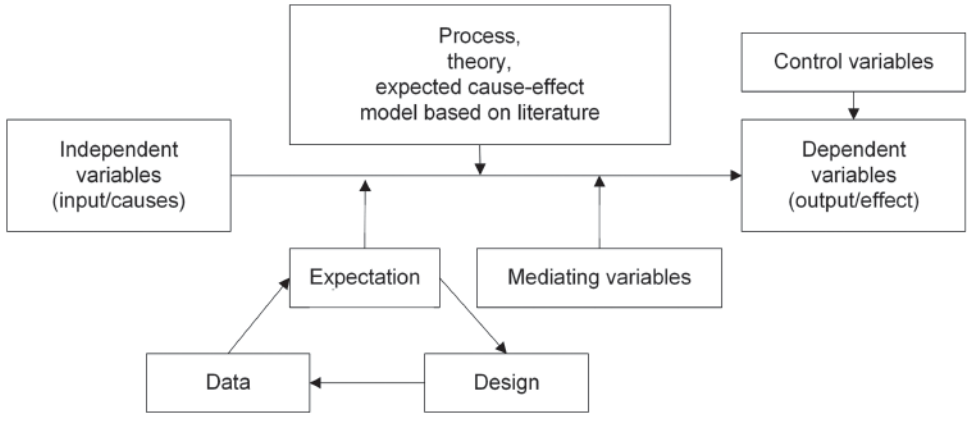

Figure 1.4 General process of quantitative research.

There are many methods of quantitative analysis, such as: statistical description, analysis of variance, meta-analysis, logic regression, multivariance analysis, correlation, factor analysis, principal component analysis, cluster analysis, nonparametric tests, and structural equation modelling. Chapter 3 discusses development of hypothesis, variables, and several methods of data analysis that are frequently used in quantitative research, including system dynamic approach, social network analysis method, interpretive structure modelling method, agent-based modelling, and data mining methods.

1.7 Mixed Methods Research Design

Mixed methods research design refers to a type of research that integrates quantitative and qualitative methodologies within a single research design. Many researchers believe that qualitative research and quantitative research methodologies complement rather than rival each other, and thus, qualitative research can compensate for the weaknesses of quantitative research and vice versa (Cooper and Schindler 2008). There are four aspects in deciding mixed methods research design: formative, paradigm debate, procedural development, and advocacy as separate design.

Bryman (2016) articulates that there are three approaches to mixed methods research: (i) triangulation: the use of quantitative research to corroborate qualitative research findings or vice versa; (ii) facilitation: one research methodology employed to aid research using the other research methodology; (iii) complementary: two research methodologies are employed so that different aspects of an investigation can be merged. However, there are also other methods of classifying the mixed methods. For instance, Creswell (2009) divided the mixed research into triangulation, embedded, explanatory, and exploratory through the relationship between qualitative and quantitative methods in the mixed research. The key to understanding mixed methods is to clearly articulate the relationships and functions of the two methods used in one single research design. Table 1.1 provides guidelines on the needs (when), the reasons (why), and the types (how) of using mixed methods research design.

Table 1.1 Guides for applying mixed methods research design.

Needs (when)	Reasons (why)	Types (how)
One form of data is insufficient by itself	To bring together the strengths of both QN and QL research to compare results or to validate, confirm, or corroborate QN results with QL findings	Triangulation design (convergence data transformation, validation of quantitative data, multilevel)
A second form of data is needed to enhance the study	There are different questions requiring different data	Embedded design (experimental correlational)
QN results are inadequate by themselves	QL data are needed to help explain or build on initial QN results.	Explanatory design (follow-up, participant selection)
QL results are inadequate by themselves	QL data are only an initial exploration to identify variables, constructs, taxonomies, or instruments for QN studies.	Exploratory design (instrument development, taxonomy development)

Note: QN – quantitative, QL – qualitative
Source: Adapted from Creswell, 2009.

Mixed methods research design is being used more and more as research problems and questions become increasingly complicated and complex, leading to the fact that one single research method is insufficient in solving the research problem or answering the research question. However, mixed method research design raises the challenge of finding the best way to mix the two different methods together and how to ensure the data collected are objective rather than subjective. There is also the potential that findings might be opposite or not complement one another. In addition, there may be concerns about the time-consuming nature of this method as it designs a mixture of qualitative and quantitative methods in many phases of the research process. Another important point for discussion is the indistinct boundary between social science research and natural science research under the mixed method research design. Mixed method research design arguably uses natural science methods to solve social science problems.

Chapter 4 examines mixed method research in great detail and depth, from definitions, mixed method research design process, and examples.

1.8 Technology-enabled Methods and Data-driven Methods

There are two main drawbacks of the research methods described above. Human bias may be embedded in the process of data collection and analysis. In addition, there is the time-consuming nature of these methods. With development of new emerging information and communication technology (ICT) and data science as well as artificial intelligence (AI), recent research has attempted to make use of these in research.

One main consideration is the use of ICT for data collection to cover the entire population or try to achieve objective data. For example, instead of asking how people act or behave in a given context, these actions or behaviour could be automatically captured and recorded using computer vision technologies (video cameras, scanners, etc.). Such