RESEARCH METHODS IN THE HEALTH SCIENCES
RESEARCH METHODS IN THE HEALTH SCIENCES

Deborah Zelizer, Kathleen McGoldrick, and Deborah Firestone

First Edition
For our students.

Your commitment to making the world a better place as the next generation of clinical and non-clinical healthcare providers is a constant source of inspiration.
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With an extra special thank you to Francesca Prainito for spearheading the students’ review of the book.
The authors of this text are faculty who teach a required 200-level research methods course in an undergraduate major, the Bachelor of Science in Health Science, in the School of Health Technology and Management, at Stony Brook University. We have taught this course for several years and during this time have reviewed numerous books, but we have not found one that is written at the appropriate undergraduate level and adequately provides a comprehensive review of the designs and methods most frequently utilized in health science research. As such, the creation of this text is informed by our experience teaching research methods to over a thousand health science students.

The uniqueness of this textbook is twofold: its purpose/scope and structure. It is written for clinical and non-clinical health science/health professions students. The purpose/scope of this textbook is not to prepare students to conduct original research; rather it is to develop a broad working knowledge of research processes across methodologies. Some professional accrediting bodies (e.g., dosimetry) have required, and others are beginning to discuss requiring, research methods in the curriculum. As such, it is our intention that this text will be useful to other two-year and four-year colleges that offer professional allied health degree programs. Feedback from our clinical students revealed that this working knowledge prepared them to understand physicians and staff at rotation sites where research was conducted. Our non-clinical students, who were admitted to masters’ and doctoral level health career programs, shared that this introductory course prepared them to be successful in graduate-level research courses or evidence-based practice courses.

This brings us to our second point, structure. This text blends broad content (at the undergraduate level) with tips and exercises to help students with multiple learning styles effectively engage with the material. Simply put, health professions students need to engage with course material beyond memorization and the rote recitation of facts and utilize more complex thinking levels and skills (e.g., application of knowledge to novel situations, synthesis of material). To that end, each chapter includes field-tested tips on how to study effectively based on students’ learning style(s) and self-directed learning activities students can use to help develop higher-order thinking skills. Anecdotally, we have had numerous students express gratitude that the explicitly embedded learning style–based study tips in our research course yielded more effective study skills that were transferable to other courses. Below are two examples that are representative of the feedback we have received from our students on course evaluations:

- *The [VARK] evaluations she did at the beginning, it really helped me learn about how to study better. I learned how I best learn and study ... made me excited to learn.*
- *I found it most valuable that [the professors] introduced how people learn differently. I was able to identify my learning method and truly thrive in this class by configuring my notes and strategies in studying.*
Additionally, we had a group of senior-year students from different learning styles volunteer to review the textbook (see the acknowledgment page); they provided substantive improvement feedback for the first edition of this book. All stated without exception:

- I really like this textbook I wish I had this when I took the class.
- This textbook would have made research methods so much easier to understand.

**VARK**

This text will utilize Dr. Neil Fleming’s VARK model to conceptualize how people learn. Dr. Fleming (1995) categorized four learning styles/modes: visual (V); aural (A); read/write (R); and kinesthetic (K). His example of what a student's class notes would look like illustrates the differences between each. A visual (V) student’s notes might look more like a colorful art project than typical formatted class notes; the lecture notes of a student with a preference for reading and writing (R) might resemble a verbatim transcript of the lecture that includes word and letter patterns (mnemonics) of important concepts. The aural (A) student’s notes are dismal; the student is so engrossed in listening to the professor that they forget to take notes, while the kinesthetic (K) student’s notes feature the real examples and stories the professor has told to illustrate points (Fleming, 1995, pp. 308–313). Dr. Fleming has an on-line test that will help students identify their learning style: [http://vark-learn.com/the-vark-questionnaire/] Dr. Fleming’s website [http://vark-learn.com/] includes a more detailed review of each learning style and numerous mode-specific suggestions on how to study. A summary of the characteristics of each learning mode is found in Table I.1 (Fleming, 2017).

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<td>V Learning = image based (e.g., material has pictures, graphs, tables, charts).</td>
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<tr>
<td>Studying = needs to use symbolic tools, such as arrows, color-coding, flowcharts, graphs, models, mind maps, and hierarchies to represent course material.</td>
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<td>A Learning = verbally based (e.g., listening to lecturer and small/large group discussion).</td>
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<td>Studying = needs to hear the course material to understand the course material; should ask to borrow an R student’s notes, should read out loud to self while studying privately and join a study group to talk out the concepts or teach someone the concepts.</td>
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<tr>
<td>R Learning = textual based (e.g., books, handouts, notes, lists).</td>
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<tr>
<td>Studying = needs repetition in reading and rewriting notes to learn, requires supplemental reading material, prefers attending professor’s office hours to joining a study group.</td>
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<tr>
<td>K Learning = tactile, sensory based (e.g., lab activities, role-play, case studies).</td>
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<tr>
<td>Studying = needs practical applications and interaction with material, needs to move while studying, especially while reading.</td>
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While VARK technically is not a learning style theory, it does include assessment of other factors that influence learning (e.g., motivation; social, physical, and environmental elements).

There are hundreds of research studies on the applicability of VARK in a variety of student populations. Research conducted in the United States and internationally with health science/health professions students has documented that a significant number are multimodal, meaning the students have two or more predominant learning styles (Balasubramaniam & Indhu, 2016; Gebru, Nasrabadi, Nigussie, & Kahsay, 2016; James, D’Amore, & Thomas, 2011; Lujan & Dicarlo, 2005; Mon, Fatini, Ye, Barakat, Jen, & Lin, 2014; Prithishkumar & Michael, 2014; Meehan-Andrews, 2009). Practically, this means that students must utilize each mode-specific strategy to learn. The research also suggests that simple awareness of learning styles, without embedding learning style–specific teaching strategies, has not yielded enhanced student learning outcomes (Liew, Sidhu, & Barua, 2015), while embedded teaching strategies intentionally developed across learning styles (Alkhasawneh, Mrayyan, Docherty, Alashram, & Yousef, 2008; Fleming, 1995; Meehan-Andrews, 2009) or coaching on study methods matched to learning style(s) (Kumar & Chacko, 2012), was associated with increased student learning outcomes.

Learning preference studies conducted with health care patients have also found that a significant number of patients are multimodal learners. For example, in additional to auditory methods, “incorporating kinesthetic methods of learning, such as role plays and problem-solving case scenarios, into standardized asthma education curricula may be beneficial to patients and families in terms of understanding and using their regimen” (Dinakar, Adams, Brimer, & Silva, 2005, p. 683). A randomized controlled study demonstrated that patients’ retention of diabetes education increased significantly when educational materials were targeted to both health literacy levels and learning style preferences (Koonce, Giuse, Kusnoor, Hurley, & Fei, 2015). Another randomized control study found a statistically significant improvement in self-care behaviors in patients’ living with type 2 diabetes when the patient education was targeted specifically to learning style (Moghadam, Araghi, Bazzi, Voshani, & Moonaghi, 2017).

Additionally, it has become more common on intake forms to ask patients how they would like to receive information on a diagnosis or receive patient education. For example, patients are asked to list their preference(s) with regard to how they would prefer their physician communicate with them.

Would they prefer the physician:

- draw a diagram;
- verbally explain it to them;
- provide handouts and brochures to read; or
- use a model that they can touch?

Once the physician, nurse practitioner, or physician assistant explains the diagnosis or treatment plan, it is often other members of the health care team who are called upon to reinforce the information with the patient or the patient’s family, underscoring the importance of exposing students to the concept of learning styles.

It is our goal that the activities found at the end of each chapter will supplement instructors’ in-class teaching and activities and provide students with ample (self-directed and learning style–specific) exercises to foster a deep connection to the material.
REFERENCES


GENERATING NEW KNOWLEDGE: CONCEPTUALIZING AND PLANNING RESEARCH

INTRODUCTION
It is important for students studying in the field of health science or a related health care profession field to have a basic understanding of the research process. Research is the driving force behind improving patient care and advancing health care knowledge and practice. The purpose of this chapter is not to prepare students to conduct original research; rather it is to develop a broad working knowledge of research processes across methodologies.

The word research is used in a variety of ways in higher education. For example, a professor requires students to write a research paper; the students work with a research librarian to optimize search terms, or the students use their phones to research the hours the library is open. Similarly, the term health science is used in numerous contexts; for example, a health science professional, a health science major, or the health science building. Therefore, an operational definition of how both terms will be used within this book is required.

HEALTH SCIENCE—DEFINED
The terms health science professionals, health care professionals, and health care providers have been used both interchangeably and distinctly to describe health professionals who fall under the term allied health professionals. According to the Association of Schools of Allied Health Professions (ASAHP), allied health professions are non-nurse and non-physician health care providers that constitute over 60 percent of the health care workforce. The association states that this workforce is required to (ASAHP, 2016, para. 1):

- use scientific principles and evidence-based practice for the diagnosis, evaluation and treatment of acute and chronic diseases; promote disease prevention and wellness for optimum health and apply administration and management skills to support health care systems in a variety of settings.

According to the ASAHP (2016, para. 4), there are over 200 allied health careers. These include but are not limited to: 

- Define at least 30 terms related to the research process;
- Compare basic and applied/clinical research;
- Differentiate among research methodologies;
- Identify the philosophical assumptions among the four research paradigms; and
- Select the research methods best suited to a study’s purpose and methodology.
health administration personnel;
audiologists, speech language pathologists;
physical therapists, occupational therapists;
respiratory therapists;
diagnostic medical personnel (medical laboratory scientists, cytogenetic technologists, diagnostic molecular scientists, histotechnologists, and pathologists’ assistants);
imaging specialists (radiographers, nuclear medicine technologists, etc.);
specialists in cancer diagnosis and treatment (medical physicists, medical dosimetrists, and radiation therapists);
nutritionists and dietitians;
physician assistants;
dental personnel (dental hygienists and dental assistants);
emergency medical personnel (EMTs, paramedics);
exercise science professionals (athletic trainers, exercise physiologists, kinesiotherapists);
health information technologists;
health educators (asthma educators, diabetes educators);
counselors (genetic counselors, mental health counselors, family therapists);
pharmacy personnel (pharmacy technicians and assistants); and
other healthcare providers and support personnel, such as medical assistants.

SCIENTIFIC METHOD AND EVIDENCE-BASED PRACTICE—DEFINED

There are two terms within the ASAHP definition that warrant further exploration: **scientific principles** and **evidence-based practice (EBP)**. Scientific principle is a global term used to describe the utilization of scientific procedures; this term is closely related to an important concept in this book: the **scientific method**. Scientific method, as defined by Merriam-Webster’s (2017) medical dictionary, is the “principles and procedures for the systematic pursuit of knowledge involving the recognition and formulation of a problem, the collection of data through observation and experiment, and the formulation and testing of hypotheses.” The concept of the scientific method will be revisited later in this chapter.

**SIDE BOX 1.1**  Important terms are bolded and italicized the first time they appear, so you may keep a list of these terms to study.
The definition of some terms/concepts will be expanded upon in subsequent chapters.

Sackett, Rosenberg, Gray, Haynes, and Richardson (1996, p. 71) define the term evidence-based medicine (EBM) as the highest level of care a physician can provide patients. They conceptualized EBM as the
conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients ... integrating individual clinical expertise with the best available external clinical evidence from systematic research. By individual clinical expertise we mean the proficiency and judgment that individual clinicians acquire through clinical experience and clinical practice.

In more recent years a new term, EBP, has evolved from EBM. Evidence-based practice includes a wider scope of health care professionals and includes patients as partners in health care delivery, as evidenced by Samonte and Vallente’s (2016, para. 1) definition.

Evidence-based practice is the amalgamation of research evidence, experience and expertise, and patient preferences in the process of clinical patient care. Clinicians bring collected experience, while patients describe personal values and past encounters. These two aspects are combined with clinically relevant research that has been proven with comprehensive methodology to develop the most optimal outcome in the patient’s care process and overall quality of life. EBP can be incorporated into various fields such as medicine, nursing, psychology, and allied health.

In both definitions, the authors make clear distinctions between EBM/systematic research and EBP/research evidence. Systematic research and research evidence are different ways of saying the same thing: all health care professionals (allied health professionals, nurses, and physicians) make individualized patient treatment/care decisions rooted in the results of research studies. Inherent in the definitions of EBM/EBP is the health care professional’s ability to understand the research process so they are able to read, evaluate, interpret, and synthesize the results of research studies.

For the purpose of this book, the definition of health science will be used as an umbrella term to include any health care field where professionals use the scientific method, research results, and EBM/EBP in the delivery of health care services. Therefore, the research examples in this book will span numerous fields in health science and will examine research conducted for the purpose of “diagnosis, evaluation and treatment of acute and chronic diseases, disease prevention, health promotion, patient and health professions education ... [or] best practices in the application of healthcare administration and management skills” (ASAHP, 2016, para. 1).

**RESEARCH—DEFINED**

The Office for Human Research Protections (OHRP), which is located in the Department of Health and Human Services (HHS), defines research as “a systematic investigation, including research development, testing and evaluation, designed to develop or contribute to generalizable knowledge” (OHRP, 2008, p. 2). Utilizing this definition, the term research transforms from describing simple fact finding to describing a systematic process designed to generate new knowledge.

With this distinction made, it becomes clear that the purpose of research is not to increase an individual’s knowledge of a topic; rather its purpose is to increase knowledge for everyone in the field of health science. The OHRP definition also uses the word generalizable to modify the word knowledge. This will be discussed later in the chapter; for now, simply put, research = generation of new knowledge. The combination of the terms research and health science implies that the pursuit of new knowledge will be health related and might involve
Research Methods in the Health Sciences

clients/patients. This necessitates another definition, the definition of human subjects. The OHRP (2008) regulations define human subjects (also known as research participants or simply as participants) as “a living individual about whom an investigator (whether professional or student) conducting research obtains (1) data through intervention or interaction with the individual, or (2) identifiable private information” (p. 2). Regulations regarding conducting research with participants will be more fully explored in Chapter 2.

What Constitutes New Knowledge?

When a researcher has an idea for a research study, the researcher must determine if the idea is indeed research by asking: If this idea is systematically defined and studied, does it have the potential to generate new knowledge? The researcher answers this question by reviewing the scientific literature; this process is called conducting a systematic review of the literature. This is such a vital concept in the determination of whether an idea will meet the definition of research and a critical component in the development of the research study that there is an entire chapter (Chapter 3) devoted to this concept/action step of research.

For now, consider the examples below to understand the steps and thought processes researchers undertake to determine whether an idea meets the definition of research.

Idea: A researcher is walking through the parking lot and someone blows smoke in their face. They start to gag and their eyes water. From this experience the researcher has an idea for a research study: What are the effects of exhaled smoke from an individual smoking a cigarette on the health of others exposed to that smoke? The researcher thinks this could be a very important study.

Literature review: The researcher conducts a review of the scientific literature by going to the library and searching for scientific articles (previous research studies) related to cigarette smoke and health. While reading the journal articles, it is realized that this potential research question has already been answered. The exhaled smoke from a cigarette has already been studied; it is labeled secondhand smoke. Secondhand smoke has been determined to have negative health consequences to those exposed to it. This research topic has progressed beyond secondhand smoke to the study of the negative health impact of third-hand smoke (the toxic chemicals that are left behind when the secondhand smoke dissipates).

Decision: Subsequent to the systematic review of the literature, the researcher realizes that they have increased their personal knowledge, but that conducting this research study will not add new knowledge to the health science scientific community. Thus, the idea fails as a potential research topic. It will not generate new knowledge; it is not research and would not be appropriate for a research study.

Implied in the example above, new knowledge builds on previous knowledge; answering one research question often leads the researcher to new unanswered questions. Thus, research is iterative; it can be seen as an ever-expanding cycle of answered questions that lead to emerging unanswered questions. Hundreds of questions must be asked and answered to develop an expansive and detailed understanding of a research topic. For example, the 2014 U.S. Department of Health and Human Services’ (USDHHS) Surgeon General’s Report:
The Health Consequences of Smoking synthesized 50 years of scientific research on the topic. The number of questions that need to be asked and answered is indeed expansive in the pursuit of new knowledge. Below are only a few summary examples of how the answer of one group of questions leads to the generation of another avenue of inquiry.

- What are the health implications of smoking cigarettes on the lungs?
  - Hundreds of studies building upon the findings of one another lead to the knowledge that people who smoke are “15 to 30 times more likely to get lung cancer or die from lung cancer than people who do not smoke” (Centers for Disease Control and Prevention, 2018, para. 2).
  - New knowledge has been generated, but this answer leads to other unanswered research questions, like ...

- What are the health implications, if any, of cigarette smoking on other organs in the human body?
  - Decades of research studies demonstrated that “smoking leads to disease and disability and harms nearly every organ of the body ... diseases caused by smoking, including such common diseases as diabetes mellitus, rheumatoid arthritis, and colorectal cancer” (USDHHS, 2014, p. 7).
  - New knowledge has been generated, but this answer leads to other unanswered research questions, like ...

- To what extent is the smoke expelled from someone’s cigarette harmful to human health?
  - Numerous iterations of research were conducted to answer this question. Exposure to “secondhand tobacco smoke has been causally linked to cancer, respiratory, and cardiovascular diseases, and to adverse effects on the health of infants and children” (USDHHS, 2014, p. 7).
  - New knowledge has been generated, but this answer leads to other unanswered research questions, like ...

- How effective are tobacco control policies in reducing smoking rates?
  - Various policies were enacted and subsequently researched to answer this question. The evidence “is sufficient to conclude that mass media campaigns, comprehensive community programs, and comprehensive statewide tobacco control programs prevent initiation of tobacco use and reduce the prevalence of tobacco use among youth and adults” (USDHHS, 2014, p. 12).
  - New knowledge has been generated, but this answer leads to other unanswered research questions, like ...

- How effective are smoking cessation interventions?
  - A multitude of interventions were researched to identify the most effective cessation strategies across diverse populations. This cumulative evidence revealed that “tobacco cessation treatments are effective across a wide population of smokers, including those with significant mental and physical comorbidity” (USDHHS, 2014, p. 12).
Over the past 50 years the research has and continues to explore the health consequences of cigarette smoking. As illustrated in the examples above, research has expanded into areas of inquiry on other tobacco products/nicotine delivery methods, exploring the impact of tobacco control policies, and behavioral interventions to reducing tobacco use. Hopefully, the point has clearly been made, research is iterative. Rigorous research not only answers questions that generate new knowledge, but simultaneously generates new unanswered questions to open new avenues of inquiry that can be systematically investigated.

What Are the Components of a Systematic Investigation?
To generate new knowledge, the OHRP definition also states that the researcher must use systematic investigation. Systematic investigation is comprised of numerous components that will be covered in greater detail throughout this book. In this chapter, the focus is on introducing the terms, concepts, and components of a systematic investigation. A systematic investigation includes utilizing approved and predefined sets of procedures, also referred to as design and methods, to conduct a research study. The design of the study is the framework, or roadmap, of how the study will be conducted; this framework includes the procedures (methods) used to conduct the study.

Whittemore and D’Eramo Melkus (2008) described research as a five-stage process: Conceptual, design, empirical, analytic, and dissemination. Table 1.1 is an adaption of these five stages, including the action steps a researcher undertakes during each stage of the research process.

<table>
<thead>
<tr>
<th>TABLE 1.1</th>
<th>Research Stages and Corresponding Action Steps</th>
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Omitted due to copyright restrictions.

Methods
As previously stated, every research study utilizes research design and methods. A comprehensive review of research designs can be found in Chapters 6–10. In this chapter, the
focus will be on defining the three research methods. Every research study employs three research methods: sampling, data collection, and data analysis.

Definition of methods:

1. **Sampling** is the way a researcher recruits or selects individuals from a population to be participants in the study.
2. **Data Collection** is the type of data that will be collected and the procedures/processes a researcher uses to collect data.
3. **Data Analysis** is how the researcher performs the analysis on the data that has been collected.

**SIDE BOX 1.2** Examples of each method, as well as introductory information on the alignment of methods with methodology, are provided in the Methods and Methodology section of this chapter.

**Scientific Merit**

A research study must be conducted by a qualified researcher, meaning that the researcher must have expertise in the research topic area and have the skills to extensively plan and implement the research study. The ultimate purpose of conducting research is to disseminate the results/finding (new knowledge) to the larger scientific community. The **scientific merit** of a study is the combination of the terms research and systematic investigation. First, the researcher must ensure that the proposed research study meets the definition of research. Second, the researcher must ensure that the proposed research study has been constructed in such a way that once the study has been concluded, new knowledge can be gleaned from the results of the study.

All research studies are judged for scientific merit. During the conceptualization stage the researcher reviews all the previous research studies done on a specific topic to identify and create the **problem statement**, which leads to the development of a **research purpose statement and research question(s)**. These three in combination outline, define, and direct the study construction. These terms will be covered in greater detail in Chapter 4. Once the researcher has conceptualized the proposed study, the next step is the design or planning process. This involves selecting the best approved and predefined sets of procedures (design and methods: sampling, data collection, data analysis) used to conduct the study.

Said another way, the study must clearly and concisely identify a problem that is worthy of being investigated and will generate new knowledge (problem statement), have a clear purpose of what the study will accomplish in relation to the problem (purpose statement), and have questions that when answered have the potential to generate new knowledge (research questions). The questions must be investigated by a qualified researcher in a manner (design and methods) that will make it possible to adequately answer the questions. Remember, it is the unbiased answers to the research questions that increase/generate new knowledge.
Review of Scientific Merit

All proposed research studies must be submitted to the scrutiny of an impartial Institutional Review Board (IRB). The primary purpose of the IRB review is to ensure that in a researcher’s zeal for new knowledge, human subjects are being treated ethically. If the researcher is part of a university, typically there is an IRB on campus; if, however, the researcher is not affiliated with an organization that has established an IRB, then the researcher must pay a private IRB company for the review. This is such an important concept and practice that there is an entire chapter (Chapter 2) devoted to ethical research, the protection of human subjects, and the role of the IRB in that protection. Included in the IRB’s review of the proposed research study is the determination of the study’s scientific merit. This review includes an assessment of the researcher’s qualifications (knowledge, expertise, and skills), design of the research study, and implementation plan. One IRB company (Solutions IRB, 2017, para. 9) offers the following questions to assist researchers in the planning phase of their research study. (Note: Some questions have been altered for brevity).

1. Are the procedures consistent with sound research design?
2. Is the study design appropriate given the hypothesis being tested? […]
3. Is the study designed in a manner likely to answer the research questions?
4. Are the research questions aligned with the proposed data collection and analysis?
5. Does the study have the potential to contribute to the field or add to the existing body of knowledge?
6. Will the knowledge to be gained [be] sufficiently important to justify the risks involved?
7. Are the risks minimized and benefits optimized to the extent possible?
8. Does the proposed sample contain [enough] participants […] to result in reliable [and] replicable [results]?

DIFFERENT TYPES OF RESEARCH

Although different types of research (basic and applied/clinical) are conducted for different purposes (exploratory, descriptive, evaluative, and explanatory), all are evaluated for scientific merit. One type of research is not superior to the other; each simply has different goals and purposes.

The two types of research are basic and applied/clinical. Basic research is a type of research that seeks to enhance overall knowledge about the “physical, biological, psychological, or social world or to shed light on historical, cultural, or aesthetic phenomena” (Leedy & Ormrod, 2013, p. 27). Applied research is a type of research that seeks to study issues that have “immediate relevance to current practices, procedures, and policies” (Leedy & Ormrod, 2013, p. 27). For the purpose of this book, applied and clinical research will share a definition with the only distinction being the setting. Clinical research is applied research conducted in the health care arena with the primary focus of finding practical solutions to improve patient care/clinical outcomes.

For example, a basic research study would explore how the human immunodeficiency virus (HIV) replicates in a human cell. This type of study is vital to creating an understanding of the life cycle of HIV, despite the fact it has no direct application to real-world practice.
Clinical research, often building on basic research studies, yields a practical, real-world outcome. For example, is drug X better than drug Y at reducing circulating virus in people living with HIV? The outcome of this study would have direct applicability to improving patient care. Physicians, nurse practitioners, and physician assistants could use the results of this study (EBM/EBP) to determine which drug to prescribe to their patients living with HIV.

There are several global purposes a research study can have; the purpose of the study is directly linked to how a researcher will construct the research question. Chapter 4 will provide guidance on the wording of research question development and examples of research questions written for each purpose; for now, a simple definition of each will be sufficient (Lanier, Ford, Reid, & Strickland, 2014).

- **Exploratory**: Explore or investigate to determine scope of issue or to understand a problem that has not been clearly defined.
- **Descriptive**: Describe the problem (who, what, where, and when; how many?)
- **Evaluative**: How well is this working?
- **Explanatory**: Determine a cause-and-effect relationship.

Simply stated, for a study, regardless of type or purpose, to have scientific merit, the totality of the proposed research study (problem statement, purpose statement, research questions, design, and methods) must be in alignment so it is possible to generate new knowledge. There will be more detailed information on this throughout the book; scientific merit is a concept that is woven through every chapter.

**How Does One Choose the Correct Research Type, Purpose, Research Design, and Methods?**

The answer is simple: a researcher chooses the type, purpose, design, and methods that can best answer the proposed research question(s). Prior to a discussion about research questions, an exploration of a researcher’s philosophical thought processes is warranted. Researchers can have varying philosophical assumptions about the world. These assumptions are foundational to how a researcher will plan and implement the research study. This segment of the chapter discusses these varying philosophical assumptions and links assumptions to research practices.

**PARADIGMS AND METHODOLOGY**

**SIDE BOX 1.3** As you read, reflect on which paradigm and associated research methodology most closely expresses how you see the world. For example:

- Was one of your favorite courses a literature class that required the analysis of symbolism to reveal the underlying truths about the human condition? If yes, you most likely will be drawn to Qualitative research.
- Conversely, was your favorite class a chemistry lab where you conducted tightly regulated experiments that had one correct outcome? If yes, you most likely will be drawn to Quantitative research.

If you are thinking, “I have no favorite; I’d use analysis of symbolism or a lab experiment based on the purpose of the project,” then you are mostly likely drawn to Mixed Methods research.
A researcher’s background and position will affect what they choose to investigate, the angle of investigation, the methods judged most adequate for this purpose, the findings considered most appropriate, and the framing and communication of conclusions (Malterud, 2001, pp. 483–484).

The quote from Malterud (2001) suggests that how a researcher sees the world informs the type of research ideas and resulting research questions a researcher will have. These basic assumptions or the worldview a researcher operates under are conceptualized as research paradigms. Guba (1990) suggests that the determination of one’s paradigm can be found in how one answers the following three questions (p. 18):

1. Ontological: What is the nature of the “knowable”? Or, what is the nature of “reality”?
2. Epistemological: What is the relationship between the knower (the inquirer) and the known (or knowable)?
3. Methodological: How should the inquirer go about finding out knowledge?

The answers to questions about truth/reality (ontology), knowledge (epistemology), and the actions taken in the pursuit of new knowledge (methodology) shed light on the researcher’s paradigm. The researcher’s paradigm is linked to the research methodology a researcher will employ. Methodology, in combination with the type of research question, will delineate the appropriate research design, sampling method(s), data collection method(s), and data analysis method(s) utilized in the systematic investigation.

There are other research paradigms; however, for the purpose of this book, only positivism, post-positivism, constructivism, and pragmatism will be explored. A summary of the answers to the questions Guba (1990) posed is presented by paradigm in the following chart. Source material used to create Table 1.2 is an amalgamation of several authors’ interpretation of the paradigms (Creswell, 2009; Guba, 1990, pp. 18–27; Guba & Lincoln, 1994; Mack, n.d.; Reichardt & Rallis, 1994; Teddlie & Tashakkori, 2009, pp. 4–15).

The positivism and post-positivism paradigms are very similar: both use a quantitative methodology to conduct research. The differences between the two are subtle. The positivist researcher seeks to prove the existence of relationships that are rooted in the immutable physical laws of nature. The post-positivist researcher entertains the possibility that units of measurement are fallible and that it might not be possible to control for all variables; therefore, they hesitate to say (like the positivist) that they have absolutely, undeniably proved something. Rather, the post-positivist researcher sees truth as constructs open to retesting and revision if enough scientific evidence is found. The post-positivist paradigm is the one that governs most health science quantitative research. This stance is very different from the constructivist researcher, whose beliefs espouse that accounts of an event can be equally true or false; the researcher does not need to find one truth but the whole truth gleaned from participants’ experiences. These health science researchers value inductive explorations, believing the most significant evidence cannot be quantified in numerical representations. Constructivists find meaning in the analysis of their participants’ perspectives, which leads to rich, comprehensive, and detailed stories of the central phenomenon (Creswell, 2009). Finally, the hallmark of the pragmatist researcher is to do what works, rejecting the need to
Table 1.2 Paradigms: Assumptions and Methodologies

<table>
<thead>
<tr>
<th>Paradigm</th>
<th>Ontological Assumptions</th>
<th>Epistemological Assumptions</th>
<th>Methodological Assumptions</th>
<th>Research Methodology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positivism</td>
<td>Cause-and-effect relationship can be found, natural laws predict and control events, research should seek absolute truths.</td>
<td>Objective: the researcher can control for bias and must remain objective so the results of the research are free from value and bias.</td>
<td>Deductive reasoning: empirical study (often conducted in a lab) that controls variables and uses rigorous scientific methods to test hypothesis.</td>
<td>Quantitative</td>
</tr>
<tr>
<td>Post-Positivism</td>
<td>Truth exists as a result of natural laws, but perhaps not all the laws are completely understood, therefore one should not say there is absolute truth.</td>
<td>Objective: control for bias and remaining objective is the benchmark, but absolute control for subjectivity and bias may not be achievable.</td>
<td>Deductive reasoning: empirical study that controls variables and uses rigorous scientific methods to test hypothesis but believes research can be conducted outside the lab.</td>
<td>Quantitative</td>
</tr>
<tr>
<td>Constructivism</td>
<td>Reality and truth are dynamic and fluid, there is not one truth; rather there are multiple truths and realities which are rooted in individual and social constructs, meaning what is true for one can be untrue for another.</td>
<td>Subjective: since truth and reality are within individuals, it is the role of the researcher to work directly with individuals to uncover meaning of the phenomenon; the research findings are the result of the in-depth interaction between researcher and participant.</td>
<td>Inductive reasoning: ontology and epistemology become one; constructs are revealed through an iterative process and are expressed in rich textual format. The goal is to generate key findings about the phenomenon which contributes to advancing knowledge.</td>
<td>Qualitative</td>
</tr>
<tr>
<td>Pragmatism</td>
<td>Truth is both governed by natural law and subjective reality.</td>
<td>Objective and subjective: rejects either/or choices; rather the researcher should focus on what works.</td>
<td>Deductive and inductive reasoning: both philosophical assumptions are compatible; one can seamlessly go between multiple types of evidence and analysis to answer a research question. There is no loyalty to either paradigm: Positivism/Post-Positivism or Constructivism.</td>
<td>Mixed Methods</td>
</tr>
</tbody>
</table>


follow only one paradigm. The pragmatist health science researcher views the paradigms and research methodologies as compatible and will use what works by combining methods of data collection and analysis to “generate deeper and broader insights, to develop important knowledge claims that respect a wider range of interest and perspectives” (Greene & Caracelli, 1997, p. 7). Pragmatism allows the health science researcher the flexibility to select designs, techniques, procedures, and data collection strategies that provide practical results for problem-centered research questions (Creswell, 2009; Greene & Caracelli, 1997; Reichardt & Rallis, 1994; Tashakkori & Teddlie, 1998).
Researchers can become entrenched in their paradigm, believing that their assumptions about research are the only correct way of conceptualizing and conducting research. It must be stated that the philosophical assumption underlying the construction of this book is pragmatism. While the authors of this book personally operate under different worldviews (paradigms), all agree that one paradigm is not superior to another.

Also, as shown in Table 1.2, paradigms are linked to research methodologies. Researchers who are positivist or post-positivist use the quantitative methodology; constructivists use the qualitative methodology; and pragmatists use mixed methods (a combination of quantitative and qualitative methodologies). A summary of the characteristics of the three methodologies are presented below (Creswell, 2009; Creswell & Plano Clark, 2011; Merriam, 2009; Teddlie & Tashakkori, 2009).

**Quantitative Methodology:** Research involves the use of deductive reasoning in the collection and analysis of numerical data with the goal of proving, explaining, predicting, testing, describing, or comparing. Based on the purpose of the research, the researcher can use the scientific method and will control, compare, or manipulate variables. Paradigm: Positivism or Post-Positivism.

**Qualitative Methodology:** Research involves the use of inductive reasoning. The researcher drives the data collection, analysis, and interpretation of comprehensive verbal, narrative, and/or visual data in order to gain insights into a particular phenomenon of interest. Paradigm: Constructivism.

**Mixed Methods:** Research asks questions that cross quantitative and qualitative methodologies, often conducting two (qualitative/quantitative or quantitative/qualitative)
studies to gain a more nuanced understanding of the topic. The combination and order of quantitative and qualitative studies are directly related to the purpose of the study and its resulting research questions. Paradigm: Pragmatism.

As previously stated, during the planning stage of a research study, the researcher selects a research design and methods. Certain designs are exclusive to certain methodologies (Figure 1.1), so when a researcher plans a study and selects a design, they are announcing to the scientific community which methodology (paradigm) the researcher is working from.

**DEDUCTIVE VERSUS INDUCTIVE REASONING**

Health care providers use the process of deductive reasoning in providing patient care. For example, a physician assistant (PA) is working with a patient who has a very high fever. The patient just returned from a trip to a tropical region known for having very high rates of malaria. Infection with malaria can cause high fevers. The PA would test the patient's blood for malaria. If the parasite that causes malaria is present, then the presumed diagnosis of malaria is supported. If, however, there is no evidence of the parasite, the PA would begin the process of ruling out other tropical diseases that cause high fever. If all tropical diseases are ruled out, the PA would begin to test for other diseases that cause high fevers until an answer is found. In research, quantitative researchers also use deductive reasoning by employing the scientific method. They begin with a theory, collect data to test the theory, and the results of the data analysis “either supports or refutes the theory” (Creswell, 2009, p. 7). This process is also known as hypothesis testing. When the researcher is able to statistically disprove one hypothesis, it is rejected, and the researcher forms new hypotheses to test until an answer has been found.

Qualitative researchers use inductive reasoning; they apply the findings from a few observations to build a general/global understanding of an issue. Inductive reasoning and/or qualitative research is a common practice when there is a lack of preexisting theory, or in an area that has very little previous research (Creswell, 2009; Merriam, 2009). The findings from these observations are not tested; rather they are offered as an explanation of what is occurring or why something is occurring. It is the reader of the research who determines whether the inductive conclusions apply to their situation.

At times, even quantitative clinical research must utilize inductive reasoning when the full use of the scientific method (experimentation) on human subjects would be impossible or unethical. The following research examples illustrate this point. Silverman, Masland, Saunders, and Schwab’s (1970) work demonstrated how a few observations, when combined, can provide a generalization applied to all cases (Figure 1.2). For example, the observations from this study showed that none of the individuals reported below (n = 2,650) regained brain function after 24 hours of brain inactivity. An electroencephalogram (EEG) is a medical test that measures brain activity. This type of data collection method would fall under quantitative research, yet the following examples reveal an inductive process to interpret and apply the results of a few cases to a larger population.

Green and Lauber’s (1972) research found that only two observations had the ability to expand the understanding of how long a child can have brain inactivity, unrelated to hypothermia or drug use, and still recover brain activity for a period of time (Figure 1.3). It
is clear that the researchers are not stating they proved that all children will recover brain activity after 24 hours of brain inactivity, but inductively these two cases had the power to inform EMB/EBP until more evidence is available to make a definitive determination.

**METHODS AND METHODOLOGY**

As previously stated, a systematic investigation requires the use of the correct methods based on methodology, design, and research question. This concept will be discussed in finer detail in Chapters 4–10, but for now, a thorough understanding of the fundamental differences between methods based on methodology will suffice. Table 1.3 provides the characteristics of each method (sampling, data collection, and data analysis) by quantitative and qualitative methodology. The table also provides a few examples of the different kinds of data that can be collected from the two methodologies. Mixed methods research would systematically use both qualitative and quantitative methods in some combination.

Sometimes the methodology of a research study is not explicitly stated; it is assumed by how the research question is written and by simply stating the research design and methods used in the study that the reader will immediately understand the researcher’s paradigm and the research methodology of the study.
As a rule, quantitative research typically asks very narrowly defined questions that are extensions of previous scientific studies. Conversely, qualitative research typically asks very broad questions to explore a previously uncharted avenue of inquiry. This will be explored in more detail in Chapters 3 and 4. Based on what is known about methodology and methods, let's revisit the research questions introduced earlier in the chapter and apply the appropriate methods to each.

1. What is the meaning of successfully completing a smoking cessation program, transitioning from a state of tobacco dependence to a state of being tobacco free, for 10–20 individuals who have recently been diagnosed with smoking-related cancer? Adapted from Vangeli & West (2012).

2. What are the effects of maternal tobacco use during pregnancy on fetal development? Adapted from USDHHS (2014).

Immediately it becomes clear by the way the research question is written that the first research question is from a qualitative study, while the other research question is from a quantitative study. The first question seeks to uncover the individuals’ personal experiences...
(subjective reality) related to participating in a smoking cessation program (uncover meaning of the phenomenon). This aligns with the qualitative assumptions about how one seeks truth and knowledge. The researcher would use inductive logic working directly with a carefully selected group of individuals (sampling), the researcher might interview participants over the course of several months and ask participants to keep diaries (data collection). The researcher would read and reread transcripts of hundreds of hours of verbal interview data and read hundreds of pages of participant diaries to uncover the common themes of meaning and experience across the 10–20 individuals (data analysis).

The second question clearly needs to use deductive logic. This aligns with the quantitative assumptions about how one seeks truth and knowledge. The researcher would select a large group of participants to include pregnant women who used tobacco products and similar women who did not use tobacco products during pregnancy (sampling). The researcher would have to control for numerous variables (e.g., length of maternal tobacco use, type of tobacco product used, maternal age, diet, frequencies of prenatal visits). The researcher might ask permission to review the results of medical tests conducted during prenatal care; for example, blood tests, amniotic fluid tests, ultrasound tests (data collection) and use several different types of statistical analyses on the data to determine if there were differences in fetal development (data analysis) associated with tobacco use.

**Rigor and Methodology**

While the quantitative and qualitative researcher view the world differently and seek truth in very divergent manners, both types of research approaches are scientific and seek to systemically generate new knowledge. Despite the vast differences in how the study is conducted (e.g., sampling, data collection, and data analysis), each methodology should be viewed as having the ability to conduct rigorous (high-quality) research. Although the concept of rigor is shared by both methodologies, the practices utilized by each to ensure it are very different. Chapter 5 will provide greater detail on the intersecting and analogous practices and procedures researchers of quantitative and qualitative methodologies utilize to ensure rigor.

Now that the concept of methodology has been presented, there is an important point that needs to be revisited: the term _generalizable results_ in the OHRP definition of research. Generalizable results are a comment on how sampling was conducted and to what extent the study results are “likely to apply, generally or specifically, in other study settings” (Kukull & Ganguli, 2012, p. 1886). Generalizability is a concept that is only relevant to quantitative research. This is why the definition of research presented earlier—research = generation of new knowledge—is a much more appropriate definition of research. Removing the word generalizable, the definition becomes inclusive of research conducted under either quantitative or qualitative methodologies. In addition, not all quantitative research studies achieve generalizable results, meaning the results of the study might only be applied to one group and might not be valid for other groups or study settings. Even within quantitative research, there are levels of rigor. Rigor can be determined by an evaluation of the study’s internal and external validity, which will be explained in Chapter 5.
SUMMARY OF MAIN IDEAS AND CONCEPTS

Below is an outline of how all the key concepts presented in this chapter are related. During the conceptualization and planning phase, all researchers ask themselves: Has this study been planned in such a way that the potential to generate new knowledge exists?

1. Research idea: Is it research?
   a. Literature review is used to determine if the research idea, when systematically studied, can lead to creation of new knowledge.
   b. There must be a researchable problem (something that is unknown).
   c. Purpose of research must be in alignment with the research problem.
   d. The research question(s) or hypothesis must align with the research purpose.

2. Planning the research study: Are all components in alignment?
   a. Methodology is selected
      i. Methodology is based on the researcher's paradigm and the nature of the research question(s) being asked.
         □ Quantitative
         □ Qualitative
         □ Mixed methods
   b. Design is selected
      i. Design must be appropriate for the methodology and research question(s).
   c. Methods are selected
      i. Methods must be appropriate for the design and research question(s).
         □ sampling – correct procedures for participant selection/recruitment.
         □ data collection – correct type of data collected in the correct way.
         □ data analysis – correct data analysis procedures/tools are selected.

STUDY PRACTICE

Study tips for all VARK styles: Reducing notes from 3:1 is a recommendation that cuts across all learning styles. Therefore, students from any of the VARK learning styles should start making flash cards for every bolded/italicized term. The important terms/concepts presented in this chapter include:

- scientific principles
- evidence-based practice
- scientific method
- research
- generalizable knowledge
- human subjects
- scientific literature
- literature review

- systematic investigation
- design
- methods:
  □ sampling
  □ data collection
  □ data analysis
- scientific merit
- problem statement
• Some of the concepts in Chapter 1 are expanded upon in later chapters; your definitions of important terms and concepts might need to be amended. Don’t let that hold you back from making cards now. As the definitions or concepts become more complex, your basic understanding of the terms at this point will be a required foundation for the new knowledge to land on.
  ▪ Learning, just like research, is an iterative process!
• Don’t use premade flash cards as they will not help you learn! The process of making the cards yourself by paraphrasing (putting the definitions into your own words) the information found in the chapter will reinforce learning.
  ▪ For example, students have shared with us, “I understood the information while I was reading it but realized I didn’t understand when I took the test.” When you reduce your notes 3:1 by paraphrasing you can easily identify if you understand the material. Simply said, if you understand the content you will be able to paraphrase. If you cannot paraphrase a concept, you have identified content you don’t understand. It is better to find areas that you need clarification on now versus when you sit down to take the exam.

Other study tips:

• V: start making a flowchart of how various components are related. Color code your flash cards based on methodology or how terms relate to one another.
• A: talk out loud to yourself as you create the flash cards and when you use flash cards to study.
• R: many of the concepts presented in the book have been simplified. If you need more detail about the topic, look up the resource material in the reference section. A simple web search might yield conflicting results and confuse you.
• K: make sure you move around while reading; the simple practice of using your finger or pen to trace the words as you read really helps.
Chapter 1  Generating New Knowledge: Conceptualizing and Planning Research | 19

PRACTICE MULTIPLE-CHOICE QUESTIONS

1. Which of the following is the correct way for a researcher to think or act? A researcher should:
   a. use the scientific method to test hypotheses
   b. realize that truth is relative; meaning an account can be both true and false at the same time
   c. be detached, neutral, and objective in order to strictly control all variables
   d. be active and engaged in the research, realizing that all research is value laden
   e. attempt to prove a cause-and-effect relationship
   f. seek a rich understanding of a phenomenon
   g. Any of the above

   The purpose of this study was to explore the experiences women who self-identify as lesbian had with the health care system as their partners prepared to give birth. The researcher purposefully selected 20 women with whom to conduct in-depth interviews. The researcher read and reread transcripts of the verbal interview data to identify common themes among the experiences. The researcher found that being acknowledged as a co-mother to the newborn was the most important finding (adapted from Dahl, Fylkesnes, Sorlie, & Malterud, 2013). Answer questions 2–4.

2. Which methodology did this study use?
   a. Mixed Methods
   b. Applied
   c. Quantitative
   d. Qualitative

3. The in-depth interviews the researcher conducted is how the researcher? __________
   a. sampled
   b. collected data
   c. analyzed the data
   d. achieved scientific merit

4. Reading and rereading the data looking for themes is how the researcher? __________
   a. sampled
   b. collected data
   c. analyzed the data
   d. achieved scientific merit

   Studies have documented that Pre-Exposure Prophylaxis (PrEP) can reduce the risk of HIV infection in people who are at high risk by more than 90% (CDC, 2016). As such, this drug treatment is strongly recommended for people who are HIV-negative and at very high risk for HIV infection. However, insufficient studies have been conducted that explore and describe the experiences of those taking PrEP daily. Further exploration must be conducted to understand the meaning this drug has in the lives of those who are at ongoing risk of HIV infection. Answer question 5.
5. **Which methodology would be used in this study?**
   a. Mixed Methods
   b. Applied
   c. Quantitative
   d. Qualitative

The purpose of this study was to create an integrated care manual for health care providers using the perspectives of patients who are homeless and living with chronic illnesses. The manual was developed from both the results of quantitative survey data and the analysis of in-depth interviews. The combined results identified 14 areas that can enhance provider competency when working with individuals that are homeless. This manual will assist the health care team in providing higher-quality health care to people who are homeless (adapted from the Colorado Coalition for the Homeless, 2013). Answer questions 6 and 7.

6. **What type of research was performed?**
   a. Basic
   b. Applied/clinical

7. **Which methodology was used in this study?**
   a. Mixed Methods
   b. Applied
   c. Quantitative
   d. Qualitative

The purpose of this study was to measure the physiological stress responses of radiologic technology students during their initial clinical rotations. Specifically, the first rotation where the students took images (X-rays) of patients in a familiar setting (radiology department where they had their lab classes) versus an unfamiliar setting (first time taking portable X-rays in the emergency department). Cortisol is a hormone that is related to stress. In this study stress responses were measured using a lab test that measured the levels of cortisol in the students' saliva (adapted from Pottier et al., 2011). Answer question 8.

8. **Which methodology would be used in this study?**
   a. Mixed Methods
   b. Applied
   c. Quantitative
   d. Qualitative

9. **Once a researcher has an idea for a new study, the first thing they should do is:**
   a. Conduct a systematic review of the literature to see if the idea rises to the level of research.
   b. Collect and analyze data, as this is the only way to find out if the idea rises to the level of research.
   c. Consider whether the idea is from the positivism, constructivism, or pragmatism perspective.
d. Submit the idea to the Institutional Review Board (IRB) to see if the idea is ethical.

10. Why do researchers ask themselves this question: Has this study been planned in such a way that the potential to generate new knowledge exists?
   a. This question is used to keep the concept of scientific merit in the researcher’s mind as they conceptualize, plan, design, and conduct the study.
   b. This question is used solely to guide the researchers through the literature review process.
   c. This question is used to keep the concept of scientific method in the researcher’s mind as they disseminate the findings (write the journal article).
   d. This question is used solely to guide the researcher through the process of identifying the paradigm the researcher holds.

**STUDY ACTIVITIES**

You now know enough about quantitative and qualitative methodologies to be able to take the terms presented in Chapter 1 and determine which methodology they belong to.

a. Take a piece of paper and make two columns, Quantitative and Qualitative. Now take your flash cards, and ask yourself: Does the word on this flash card apply to both methodologies or is it limited to one?
   i. If the card applies to both quantitative and qualitative, place it above the paper. If the card is limited to one of the methodologies, then place it in the appropriate column.
   ii. Once you have placed all the cards at the top of the page or in one of the columns, make a hierarchal outline with the cards based on how they are related to each other. This activity will be very helpful to students of all learning styles (reducing notes to 3:1).

b. As a variation on the flash card activity, make a list of terms and words found in this chapter. Now, on a separate piece of paper, write each word/term under one of the headings below.
   Match the list of words, terms, and concepts with the methodologies. For example, under which column would the following words/terms go?
   Scientific merit; sampling; compare two groups; understand; impact; research; paradigm; variables; scientific method; data collection; predicting; rigor; and inductive reasoning.
   Quantitative only Common to both QUAN/QUAL Qualitative only

   c. Advanced activity: Without the use of flash cards
      i. From memory, write the terms in the corresponding columns.
         Quantitative only Common to both QUAN/QUAL Qualitative only
      ii. From memory, write examples of methods for each methodology.
REFERENCES


