UNDERGRADUATE RESEARCH

Elizabeth J. Sandell, Ph.D.

Undergraduate Research Projects: Step-by-Step

By Elizabeth J. Sandell

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Module 1: Introduction to the course

Module Contents

This workbook is intended to complement any individual or group of undergraduate researchers in their investigations. The step-by-step approach will provide understanding and experience with scholarly inquiry. Students will discover content and practice skills related to scholarly inquiry and their academic subjects.

1.1 Workbook organization

This is more a workbook or lab manual than a typical textbook. The modules are organized in a roughly chronological order, step-by-step so the investigation proceeds. However, occasionally researchers are likely to move backward to revisit material needed in order to continue forward. The modules are designed for newcomers to scientific study – usually college students in their first or second year in academic work - working with a more experienced researcher or faculty member. The content of the modules should be applicable to an undergraduate program of study in academic disciplines related to: education, social services, psychology, communications, management and organization, and other human sciences. The workbook format will guide individuals or groups through a project during an entire academic year, beginning with the research proposal and ending with presentation or manuscript. Work might be accomplished in a course context or independently. If the individual or research teams work approximately 9 hours per week, then each module may take two or three weeks to complete. The workbook includes a series of modules.

- Module 1: Introduction to the course
- Module 2: Introduction to undergraduate research
- Module 3: Get started in undergraduate research
- Module 4: Identify a research problem or question
- Module 5: Search for scholarly literature
- Module 6: Responsible conduct of research
- Module 7: Design the methodology
- Module 8: Recruit research subjects

- Module 9: Collect data
- Module 10: Analyze quantitative data
- Module 11: Analyze qualitative data
- Module 12: Write literature review
- Module 13: Discuss results
- Module 14: Disseminate results: Make presentations and posters
- Module 15: Disseminate results: Write reports and articles

1.2 Course learning goals

As a result of this work, students should increase their knowledge in:

- A variety of research approaches and terminology.
- Ethical principles about academic honesty and research with human subjects.
- Appropriate scholarly standards for evaluating evidence.
- How research is situated within broader academic and professional contexts.

As a result of work in this course, students should be able to:

- Articulate and refine the question for inquiry.
- Identify and use resources to foster understanding and inquiry.
- Organize project activities.
- Manage time.
- Coordinate team members.
- Respond respectfully to others who have different ideas and values (critical thinking, active listening, evaluating, synthesizing, negotiating).
- Use software related to word processing, data analysis, and reporting.
- Communicate with academic audiences (speaking, listening, reading, researching, writing, public speaking).
- Work harmoniously with other students, faculty and other research assistants.

- Communicate the results of the project for a specified audience.

1.3 Resources needed

Partners along the way will support the work of the student researchers: mentors, librarians, statisticians, Institutional Review Board for research with human subjects, etc. Student researchers will also need computers, access to the internet, word processing software, data spreadsheet software, presentation software, statistical programming, online communication platforms, etc.

1.4 About the author

Elizabeth J. Sandell is a professor in the College of Education at Minnesota State University, Mankato, MN. She received her B. A. (Social Work), M. A. (Educational Administration), and Ph. D. (Curriculum and Instruction) from the University of Minnesota. She has journeyed to all 50 US states and to 6 continents. Her research agenda includes development and evaluation of approaches to multicultural and diverse education in USA and in the Russian Federation.

Figure 1.1 Author Elizabeth J. Sandell [1]

Between 2007 and 2019, Dr. Sandell mentored more than 70 undergraduate and graduate students (including students from Russia, Azerbaijan, Moldova, Belarus, Ghana, Nigeria, Ivory Coast, Philippines, Venezuela, and Mexico). Members of her undergraduate research teams have presented oral and poster sessions at the Minnesota State University, Mankato Undergraduate Research Symposium, Minnesota Posters at the Capitol, the National Conference on Undergraduate Research, the Minnesota Undergraduate Scholars Conference, and the 2019 World Congress on Undergraduate Research. Her mission is to teach, organize, and host people in transition, so they grow in faith and hope, control their own decisions and resources, and use their gifts and talents. Mentoring university students in undergraduate research is one way she follows her mission.

Image credits

[1] Sandell, E. J. 2019.

Module 2: Introduction to undergraduate research

Module Contents

Figure 2.1 Research team at NCUR 2018 - 6. [1]

2.1 Introduction

No matter what your academic emphasis might be, research as an undergraduate student is tremendously valuable ... not to mention, it's fun! Research experiences in any subject will give you opportunities to learn about research techniques, to apply what you learn in the classroom, to explore past investigations, and to build relationships with faculty members, other students, and professionals in your areas of interest. This module will take you step-by-step into beginning your own project with a faculty mentor.

2.2 Module learning goals

In this first module, you will:

- Understand the intent, organization, and learning goals of this course.
- Consider definitions and beliefs about *science* and *research*.
- Learn about the educational, professional, and personal benefits of conducting research.
- Know your own reasons for conducting research.
- Begin your own research journal.

2.3 Key terms

Stop and think about: The ideas of science and research are sometimes intimidating and sometimes exhilarating.

We might get more comfortable with key terms by considering metaphors for their meanings. A **metaphor** is a figure of speech in which a word or phrase is applied to an object or action to which it is not literally applicable. Sometimes metaphors help us reach deeper meanings and understandings.

Figure 2.2 An array of question marks [2]

For example: Research is like a *question mark* because *it helps us answer our questions about the subject, process, or discipline and how it might be changed and improved. It also sometimes presents even more questions to answer with more research.*

Science is *a body of knowledge* about a specific discipline or subject area. And science is also *a systematic process* used to examine and organize the world around us. Those who practice science ask questions such as "what?" and "why?" and "how?" and use data to answer those questions.

We all use science every day. What kind of toothpaste shall I use? How can I get a promotion at work? What grade will I get in this class? Will people like my new outfit? If those who practice science organize their investigations systematically, they are researchers.

Research is *a systematic investigation* used to collect data to answer questions posed by scientists, to establish consistent understandings, and to reach new conclusions. Different types of research provide different understandings and conclusions.

Applied research is carried out for practical applications and problem-solving functions.

Participatory or action research has a problem-solving function for social justice to benefit people who are powerless or marginalized. Participatory action research involves community members as co-participants to make their own decisions and take action, to improve their own lives.

Basic research is carried out to discover something simply for the sake of knowledge to improve our understanding of the world, and for academic rather than commercial purposes.

Program evaluation collects information in order to judge the value or usefulness of specific, ongoing programming. Usually, it occurs in community settings that cannot and probably do not want to control for number of participants or to randomly select those who receive services. Carried out to gauge the relevance, suitability and effectiveness of a specific (public relations or other) campaign or program, being implemented. Also: evaluation research.

Evaluation research is carried out to gauge the relevance, suitability and effectiveness of a specific (public relations or other) campaign or program, being implemented. Also: program evaluation.

Formative research is research that occurs before a program is designed and implemented, or while a program is being conducted.

Summative research is conducted at the end of a project and is used to determine the project's success. It can also gauge customer satisfaction or aid in the development of future projects. Also: conclusion research.

Experimental research studies *the effect of a particular approach or treatment*. The experimental research design identifies conditions or situations about which the investigators want to reach some conclusions. Usually, the researchers create an artificial environment, so they can safely manipulate the situation. This enables them to reach conclusions about the impact of those conditions or situations.

Variable is the observable or measurable counterpart of a construct describing how a researcher will measure the construct. It has a set of values assigned to it and can be either quantitative or qualitative.

Independent variables are the treatments, conditions or situations that the investigators manipulate to influence the people, animals, plants or things.

A **dependent variable** is influenced by the treatments, conditions or situations (the independent variables).

Confounding variables influence both the dependent *variable* and independent *variable*, causing a false or misleading association.

Treatment group of subjects is the group of participants or objects that experience the particular treatments, conditions or situations.

Control group of subjects is similar to the treatment group, but not exposed to the same treatments, conditions or situations.

The **research question** is the overall question, problem, or topic that the researcher wants to answer.

The **hypothesis** is the tentative conclusion that the investigators expect to reach.

A **theory** is based on several related hypotheses that form *an organized set of ideas* that describes, explains, and predicts behavior.

2.4 An overview of research

Watch the four-minute video to get acquainted with some of the terms used in research. Then, complete the matching task to practice some of the definitions mentioned in the video.

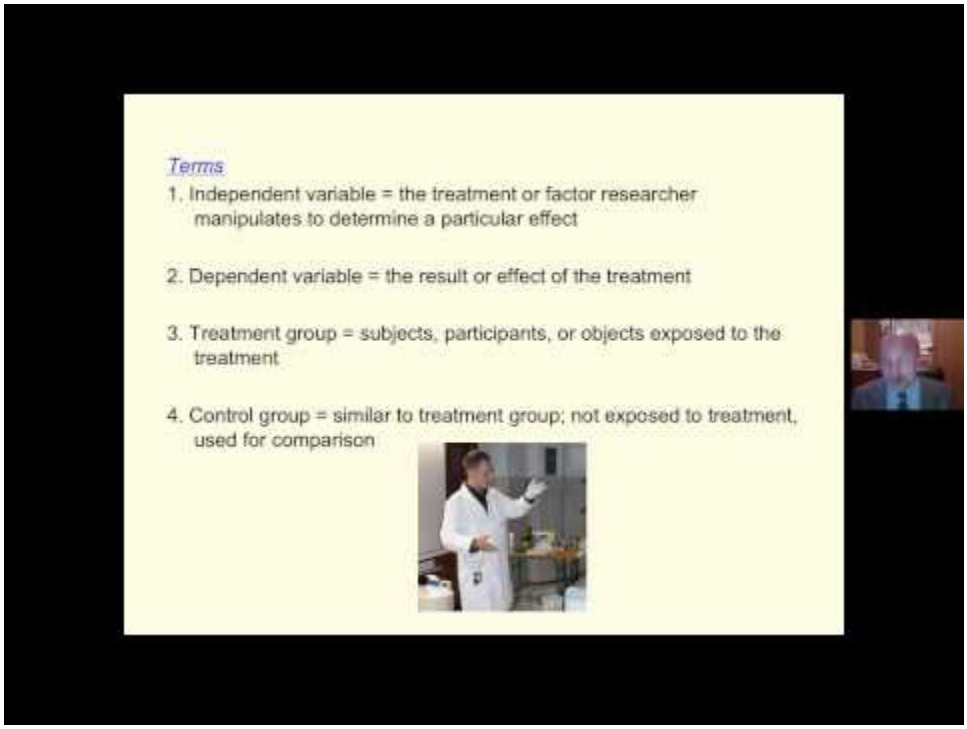

Figure 2.3 Research in Education: Overview. A. P. Johnson. 2014. Source: YouTube.

Stop and think: Match the definitions with key terms.

2.5 Reasons for research

Here are some comments from students about what they learned through their experiences in undergraduate research.

- *I learned a lot about academic research, so I am thinking about going to graduate school.*
- *I learned to be organized with all the research material.*
- *I learned something about designing research projects.*
- *I learned that it's best to be well-read on background and what the research entails.*
- *I learned about following procedures with human subjects in research.*
- *I learned to be confident in the ways I present my research to other professionals.*
- *I feel like what we are doing really is influencing teaching in the community.*
- *I feel that without research projects (and trial and errors) that we cannot improve the community.*
- *Stop and think about: There are many positive reasons for research.*

Educational benefits

- Apply concepts from university courses to 'real life' situations.
- Get involved in research typically only available to advanced graduate students and faculty members.
- Gain further creative achievements; learn about issues, methods, and leaders in a field of study.
- Learn how to learn in a new way.
- Develop specific skills that will help later to design and conduct scholarly research projects.
- Earn scholarships and awards and grants.
- Sharpen problem-solving skills.

Professional benefits

- Learn content and skills from faculty mentors.
- Enhance communication skills.
- Explore potential careers.
- Develop leadership skills.

- Learn a wide variety of research approaches and terminology.
- Practice high-level project planning skills.
- Acquire letters of recommendation.
- Network with others who share your interests.
- Make or contribute to a discovery.
- Prepare for graduate school.
- Practice presentation skills.
- Learn technical skills.
- Set yourself apart from the crowd.

Personal benefits

- Build confidence.
- Develop ability to work independently.
- Enhance awareness of ethical issues.
- Grow as a critical thinker.
- Interact with others in small groups.
- Make new friends.
- Develop organizational strategies. Increase self-motivation. Improve self-reliance.
- Practice time-management skills.
- Have fun!

Here are some of the tasks of research: Generate data, conduct experiments, create an annotated bibliography, write a review of the literature, administer surveys and questionnaires, interview research subjects, find primary source materials, maintain laboratory equipment, and transcribe interview. With all these activities (and more!), we need to have good reasons for research.

2.6 Real-world application: create your research journal

Figure 1.4 Research Journal [3]

Your research journal (also known as a 'log') is a notebook used to record thoughts and observations related to your research: such as insights, brainstorming, interpretations, diagrams, quotes, scores, questions, or chronological notes about your research project. All this can become data for analysis and for reporting.

Your journal will help you keep track of every step and every decision in your study. You will want to write reports so that any other researcher could recreate your study exactly, if presented with the same context. This applies to good proposals, too. Any funding organization should be able to recreate in detail the various components of your study.

Purpose

The journal is a record of everything about your research contemporaneously. It is not for notes on your readings, although you may find some quotes or you might make some reflections based on your readings. It is not for your

supervisor, your peers, or your professor, although you may choose to share some ideas with them along the way. Write what *you* want to write. You do not need to worry about perfection, validity, or correctness of the ideas.

The journal encourages the practice of writing. You need not be absolutely confident about your ideas. Sometimes just the process of writing will help clarify your ideas. Confusions and connections become more clear as you write. Some research projects are long. If you record all your activities and thoughts about the project, you may use some of the ideas in the final report.

Format

Locate a notebook that inspires you: a spiral notebook, an artist's sketchbook, a 3-ring binder, a moleskin journal, a composition book, etc. Find a pencil or pen that feels just right. Start your research journal now. Number each page.

Keep everything in one notebook and keep it in chronological order. Use headings to be clear about topics. Keep track of every step and every decision. You want to maintain records so that any other researcher could recreate your study exactly.

Enter topics and page numbers in an index in the back of the notebook.

Your journal may read like a diary sometimes. Even personal events can shed light on your project. Remember, no one else has to see this except you. There may be some messes and mistakes, but there will be some gems of writing.

Note: Your journal might not go directly to the written stage. You might choose to talk into a recording device. Some researchers record audio notes before and after they make observations or interview research subjects. Later, they may listen to the recordings and selectively transcribe notes into their written journal.

Begin the journal

Begin your own research journal by taking these steps:

Step 1: Locate a notebook that inspires you.

Step 2: Find a pen or pencil that feels just right.

Step 3: Number each page.

Step 4: Create a title page that names your journal and your contact information (in case of loss).

Step 5: Create space for an index at the back of the notebook (the last 6 pages).

2.7 Journal entry

Date the first page (for your entry today). Write for 5 to 10 minutes about your thoughts within module 1. This time, describe some of your beliefs about research, as well as some of your reasons for doing research. Your journal entries will lead you farther into completing documents related to your research project.

2.8 In summary

In this module, you have started the journey of research. You have:

- Recognized the intended course and student outcomes.
- Learned about the organization of this workbook.
- Realized some of the initial resources needed for this work.
- Considered the definitions of *science* and *research*.
- Created your own metaphor for the concept of *research*.
- Explained your current beliefs about research.

- Learned about the educational, professional, and personal benefits of conducting research.
- Described your own reasons for conducting research.
- Described in your own words the terms science, pseudoscience, research, and action research.
- Learned about the practical use, content, and format of a research journal.
- Started your own research journal.

Add to your resume: Contact Information

Your name
Your address with zipcode
Your telephone numbers and email
Your LinkedIn address

References

Johnson, A. P. 2012. A Short Guide to Action Research**.** New York, NY: Pearson. ISBN: 9780132685863.

Johnson, A. P. 2014. [Video file]. Research in Education: Overview. Mankato, MN: Minnesota State University. Accessed 5 June 2019.

Image credits

[1] Sandell, E. J. 2018. Research team at NCUR 2018 - 6. [Photograph]. Used by permission.

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Module 3: Get started in research

Module Contents

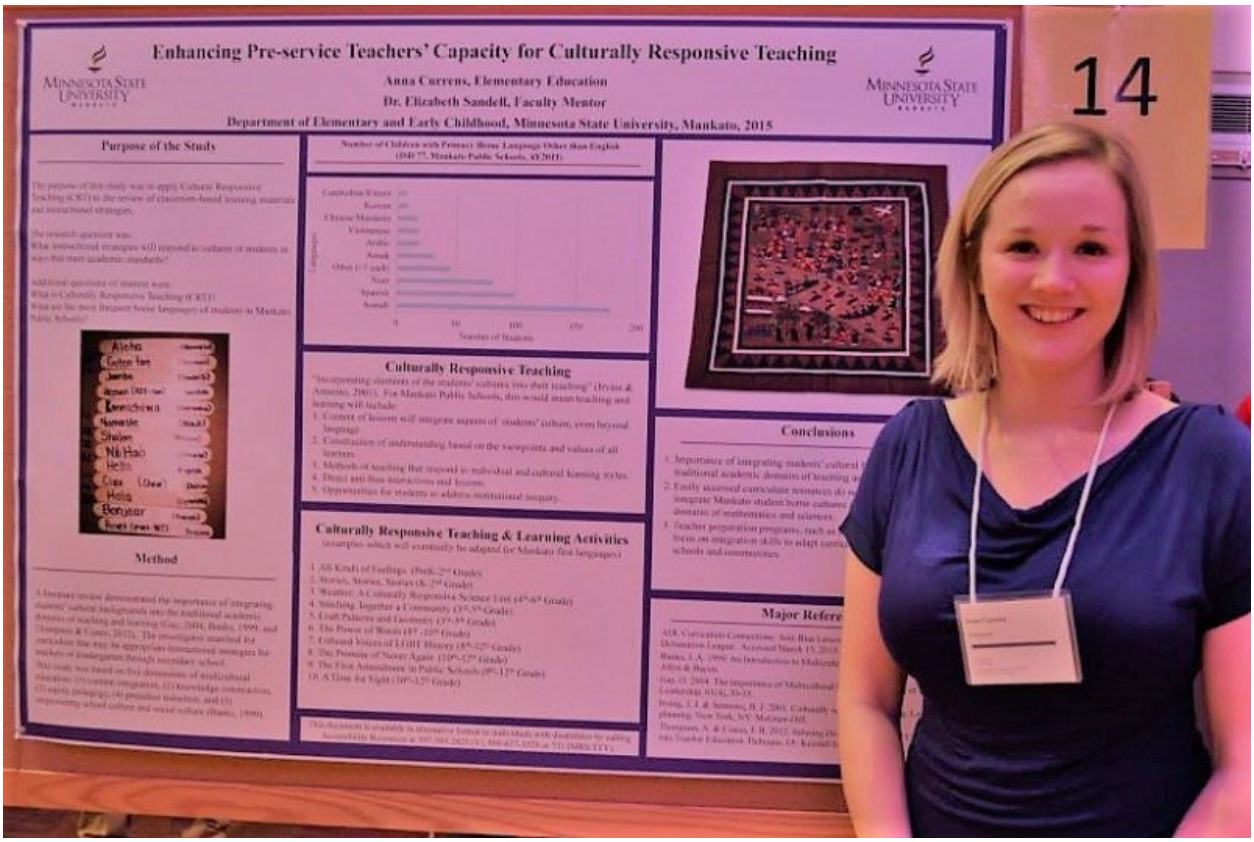

Figure 3:1 Research team at URS 2015 - 1. [1]

3.1 Introduction to module

This workbook is meant to guide students through participating in research projects in education and the social sciences... step-by-step.

"The White Rabbit put on his spectacles. 'Where shall I begin, please your Majesty?' he asked. 'Begin at the beginning,' the King said gravely, 'and go on till you come to the end: then stop.'" (Carroll, 1832 - 1898, Chapter 12).

And when we work our way through a project step-by-step, it's best to start at the beginning. So, we are going to begin at the beginning: establishing a mentor-mentee relationship between faculty member and undergraduate student. In **Module 2**, we suggested that one of the professional benefits to undergraduate research was learning content and skills from faculty mentors. Such more experienced faculty members are critical to introducing new researchers to the roles and skills of academic and scientific investigations.

3.2 Module learning goals

Undergraduates seeking a research opportunity should complete activities in this module in order to:

- Learn about different models of research.
- Understand expectations held by a research mentor.
- Identify opportunities for working with a faculty mentor.
- Practice the etiquette about contacting professors about research collaboration.
- Make initial contacts with possible research mentors.
- Begin participation in a scholarly project.

3.3 Key terms

Mentor is a faculty supervisor who takes on the responsibility of teaching the beginning researcher the skills, knowledge base, and culture of that discipline.

Mentee is a person who is advised, trained, or counseled by a mentor.

3.4 Determine the research model

Undergraduate research can mean *learning about* research, *assisting with* a mentor's project, or creating a new research project. Foster and Usher (2018) have described three levels of research that may be scaffolded so that undergraduate students make progress in understanding and accomplishing scholarly and creative effort. Each level builds on the previous level/s.

Level 1: Discovery - Students begin to understand the value of knowledge and how it is generated and communicated. The Discovery Level is *learning about* research. Activities may include listening to lectures and reports of research completed by other persons, practicing literature searches, learning

the steps in laboratory-based investigations, and studying statistics. At this level, students are not engaged in the research project itself.

Level 2: Inquiry - Students are actively engaged in the elements of scholarly inquiry, with or alongside a more experienced faculty mentor. The Inquiry Level is *practicing the processes* of research. Activities may include shadowing more experienced researchers, replicating the steps in research, practicing various types of inquiry (interviews, etc.), analyzing data, synthesizing scholarly investigations, and preparing reports.

Level 3: Creation - Students actually create an original or authentic scholarly project through a research- and scholarship-intensive experience. The Creation Level is *initiating, designing and completing* the research. Activities include imagining and initiating the project, with only occasional consultation with the faculty mentor.

3.5 Expectations of mentors

Undergraduate research is a partnership between a faculty member (or mentor) and a college student (or mentee).

The research partnership may be initiated by a student who looks for a faculty mentor or by a faculty member who wants to add undergraduate students to a research team. For the best possible experience with your mentor, study these tips and general mentoring resources that are adapted from Monte, 2001. Generally, faculty mentors share the following expectations for undergraduate researchers.

Desire to Learn - Demonstrate your commitment to curiosity and expanding your own knowledge.

Self-motivation - Show your ability to work independently. Do not expect your mentor to prompt you to show up or finish a project.

Communication Skills - Report about your progress and seek advice when you have a problem or make a mistake.

Time Commitment - Some mentors expect that you work regular hours each week or that you commit to several semesters for the project. Clarify the time and procedures for recording your hours.

Honor and Standards - Be an active and reliable participant in the research experience. Observe standards of academic integrity, your profession's code of ethics, and the university's code of student conduct.

Research Ethics - If your project uses human subjects, animal subjects, or dangerous materials, or if you will use data collected from or about people, you and your mentor probably need approval from the Institutional Review Board (IRB) or similar agency.

Coursework - Some mentors may prefer that you have already completed a specific course or courses. Be sure to discuss coursework requirements with the professor you consider.

Course Credit - Some mentors may prefer that you enroll in course credit for your research project. Learn about the requirements in your department. Many colleges offer an elective or required course. If your project will last more than one term, be sure to find out how to enroll in multiple courses.

3.6 Real-world application: Locate a faculty mentor

You may take the initiative to connect with a mentor. Start as early in your academic career as possible. Connecting with a faculty member offers the possibility of working with them for several years.

Preparation

Before you approach a professor, do your homework to be sure they are interested in research projects in which you might be interested.

Figure 3.2 Identify an undergraduate research mentor. Center for Engaged Learning. 2014. Source: YouTube.

- Talk to some of some of your favorite faculty members from the past. For interesting class topics, ask your professors if they are doing research in those areas.
- Visit with guest lecturers to find out about research opportunities. You may get some leads to other researchers in related areas.
- Look to your student peers as resources. They may know of openings on research teams.
- Search databases for possibilities.
- Read professors' profiles on the web pages for their academic departments.
- Examine the professor's web site: view their biographies, research focus, and publications.

- Search for key words on the university’s web-page.

Contact a faculty member

After you identify one or two possible research mentors, prepare an email or letter to introduce yourself:

- Be professional. Use a formal, respectful tone. Avoid phrases such as "please get back to me as soon as possible."
- Address the message to 'Prof. Scholar' or 'Dr. Researcher' (except insert their surname after the title).
- Include information about yourself, such as any relevant courses or previous research experience.
- Describe why you are especially interested in their mentoring.
- Briefly state your own interests and topics you want to examine.
- Be enthusiastic and express thanks for the professor's consideration.

Note: Do not take rejections personally. Often faculty members have other commitments, such as sabbatical leave or projects with other students. If a particular professor cannot work with you, perhaps he or she can suggest another collaborator.

Figure 3.3 Research team at URS 2017 - 2. [2]

Prepare for meeting with a potential mentor

- Recall what caused your interest in this topic (such as, past courses, family and friends, life experiences, and so forth).
- Check your work commitments and course commitments to estimate the time you have available. Be realistic.
- Describe the experiences and skills that you can add to the project.
- Dress professionally.
- Ask questions about the project (goals, design, etc.), your workload, and the next steps.

Stop and think:

- Be willing to begin. Your mentor will encourage you to gain skills and experiences. Try out any opportunity for learning.
- Be open, confident, excited, and relaxed. Your interests and ideas will make a difference in the project.
- Be curious. Ask questions: "what," "why," "how?"
- Be trustworthy. Fulfill your tasks completely and on time.
- Be accountable. Provide clear and timely progress reports.
- Be reflective. Consider how the project challenges you, what surprises you. Speculate on the reasons for decisions and results.
- Be thankful. Express your appreciation to your mentor, to other team members, to the project participants.

In many cases, a mentor continues to contribute to a mentee's development even after the completion of the research project. Mentors can offer advice or recommendations for graduate school and career options. They can help students network with other scholars in their field. This relationship is worth the investment of time and energy.

3.7 Journal entry

Date the next blank page (for your entry today). Write for 5 to 10 minutes about your thoughts and work within module 2.

1. Describe the research model that you want to use.
2. Tell the story about your search for a faculty mentor.
3. Make notes about the conversations you have had with one or more potential faculty mentors.
4. Speculate on what will happen next.

3.8 In summary

In this module, you have taken an important first step in the journey of research: you have prepared and possibly even contacted a faculty mentor. After completing this module, you should now:

- Understand three different models of research.
- Understand expectations held by a research mentor.
- Identify opportunities for working with a faculty mentor.
- Follow the etiquette about contacting professors about research collaboration.
- Make initial contacts with possible research mentors.
- Know the next steps for entering into the mentor's research project.

Add to your resume: Summary of qualifications

I am an undergraduate student in Elementary Education at Minnesota State University, Mankato with an expected graduation date of June 2020. I have completed course work in Human Relations in a Multicultural Society, Introduction to Sociology, and Research. My cumulative GPA is 3.65 on a 4-point scale. Since Fall 2018, I have been on the research team for Dr. Elizabeth Sandell, PI, on questions related to cultural competence of undergraduate students.

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Image credits

[1] Sandell, E. J. 2015. Research team at URS 2015 - 1. [Photograph]. Used by permission.

[2] Sandell, E. J. 2017. Research team at URS 2016 - 2. [Photograph]. Used by permission.

Module 4: Identify a research problem or question

Module Contents

Add to your resume: Education

References

Image credits

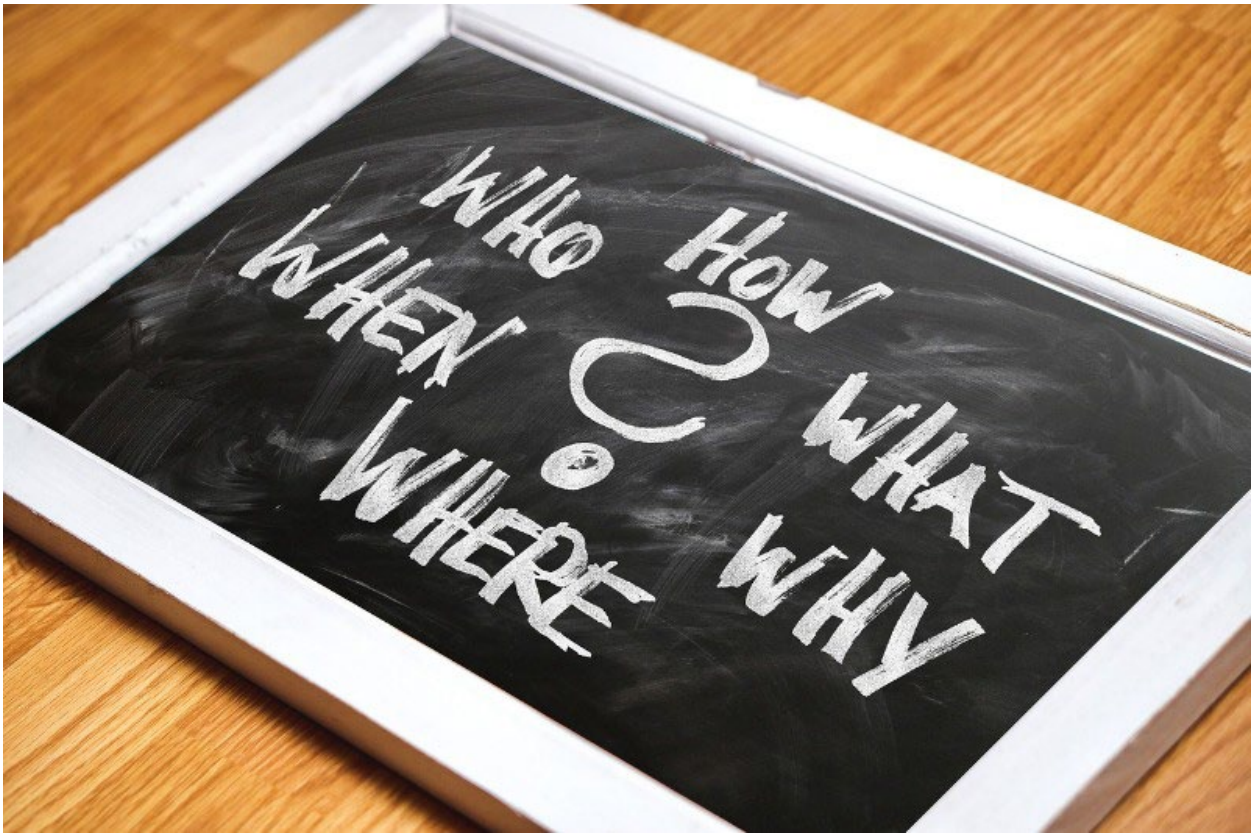

Figure 4.1 Slate of Questions [1]

4.1 Introduction to module

Stop and think: What will be the stimulus for your research project? your hobby, an open question, the faculty mentor's research area, a known problem, an artifact, a performance, a community action, an article, something else? Who will determine the research focus – a faculty member, you, or someone else?

Remember the decisions you made in **Module 3** about the research model you preferred: Discovery, Inquiry, or Creation. The faculty mentor may

determine details, while the student shadows their work (Discovery). Or, the faculty mentor could decide the general research area, allowing the students to customize the project (Inquiry). Or the student might define and design the investigation (Creation).

Whichever research model you choose, the research will be defined by the research problem. The **research problem** is a statement about a concern, a condition, a difficulty, or a question in scholarly literature, in theory, or in practice. This module will lead you to focus your project by crafting your research problem statement.

4.2 Module learning goals

Undergraduates involved in a research opportunity should complete activities in this module in order to:

- Learn the typical steps in the research process.
- Learn several key research terms.
- Explore several possibilities for the research topic.
- De-construct the contents and format of a scholarly journal article.
- Articulate the question for inquiry.

4.3 Steps in the research process

The steps in conducting research projects are generally similar, no matter which problem, topic, or question you determine. Here is a summary of those steps.

Step 1: Identify the research problem or question (addressed in this module)

The first step in the process is to identify the topic of the project. It's impossible to explore all aspects of a particular topic. So, the investigators more specifically define the scope for the project into a research problem or

question. This module features the identification of a problem, topic, or question. Subsequent modules will lead you through the following steps.

Step 2: Search the literature (see Module 5 and Module 12)

The researchers must learn more about the topic by searching the literature. This step will provide knowledge about the significance of the topic, past studies, research design, and recent conclusions by other investigators.

Step 3: Define terms and concepts (see Module 7)

Vocabulary often has differing definitions, depending on the listeners or readers. Investigators must define these important words or phrases used in the study. Definitions also make the project more manageable for the investigators.

Step 4: Define the group of subjects to study (see Module 8)

The purpose of the study and the problem or question will help investigators to identify the group of subjects to be studied. It is not necessary to collect information on every single member of the group in which you are interested. Defining the group will: (a) create a manageable size for the project, (b) describes the focus for data collection, and (c) identify the group to which the results and conclusions might be generalized.

Step 5: Design the study (throughout the handbook)

The study design serves as the step-by-step plan for the entire study in such detail that it would be possible for others to replicate the research. The design presents:

1. investigators who will participate in the study
2. subjects who will participate in the study
3. content of the intervention (independent variables)

4. what data will be collected
5. who will collect the data
6. how, when, and where data will be collected
7. how the data will be analyzed

Step 6: Collect the data (see Module 9)

Every project includes collecting data on dependent and independent variables. Data is the information needed to build responses to the topic, problem, or question. The information may be collected from academic literature, written material elsewhere, research subjects, or the investigators themselves.

Step 7: Analyze the data (see Module 10 and Module 11)

The final step of the process is the data analysis, so that the research question can be answered. Investigators now analyze the data according to the plan. For quantitative research, the data will be analyzed to determine if differences are statistically significant. If the differences are statistically significant, the study validates the theory that was the focus of the study.

Step 8: Discuss results and develop conclusions (see Module 13)

The results are then reviewed and summarized to respond to the research questions. Using the results, investigators suggest how to apply the results to the entire population (defined in an earlier step).

Step 9: Disseminate the results (see Module 14 and Module 15)

Investigators use a variety of dissemination strategies to share the results with other scholars and the wider community. Materials may be organized into scholarly journal articles, presented at conferences, contributed to internet resources, produced into podcast, and more.

Step 10: Return to the beginning

Research, especially action research, is cyclical and recursive, meaning that the steps are completed, revisited, and then completed again. Each research project provokes even more questions and prompts more research.

The following video describes the steps in doing **action research**. Although the video describes teacher research about effectiveness of strategies in their own classroom, for most research in education, the steps are relatively similar. Module 3 addresses the first step: identifying the problem, topic, or question to be studied. Later modules will describe the other steps.

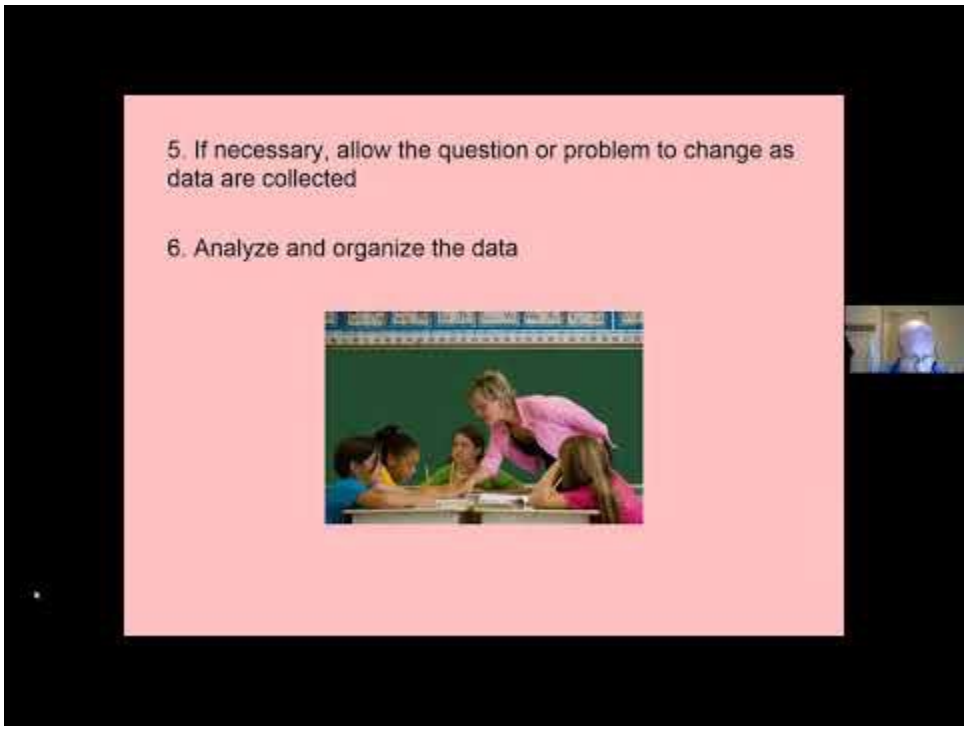

Figure 4.2 A. P. Johnson. 2018. Action Research: The Steps. Source: YouTube.

4.4 Key terms

Research problem - a statement about a concern, a situation, an issue, or a question in academic literature.

Research topic - a subject or issue in which an investigator is interested.

Research question - the question around which you will organize your research .

Action research - "systematic observation of one's own classroom or teaching practice with the purpose of understanding and improving the quality of instruction and enhancing learning (Johnson, 2018)."

Recursive process - steps that are completed, revisited, and then completed again.

Scholarly sources - materials written by experts in a particular field that inform others about recent research and conclusions (also referred to as academic, peer-reviewed, or refereed sources) .

4.5 Brainstorm topics

Brainstorm various topics that you like or are curious about. What kinds of problems interest you? Are you most interested in studying the natural world, human society, or creative expression? What relevant coursework have you taken or do you plan to take? What works in your field of study and what would you like to do better? Is there something you care about and would like to explore? Consider your favorite courses and your work, volunteer, or extracurricular experience that could relate to your research interests. What fascinates, frustrates, or intrigues you?

4.6 Explore before diving in

As you enter into research, you do not need to commit to a problem, topic, or question right away. Take time to explore several topics. For now, choose your top three ideas and prepare to write about why they interest you, what you already know about them, and what you want to find out. Make a sticky

note about each of your three topics from your brainstorming sheet. Place each sticky note on a separate sheet of the writing page. Then, expand your thoughts on each page by completing one QuAD graphic organizer for each of the three topics:

```
Question  Answers  Details
```

In column 1, make a list of the questions that you have about the problem or topic. In the middle column, make notes about possible answers to those questions. In column 3, add any notes or details about the questions or the possible answers.

Writing about your top three questions allows you to reflect on which topic would truly be the best pick. Sometimes researchers thought they had a topic that they were certain to address, but after they completed this activity, they actually changed their mind.

4.7 Real world application: Find one scholarly article

After all the brainstorming, choose just one idea that most interests you right now. The topic could be from your course of study or profession, or something else, such as soccer, quilting, car engines, or humor. With an Internet search engine, enter your topic followed by the word *research*.

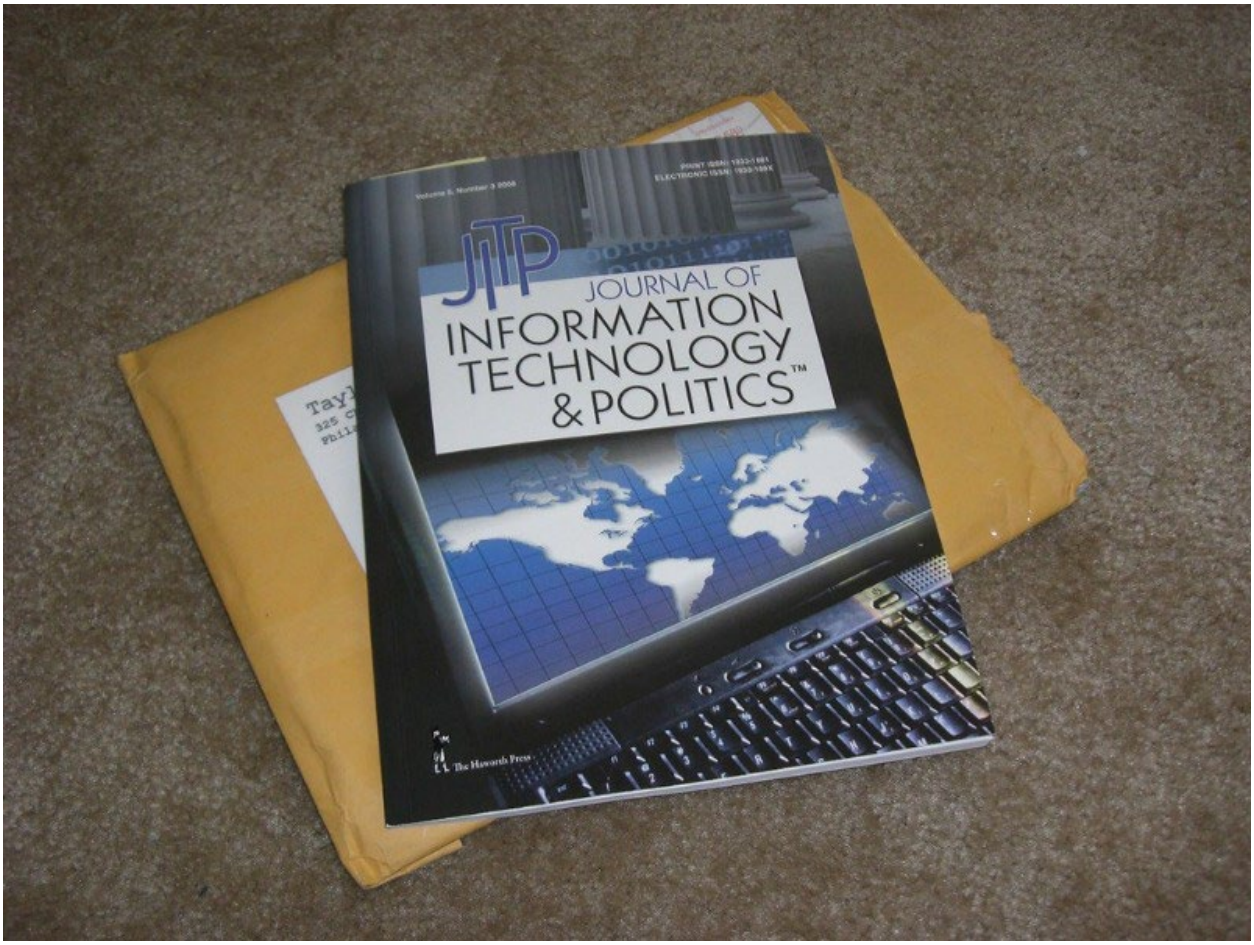

Figure 4.3 Academic Journal [2]

Find and describe a scholarly article about academic research related to the topic you selected.

In your journal, note these items about the scholarly article:

1. Topic of interest.
2. Name of author/s.
3. Title of article.
4. Publication name.
5. Volume number/ issue number/ page numbers.
6. Key words identified to index the article.
7. Key terms defined by the author.
8. Name the author's problem, topic, or question.

9. Describe the author's justification for investigating this problem, topic, or question. Why is this an important topic, problem, or question to investigate?
10. Describe the research design.
11. Summarize the research results.
12. Examine the article's list of references.

Note: Related to the next module, you may use the key words and the list of references to search for additional scholarly to look review.

4.8 Frame the problem or question

The article you just examined should also include a statement of a research problem, topic, or question. This will provide you with insight about framing your own focus.

Here are some examples:

- In what ways do marketing images reflect marginalized groups?
- What are the class-wide effects of stability balls used in grade four classrooms?
- What is one fairy tale's underlying morality and tension, and what does it tell us about the culture and society at the time it was written down?
- What is the relationship between intensive mothering and work-family conflicts of working mothers?
- What is one student's learning experience of immersion into a different culture? What were the barriers to learning and what were the critical learning moments?

Now, review your top three ideas for your own research. Select your favorite and rephrase the idea to reflect the form of a scientific study.

To understand the differences between a research topic and a research question, review the ideas about Formulating Your Research Question from

the Writing Studio at the Vanderbilt University. Then, review your research question with this checklist. (If any of your answers are 'no,' consider revising your research question.)

- I am curious about the topic and inquiry.
- The study will build on previous scholarly work.
- The research question is not too narrow and not too broad.
- There are adequate resources to complete the project.
- There is adequate time to complete the project.
- I will be able to locate information to support or contradict my ideas.
- Other people will care about the results of the research.

4.9 Journal entry

Date the next blank page (for your entry today). Write for 5 to 10 minutes about your topic. Answer questions such as:

- Why do you like the topic? Why did you choose the topic?
- Where does it fit within your personal or professional experience?
- What decisions have you made about narrowing the topic? Why did you choose to narrow down the topic in such ways?
- What are some specific ideas for research questions?

4.10 In summary

In this module, you have taken an important first step in the journey of research: you have prepared and possibly even contacted a faculty mentor. After completing this module, you should now:

- Know the steps in the research process.
- Understand several key terms in research.
- Know how to de-construct a scholarly journal article.
- Establish the focus or research question for your research.

Review

Important guidelines for research questions
Show Correct Answer
Show Responses

Two important guidelines to follow when choosing a research question are to make sure that you have adequate resources to complete the process and that your topic ...

A
is neither too broad nor too narrow.

B
is as broad as possible.

C
is as narrow and specific as possible.

D
has never been researched before.

Add to your resume: Education

Bachelor of Arts, Communication and Literature Expected 2020
Minnesota State University, Mankato, MN
Capstone: Intercultural communication among undergraduate students

References

Johnson, A. P. 2012. A Short Guide to Action Research. New York, NY: Pearson. ISBN: 9780132685863.

Johnson, A. P. 2018. [Video file]. Action Research: The Steps. Mankato, MN: Minnesota State University, Mankato.

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[1] Image by Gerd Altmann from Pixabay under CC0 Public Domain.

[2] Image by justgrimes is licensed under CC BY-SA 2.0

Module 5: Search for scholarly literature

Module Contents

Figure 5.1 Research team at WCUR 2019 – 1. [1]

5.1 Introduction to the module

Literature reviews are important at the beginning of your project for several reasons. First, a researcher needs to develop an overall, detailed understanding of the topic. Other investigators will have also reported background, history, and context. You will find value in what others have done before you, so you can learn from them (e.g., their methodologies, theoretical bases, measurements, sampling strategies, limitations, and recommendations). Since we want to contribute to the knowledge base of the field, we may want to avoid repeating a study that has already done. By reviewing previous reports, we can make adjustments in study design or sampling that will make our contributions unique. Finally, the literature review assists your effort to place your own work within your discipline.

The literature search and review process has several distinct components:

- the **literature search**, an extensive compilation of references identifying relevant research and theory in a selected field of study that relates to the research question (generally started at the beginning of the project). The search helps you formulate the research question and design the project's research methodology.
- the **literature review**, in which investigators analyze and interpret the collected information to demonstrate building on previous work and how the project is needed and significant for the field or discipline.
- the **literature discussion**, consideration of how the project results relate to those found by previous researchers (near the conclusion of the project).

This module provides information and processes for you to work on the literature ***search***. The literature search involves locating the materials that you will review for your research: journal articles, research, research reports, ERIC documents, books, and other sources related to a particular topic. The literature review and literature discussion will be addressed in a later module.

Scholarly literature goes through a process called **peer review**, so we can be fairly confident in the findings of the study. Usually, a study reported in the scholarly literature was original (primary) research planned and conducted by the authors of the article. The peer reviewers assessed the study and the article for its scientific merit. Through the review process, the authors incorporated information about the limitations of the study and possible improvements to the study.

Consider the following questions as you begin:

1. If other researchers have asked similar question(s), how did they answer them? In what settings? What did they find? How might your study complement the others or fill in some gaps?

2. What does the research say about “what is working?” What previous work helps you understand rather than simply make assumptions about the context for your intervention?
3. What theories of teaching and learning are relevant to your project?

The answers to questions such as these should relate to your review of the scholarly literature.

5.2 Module learning goals

Undergraduates seeking to understand the current academic knowledge about their topic of interest should complete this module in order to:

- Define, articulate, and use terminology, concepts, and theory in the project's field or discipline.
- Understand distinctions between types of literature.
- Articulate the search strategy for the project.
- Use library and other tools to search for existing body of research relevant to the topic.
- Practice formatting the supporting bibliography.

5.3 Key terms

Literature search is the process of locating existing research publications on the topic area of a new study.

Literature review is an examination of the existing research publications on the topic area of a new study, to discuss the existing researchers' theorizing, research designs, data collection methods, findings, strengths, limitations and contexts as relevant to the new one.

Literature discussion considers the investigator's findings in relation to those of previous researchers; includes the investigator's own views and

observations; and suggests alternative explanations about other factors that may have given rise to those findings.

Peer review is a process by which the articles or books are reviewed by other experts in the same field of research.

Primary sources are scholarly publications written by those who conducted the research. Such sources are generally published as academic works, such as journal articles, books, etc.

Secondary sources are summaries of existing research, literature reviews, analyses, commentaries, opinions, textbooks, etc. written by people who did not carry out the original research. Such sources help to identify the key research studies, theories and scholars in the area of investigation.

5.4 Types of literature

Stop and think about: where do you get your professional and scholarly information from?

As you begin to search for resources related to your research project, begin to distinguish among three types: popular, professional or trade, and scholarly sources.

Popular sources include articles designed to appeal to a broad and general audience. Such material could be written by almost anyone, from freelance authors to professional experts. Popular sources are often filled with advertisements and intended to make a profit for their publishers. Examples of popular sources are: *The Washington Post*, *Time*, *National Geographic, Psychology Today*, *Parent Magazine, The Republic*, and *Science News.*

Professional or trade sources include materials intended for a specific audience, usually practitioners in a particular profession. Such material is

often written by the professionals in that field and may refer to some research studies, but the articles are not reporting on original research. Examples of professional and trade sources are: *Young Children, Men in Nursing, Commercial Property Executive,* and *Roast.*

Scholarly sources include journals with articles written *by* and *for* experts in a very specialized field or discipline. These sources are frequently **peer-reviewed** by other experts, often report results of original studies, and are usually grounded in theory and research. Examples of scholarly or academic journals are: *Educational Researcher, Journal of Teacher Education, Journal of Educational Policy, TESOL Quarterly,* and *Comparative Education Review.*

There are two major types of **peer-reviewed** articles: research and review.

Research or experimental articles describe original investigations. Experimental or research articles are called 'primary sources.' The articles provide the actual description of original research work, results, and conclusions in such detail that the project could almost be replicated based on the material.

Review articles provide an overview of recent research results in a particular field. Review articles summarize work that was conducted by persons other than the original authors. Review articles are called 'secondary sources.' When a review article is peer-reviewed, it is as positively regarded as original research.

5.5 Literature search strategies

There are three stages in a literature search strategy: a broad scan with key words, a focused search, and assessment of specific works that appear useful. Watch the 3-minute video, Creating an effective search strategy**.** Then, create and practice your literature search strategy with these steps.

1. Recall your research question from an earlier module.

2. Choose the three main ideas in your research question. These main ideas may be a single word or a phrase.

3. Make a list of **synonyms** for each of those three ideas. This is a brainstorm step.

4. Choose at least two key words or phrases from your list in the previous step to enter into the internet search engine or **literature database**. Your librarian can help you decide which database to use. Tip: Use databases with the capability to easily export the information into a bibliographic management system, such as RefWorks.

5. Examine the results of the broad search. Choose 2 or 3 articles that appear useful. Look at the key words identified in each of your top selections. Refine your key words and do a more focused search.

How will you know you have found quality academic articles? If the article is:

1. Related to your own inquiry (Based on your research question and key words).
2. **Peer-reviewed** by scholars in the field or discipline (This information is available within the search engine).
3. Primary source materials (Original scientific research, not a review).
4. Highly cited in other works (This information is available within the search engine. Keep in mind that a high number of citations only suggests that the article is valuable to the field or discipline).

[Author's note: Personally, I have found that my search is nearly finished when the same articles surface repeatedly through different key word searches.]

As you skim the results, make notes about the article's relevancy for your research. Use a code of symbols, such as:

***** highly relevant; must read; export into RefWorks.
**** closely relevant; should read; export into RefWorks.
*** somewhat relevant; might read; export into RefWorks.
** loosely relevant; read abstract; refer to later; export into RefWorks.
* not relevant; nice to know; won't refer to later.

5.6 Tracking search results (RefWorks)

[Author's note: RefWorks literally changed my scholarly life. I am not receiving any remuneration for this endorsement.]

You may find value in acquiring an electronic tool to gather, organize, read, and cite research materials. RefWorks is a web-based commercial reference management software package that is produced by RefWorks-COS, a business unit of ProQuest LLC. There are also alternatives: BibMe, CiteULike, EasyBib, EndNote, KnightCite, Mendeley, Son of Citation Machine, Zotero, and more. This text is working with RefWorks because it was available through the local campus library. RefWorks makes it easy to:

- Use the language of your choice.
- Create your own databases of resources for multiple projects.
- Access and manage research information online, from any browser.
- Import references from diverse information resources, with auto completion and easy retrieval of full text.
- Retrieve information from diverse and dynamic sources, including Web sites and RSS feeds.
- Instantly retrieve up-to-date information on cited authors.
- Generate and format bibliographies and manuscripts in any citation style, in seconds.
- Collaborate with others on joint projects by organizing, annotating, and sharing information.

In this brief video introduction to RefWorks, learn how to find and save references, how to organize references once they're in RefWorks, and how to cite those references in writing.

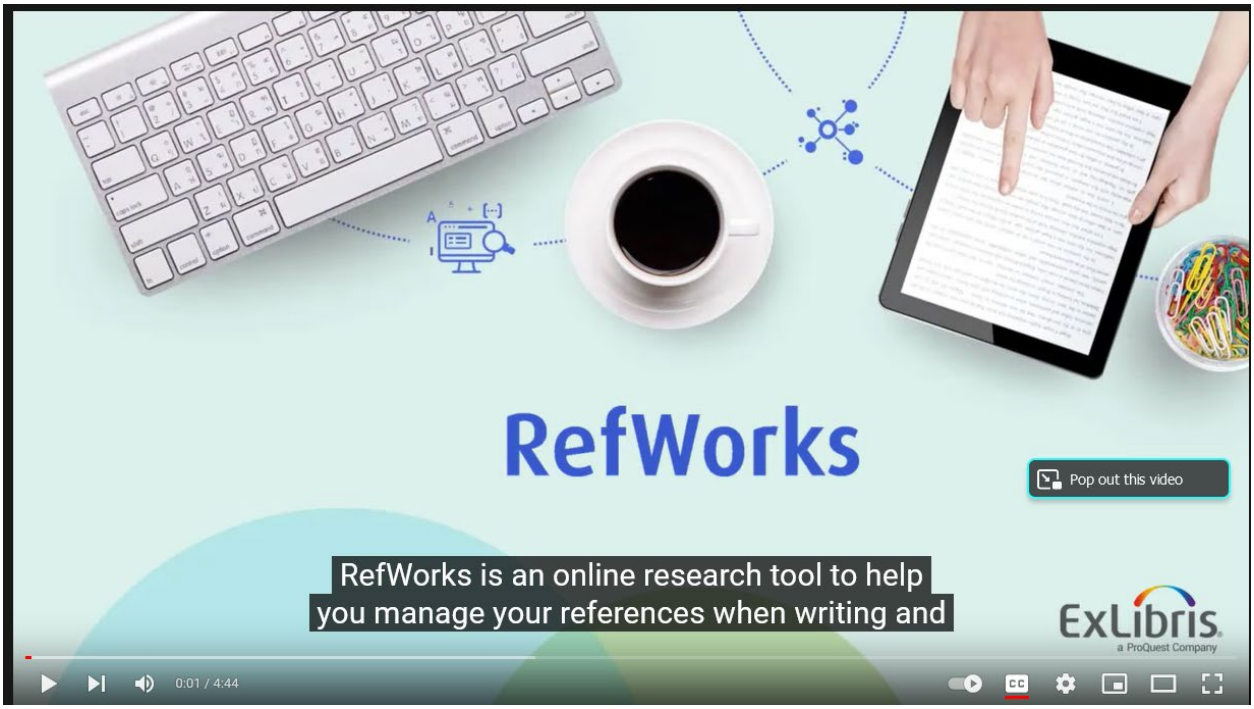

Figure 5.2 Introduction to RefWorks. Ex Libris Knowledge Center. 2020. Source: YouTube.

You will find more information at the RefWorks User Guide by Ex Libris Knowledge Center. RefWorks is not a free resource, but your college library may have a subscription.

5.7 Real-world application: Summarize 5 articles

Using the search strategies described earlier, locate 5 scholarly articles that relate to your research question. Export their information into the reference management software of your choice. Then, take some time to quickly

examine these sections of the article: abstract, introduction, tables and figures, and discussion. Enter this information into the worksheet:

Article Summary Worksheet (repeat for each of the 5 articles)

Author. (year). Article Title, Journal Title, Volume(Number), pp#-#

_____

_____

Describe the study (who, what, when, where)

_____

_____

Describe the purpose of the study (why, the research question)

_____

_____

Describe the main points from the discussion section

_____

_____

_____

Note other interesting information

_____

_____

An interesting quote

_____

_____

5.8 Journal entry

Date the next blank page (for your entry today). Write for 5 to 10 minutes about your literature search strategy.

- Re-write your research question from an earlier module.
- Choose the three main ideas in your research question. These main ideas may be a single word or a phrase. Write your list of synonyms for each of those three ideas.
- Write the key words or phrases from your list that you entered into the internet search engine or literature database. Which database/s did you use?
- Make notes about the results of the broad search and the 2 or 3 articles that appear useful. Which key words were identified in each of your

top selections? How did you refine your key words and do a more focused search?

5.9 In summary

In this module, you have practiced locating scholarly works which provide the context for your own research. After completing this module, you have now:

- Defined, articulated and used terminology, concepts, and theory related to the project's field or discipline.
- Distinguished among types of literature.
- Articulated the search strategy for the project.
- Identified the key words related to the search strategy.
- Used library and other tools to search for existing body of research relevant to the topic.
- Identified and started to make use of relevant previous work that supports the research.
- Practiced formatting the supporting bibliography.

Add to your resume: Related experiences

Research Assistant, College of Education, Minnesota State University, Mankato, MN Fall 2018 - present.

References

Ex Libris Knowledge Center. 2020. [Video file]. Introduction to RefWorks. Accessed 16 September 2022.

Ex Libris Knowledge Center. 2022. RefWorks User Guide. Accessed 16 September 2022.

Johnson, A. P. 2012. “Reviewing the literature” in A short guide to action research. Upper Saddle River, NJ: Pearson.

Purdue University Libraries. [Video] Creating an effective search strategy. Accessed 10 May 2019.

Image credits

[1] Sandell, E. J. 2019. Research team at WCUR 2019 – 1. [Photograph]. Used by permission.

Module 6: Responsible conduct of research

Module Contents

Figure 6.1 Research team at URS 2015 – 3. [1]

6.1 Introduction to the module

Responsible conduct of research is “the practice of scientific investigation with integrity. It involves the awareness and application of established professional norms and ethical principles in the performance of all activities related to scientific research” (National Institutes of Health, 2009).

Research is ultimately about creating knowledge. Research integrity is about ensuring that this knowledge can be trusted. Trust is strengthened when investigators follow uniform procedures, respect the rights of research subjects, and keep accurate records and data.

Whatever your field of study, it is crucial to ensure that your research project meets all ethical, legal, and safety requirements. You may need to take one or more of these steps even before starting your research project:

- Discuss ethical implications of your project with a faculty mentor
- Obtain approval for your project from your college or university Institutional Review Board
- Complete laboratory safety training
- Clarify the roles and expectations of contributors to the research project
- Consider other ethical or legal questions about your project

Responsible conduct of research involves a variety of elements (specified by the National Institutes of Health, 2009), such as:

1. policies regarding human subjects
2. practices involving live vertebrate animal subjects in research
3. safe laboratory practices
4. conflicts of interest – personal, professional, and financial
5. mentor/mentee responsibilities and relationships
6. collaborative research including collaborations with industry
7. peer review
8. data acquisition and laboratory tools; management, sharing and ownership
9. research misconduct and policies for handling misconduct
10. responsible authorship and publication

This module will address policies and practices of research with human subjects. Other details are beyond the scope of this workbook.

6.2 Module learning goals

Undergraduates seeking to conduct research with integrity should complete this module in order to:

- Understand the background to laws, rules, and limitations of conducting research with human subjects.
- Consider definitions and beliefs about responsible conduct of research with human subjects.
- Learn about the principles of conducting research.
- Complete training about ethical conduct of research.
- Follow ethical principles for research.
- Add to your research journal.

6.3 Key terms

Stop and think about: What could go wrong in your research project? How might research subjects be hurt? How might they benefit? The ethical considerations of research with human subjects are embedded within some key terms.

Research integrity is the commitment to the trustworthiness of the research process by the greater scientific community.

Principal investigator (PI) is the person who directs a research project. Usually, the PI writes and submits grant applications, oversees the scientific aspects of the grant and is responsible for managing the research.

Research ethics are about applying moral principles to your academic research.

Respect for persons means that research subjects have the right to self-determination, as well as the right to protection of vulnerable subjects (i.e., children, prisoners, and certain conditions).

Informed consent is agreement to participate in well-defined research, with full knowledge of the possible risks and benefits.

Confidentiality is a situation where the identities of the participants are protected and not made public by the researcher.

Privacy means that subjects have freedom (a) from intrusion, (b) from being observed by others, (c) from being seen, heard, or disturbed by others, or (d) having control over the extent, timing, and circumstances of sharing oneself (physically, behaviorally, intellectually) with others.

Beneficence means generosity or charity, including good or charitable acts, especially such as a generous gift. The idea is that research should maximize potential benefits and minimize potential risks to the research subjects.

Justice means investigators to distribute the risks and potential benefits of research equally among those who may benefit from the research.

Institutional Review Board (IRB) is a type of committee that applies research ethics by reviewing proposed research methods to ensure they are ethical and meet the moral principles of academic research.

6.4 Research ethics

When you become a researcher, you assume an ethical responsibility to consider how the research process will have an impact on your research participants or subjects, your research team, your school, your colleagues, and the wider scholarly community. Research ethics is about applying moral principles to your academic research.

Watch this 7-minute video about ethics and research with human subjects.

Figure 5.2 Ethics: Human Subject Research. P. Jenkinson. 2016. Source: YouTube.

6.5 Research involving human subjects

Throughout history, research with human subjects has resulted in benefits, such as reduced disease, treatments for illnesses and disabilities, and more effective education and social services. However, there were times when research resulted in considerable risk and even harm for the human subjects involved. As a result, the wider scientific community has adopted principles and procedures to protect human subjects and to be sure they are fully informed about the consequences of their participation.

Principles for conduct of research with human subjects

In 1979, the National Commission for Protection of Human Subjects, through the US Department of Health, Education, and Welfare, issued The **Belmont Report**. This report outlined three principles for conduct of research with human subjects: (a) Respect for Persons; (b) Beneficence; and (c) Justice.

The principle of **Respect for Persons** means that research subjects have the right to self-determination and protection. Therefore, researchers must avoid coercion and, instead, ensure voluntary participation, obtain informed consent, maintain confidentiality and privacy, and allow subjects to withdraw without penalties.

- **Informed consent** must be obtained before beginning the project with human subjects. In other words, the person agreeing to be a research subject must be informed and must agree voluntarily.
- **Confidentiality** means that the research is carried out under the expectation that anything done or revealed will be kept quiet in ways that are consistent with the understanding of the original research agreement.
- **Privacy** means that a research subject is protected from disturbance or intrusion by others. They should be safe from public sight or from being required to share their information with others.

Beneficence means generosity or charity, including good or charitable acts, especially such as a generous gift. The principle is that research should maximize potential benefits and minimize potential risks to the research subjects. Possible harm associated with this principle may be “social harm” when it compromises a reputation or has an impact on financial status, employability, insurability, stigmatization, or discrimination.

Justice means fairness or equity, including distribution of the risks and potential benefits of research equally among those who may benefit from the research. The IRB will review the characteristics of the population under study to be sure that the investigators are not targeting vulnerable subjects because they are easily available. Researchers also must not systematically exclude subjects because they are likely to benefit from the research and thereby become more privileged.

Training in research ethics

All researchers (including undergraduates) who will be working with human subjects must first complete training about human subjects' research. The level, content, and amount of training will depend on the role you play in the research projects. For example, each research project will have a principal investigator (PI), who usually participated in very extensive training. For campus-based projects, research mentors will have stringent training to complete. Students who are learning about research will have much less training to complete.

The **Collaborative Institutional Training Initiative** (CITI) provides web-based research education content for many investigators in the biomedical, social, and behavioral subjects. There are many professional development modules available (e.g., Assessing Risk, Research with Children, International Research, etc.). Many universities subscribe to the CITI service. Individuals may also purchase access to the service. Certificates and continuing education units (CEUs) are available.

Figure 6.3 CITI completion certificate [2]

For undergraduate researchers, watch this 2.5-minute video to see what one university requires of students with its subscription to CITI: Students Grad and Undergrad > Stage I Basic Course (See Social - Behavioral - Educational SBE). This university requires completion of 5 modules, and the modules are identified when you sign in with your university's credentials. Every student must complete these three: History and ethical principles; Informed consent; and Privacy and confidentiality. Then every student must complete their choice of 2 of the remaining 29 modules. Each module ends with a quiz. You need to achieve at least 80% on each quiz in order to pass.

Share with your mentor: You may need to send a record of completion to your mentor and the IRB Coordinator at your university.

Share on your resume: You can also add your completion information to your professional resume. In the category "Certifications," add:

Certificate, Students in Research (Students – Class Projects). [completion date] - [expiration date]. Record ID xxxxxxxx. 21.5 hours. Miami, FL: Collaborative Institutional Training Initiative (CITI).

Share on LinkedIn: You can also share your course completion in the Certifications section of your LinkedIn profile. LinkedIn users can then see the full PDF by clicking on the course title from your profile. To share your course completion on LinkedIn:

- Log into your CITI Program account.
- Go to My Records.
- Click the View-Print-Share link for the course completion that you want to share.
- Copy the Report or Certificate "verify" permalink (URL) (NOTE: normally you will want the Certificate URL, since it does not contain quiz scores).
- Log into LinkedIn and upload your completion information to your LinkedIn profile in the category "Certifications."

6.6 Institutional Review Boards

Since 1974, the National Research Act (93rd United States Congress, 1974) has required all universities in the USA to establish an Institutional Review Board (IRB) before beginning research with human subjects, so that projects are safe, responsible, and legal. IRBs help to (a) safeguard the rights and welfare of human subjects and (b) assist faculty in avoiding unethical actions. As a student doing research involving human subjects, you are responsible to conduct the investigation in an appropriate and ethical manner. You and your mentor should clarify whether you need IRB approval.

Three research levels

In general, there are three levels of research that require IRB review: (a) research with less than minimal risk, (b) research with minimal risk, and (c) research that involves serious risk. Your faculty mentor should consult with the university's IRB Administrator, IRB Coordinator, and/or IRB Co-Chair(s) to determine the level of the research or even if the project qualifies as research that is reviewed by the IRB. Advance consultation will assist you in following the correct protocols for studies with human subjects.

Applying for IRB approval

There are several steps to follow for a researcher to apply for IRB approval of their study:

1. The PI must be university faculty or staff.
2. Your institution's IRB will provide information and procedures.
3. Review the IRB Information and IRB Proposal Guidelines.
4. Complete the application (according to the IRB Proposal Guidelines).
5. Submit the application to the IRB.
6. After the IRB gives approval, the investigators may begin data collection.
7. Notify the IRB if there are any changes to the research design or data collection procedures.

Watch a 28-minute video, Preparing the IRB Application, with Jaxson Judkins from the Center for Excellence in Scholarship and Research at Minnesota State University, Mankato, MN.

A resource such as IRBnet may be available through your university. IRBnet is a web-based service to process applications for IRBs and others while ensuring compliance with research ethics. If your university subscribes to IRBnet, you may create an IRBnet account with your university's credentials and submit your review documents online. Keep in mind: Nothing should be

submitted to the online system until your faculty mentor indicates that the application form and all other documents are ready for review by the IRB. Your faculty mentor is still in charge of the research and responsible for its ethical practices. When you do submit the documents for review, you must provide the name and contact information for the faculty member who is supervising your project. That person must be listed and sign the proposal as the PI. *Please note that it is your responsibility to notify the faculty mentor of your online proposal.*

6.7 Real-world application: Your research with human subjects

For more insight into responsible conduct of research by undergraduate researchers, see this resource: Guidance on designing Undergraduate-Initiated Research Activities (UIRA) from the Committee for Protection of Human Subjects at the University of California, Berkeley, 2013.

Respond to these questions about your research with human subjects. Your responses will assist you when you prepare your application for IRB approval of your study.

6.8 Journal entry

Date the next blank page (for your entry today). Write for 5 to 10 minutes about your thoughts about research with human subjects.

- What did you learn?
- How will your project respect and protect human subjects?
- What are some of the risks for human subjects? (jeopardy to their grades? interference with learning? mental health triggers? invasion of privacy?)
- What questions do you still have?

6.9 In summary

In this module, you have gained an important status in the journey of research: you have completed online training in responsible conduct of research with human subjects. After completing this module, you should now:

- Be aware of the background to laws, rules, and limitations of conducting research with human subjects.
- Know the definitions and beliefs about responsible conduct of research with human subjects.
- Understand the principles of conducting research.
- Have completed training about ethical conduct of research.
- Have added your reflections to your research journal.

Add to resume: Licenses and certifications

Certificate, Students in Research (Students – Class Projects). [completion date] - [expiration date]. Record ID xxxxxxxx. 21.5 hours. Miami, FL: Collaborative Institutional Training Initiative (CITI).

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[1] Sandell, E. J. 2015. Research team at URS 2015 - 3. [Photograph]. Used by permission.

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Module 7: Design the methodology

Module Contents

Image credits

Figure 7.1 Research team at URS 2015 – 1. [1]

7.1 Introduction to the module

The study's design should be decided on the basis of its proposed objectives and the availability of resources, in addition to ethical considerations.

In earlier modules, you decided on a hypothesis or a research question. That decision determined the basics of your study design. Your specific design will depend upon the aims and objectives of your study - which are embedded within the hypothesis or the research question.

All other aspects of your project will follow from your study design. You must determine the design before moving to concerns such as: sample size and requirements, data collection, and data analysis, which are discussed in other modules.

7.2 Module learning goals

Undergraduates conducting research projects who are designing their project's methodology should complete this module in order to:

- Articulate the theoretical basis for your research.
- Determine if your project will be quantitative, qualitative, or mixed methods.
- Define the variables in your investigation.
- Consider possible strategies for data collection.
- Create your data dictionary.

7.3 Key terms

Research is about asking questions, collecting data, and making conclusions based on that data.

Systematic research means that, before the research even begins, there is a plan that describes what, when, how, and how often you will collect the data.

Methodology is the strategic plan of action, process or design used in a research study or investigation.

Quantitative research produces data in numerical form and is usually analyzed using descriptive and inferential statistics.

Quantitative data is numerical and can be counted, e.g., responses to close-ended questions in a survey.

Qualitative research produces evidence in textual, verbal, or visual form and is most often analyzed qualitatively, but it can also be analyzed quantitatively.

Qualitative data is not numerical and is embedded in their context, e.g., responses to open-ended questions in a survey or opinions of people.

Experimental research is conducted with a scientific approach, where a set of variables are kept constant while the other set of variables are being measured as the subject of experiment.

Quasi-experimental research resembles experimental research but is not true experimental research. The independent variable is manipulated; however, participants are not randomly assigned to conditions or orders of conditions.

A **variable** is the quality or condition about which you want to reach conclusions.

Independent variables are treatments or factors that you manipulate or you observe to determine a particular effect in an investigation.

Dependent variables are the particular effects or results of the manipulation of the independent variable.

Data (plural) are any form of information, observations, or facts that are collected or recorded. It may take various forms: numbers, narrative, scales, or observations.

A **theory** is a set of ideas that describes, explains, and predicts behavior or data.

A data dictionary explains what all the variable names and values really mean.

7.4 Theoretical basis

Your investigation should be based on a theory, a set of ideas that describes, explains, and predicts behavior or data. There are many theories that have been used in undergraduate research studies. Here is a list of just a few:

- Theory of cognitive dissonance
- Constructivist theory
- Holistic learning theory
- Drive reduction theory
- Behavioral learning theory
- Information processing theory
- Levels of processing theory
- Multiple intelligence theory
- Triarchic theory of intelligence
- Social learning theory
- Situated learning theory

If you examine the scholarly articles you found in your literature search, you will probably see that almost every researcher has formed their study from a theoretical basis.

7.5 Quantitative? or Qualitative?

If you selected a **hypothesis**, you will have a **quantitative study**, to test cause and effect relationships. This is also called an **experimental study**.

If you decided on a **research question**, you will have many options for a **qualitative study**: **quasi-experimental research, descriptive research, correlational research, survey research, evaluation research, and others.**

You may not be aware of the differences between qualitative research and quantitative research methods. Some mistakenly think the two terms can be used interchangeably. For a quick introduction, watch the 7-minute video, "Quantitative and Qualitative Research in Education" by Dr. Andy Johnson.

Figure 7.2 Quantitative and Qualitative Research in Education. A. P. Johnson. 2014. Source: YouTube.

Quantitative research produces data in numerical form and is usually analyzed using descriptive and inferential statistics. Qualitative data is evidence in textual, verbal, or visual form and is most often analyzed qualitatively (interpretive text analysis for meaning, themes, patterns), but it can also be analyzed quantitatively (content analysis counting the frequency of an idea, phrase, theme, or pattern). This chart summarizes the characteristics of these two approaches.

Characteristics	Quantitative	Qualitative
Objectives / Purposes	Generalize results from a sample to the larger population. Measure incidence of various characteristics in a sample.	Understand underlying reasons and motivations. Gain insights into a problem's setting. Generate ideas for later quantitative research.

Sample	Usually a large number of subjects who represent the population of interest. Randomly selected subjects.	Usually a small number of non-representative cases. Subjects selected to fulfill a certain number.
Data collection	Structured techniques, such as online questionnaires, on-street, or telephone interviews.	Unstructured or semi-structured techniques, such as individual interviews or group discussions.
Data analysis	Statistical data. Findings are presented as conclusive and descriptive in nature.	Non-statistical.
Outcomes	Used to recommend a final course of action.	Exploratory or investigative. Findings are not conclusive and cannot make generalizations about the larger population.

Neither type of data is better than the other, and it may even be best to have both. For instance, if you use a pre- and post-test to measure the effectiveness of an intervention and see a major improvement, qualitative data (e.g., open-ended surveys, interviews, focus groups, think-alouds, essay questions) will help you identify what contributed to the difference—and what it looks like.

7.6 Operational definition of variables

A **variable** is the quality or condition about which you want to reach conclusions. The theoretical basis for your study and the determination of

quantitative or qualitative design will lead you to determining which variables you will examine.

Your study is likely to have one or more **independent variables**: treatments or factors that you manipulate, or you observe to determine a particular effect in an investigation. If you design a quantitative study, you probably will have only one independent variable.

Dependent variables are the particular effects or results of the manipulation of the independent variable. Note: The dependent variable is dependent on the independent variable because the independent variable is … wait for it … independent!

Making the variables '**operational**' involves clear description of what is understood by each variable, what type of variable is being considered, and the way its values are to be reported (quantitatively, when the variable is numerical; qualitatively, when the variables do not have numerical values).

7.7 Confounding variables

Most investigations also have **confounding variables**. These are factors that may 'mess up' the actual relationship between independent and dependent variables. This makes it possible to imagine other interpretations of the results. You will want to make sure that you do all you can to reduce or eliminate threats to the validity of your study by controlling the confounding variables. Confounding variables are often outside of the researcher's control (e.g., selection of subjects, loss of cases, control of instruments, etc.). So, it will be important to keep track of these variables and discuss them in your reports and presentations.

- subject characteristics
- mortality
- location

- instrumentation
- testing
- history
- maturation
- regression
- implementation
- attitude
- other

7.8 Data collection strategies

Within the categories of quantitative and qualitative research, there are many different approaches to research design. Here is a list of some possibilities.

- Action research: "a disciplined process of inquiry conducted *by* and *for* those taking the action. The primary reason for engaging in action research is to assist the “actor” in improving and/or refining his or her actions (Sagor, 2000)."
- Applied research: “aims at finding a solution for an immediate problem facing a society, or an industrial/business organisation (Kothari, 2008).”
- Case study: gives detailed consideration to the development or change of a particular person, group, or situation over a period of time.
- Causal-comparative study: "used to identify cause-effect relationships or to examine the consequences of differences that already exist between two groups. Causal-comparative research is also sometimes referred to as 'ex-post facto' research because the researcher is attempting to determine the cause or reason for differences that already exist among groups of individuals (Ragin, 2014)."
- Content analysis: " a research technique used to make replicable and valid inferences by interpreting and coding textual material. By systematically evaluating texts (e.g., documents, oral communication, and graphics), qualitative data can be converted into quantitative data (Duriau, Reger, & Pfarrer, 2007).

- Correlational research: assesses the statistical relationship (i.e., the correlation) between two variables with little effort to control extraneous variables.
- Descriptive study: provides a description of the researcher's observations, findings, results of data analyses, what people said during interviews, etc., of a phenomenon under study.
- Ethnographic study: a qualitative research methodology used to observe people in their natural and uncontrolled social and cultural settings.
- Evaluation research: uses standard research methods, as a specific research methodology and as an assessment process related o the evaluation of social programs.
- Experimental research or fundamental research: "mainly concerned with generalizations and with the formulation of a theory (Kothari, 2008)."
- Exploratory research: used for a problem that has not been studied clearly yet. The study helps to establish priorities, develop operational definitions and create the final research design, data-collection methods and sampling strategies.
- Historical study: examines past events to draw conclusions and make predictions about the future.
- Longitudinal study: follows subjects over time with continuous or repeated monitoring of the variables under study.
- Survey research: any measurement procedure that involves asking questions of participants. A "survey" can be anything from a short paper-and-pencil form to an intensive in-depth interview.

It's possible use similar data collection methods for various types of research. For example, questionnaires, focus group discussions, interviews, and observations may be used with case studies, ethnographic studies, longitudinal studies, and survey research. Again, no type of data collection is better than any other. It may even be best to have several so that you could make some comparisons and seek explanations.

Think about: There are many different kinds of information that could be collected for your research project. However, there probably is not enough money to support collecting all sorts of information. So, you will want to choose processes that are affordably related to the hypothesis or research questions.

Measurement instruments are strategies and methods used to obtain data from subjects. **Primary data** is gathered by the researcher. **Secondary data** is collected from material already obtained and processed by others before it is available to the researcher.

Data collection instruments include questionnaires and surveys, interviews, observations, focus group discussion, and experiment.

The scale of **measurement** will affect the type of analytical techniques that can be used on the data, and the conclusions that can be drawn from the data. There are four scales of measurement: nominal, ordinal, interval, and ratio.

Nominal data involves two or more categories. Nominal data is often used for demographic data.

Ordinal data involves ranking objects or individuals on a variable, without assuming equal distance between the ranks. Ordinal data is often used for satisfaction data.

Interval data involves ranking objects or individuals on a variable, with assuming equal distance between ranks and without an absolute zero.

Ratio data sets involve equal intervals between values and an absolute zero value. For example, ratio scales may be used for temperature, height, weight, time, distance, and speed.

For more information, read this article by J. A. Yaya (2014) Choosing the right measurement instrument for your project: Tips to apply.

Your research mentor will have advice about instruments to use for collecting data and measuring variables. Here are several possibilities: read, observe, checklist, interview, weigh, measure, survey, time, create and test, listen, or count.

7.9 Real-world application: Create the data dictionary

The purpose of a **data dictionary** is to explain what all the variable names and values really mean. A data dictionary is extremely useful for helping others (including statisticians) to understand your data.

A data dictionary will include this information for every variable:

1. Variable names from the data spreadsheet.
2. Readable variable names in human words.
3. Measurement units.
4. Allowed values with minimum and maximum values.
5. Definition of the variable.
6. Synonyms (optional) that could be substituted for the variable name.
7. Description of the variable (optional) with enough information for others to understand.

For more information, see Open Science Framework Help (n.d.) How to make a data dictionary.

At this link, you may review several example data dictionaries provided by the USGS.

Create your own data dictionary and review it with your faculty mentor.

7.10 Journal entry

Date the next blank page (for your entry today). Write for 5 to 10 minutes about your thoughts about research methodology and design.

- What did you learn?
- What did you decide about data collection? Why?
- What decisions did you make about definitions of variables? Why?
- What are the pro's and con's of your methodology?

7.11 In summary

In this module, you have designed the methodology for your research. After completing this module, you should now have:

- Articulated the theoretical basis for your research.
- Determined if your project will be quantitative, qualitative, or mixed methods.
- Defined the variables in your investigation.
- Considered possible strategies for data collection.
- Created your data dictionary.

Add to your resume: Publications

McNabb, C. and Tupy, S. J. (2011). Change in cultural competency among students during an intentional human relations experience. *Journal of Undergraduate Research at Minnesota State University, Mankato, 11*, (1), Article 7. Available at: http://cornerstone.lib.mnsu.edu/jur/vol11/iss1/7.

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Module 8: Recruit research subjects

Module Contents

Update your resume: Special skills

References

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Figure 8.1 Research team at NCUR 2018 – 5. [1]

8.1 Introduction to the module

The **subjects** or participants in a study can have a profound impact on the outcome and conclusions. In this module, we'll look at the procedure for selecting a **sample** from the entire **population** to participate in the study. This module will also examine why it is so important for a sample to represent the population, which is the group of people to which you want to **generalize** the

results. Finally, student researchers will consider the process for obtaining informed consent from human subjects.

8.2 Module learning goals

Undergraduates conducting research with human subjects should complete this module in order to:

- Learn about the importance of selecting a sample that will enable researchers to generalize the study's results.
- Determine a plan to sample the population related to the research investigation.
- Learn about the importance of ongoing informed consent from human subjects.
- Determine a plan to obtain informed consent for your study.
- Add to your research journal.

8.3 Key terms

Subject can be a person studied in a research project; may receive a treatment and may change in some way. Sometimes called a participant or respondent.

Informed Consent is a voluntary agreement to participate in research. It is not just a form to be signed but it is a process, in which the subject has an understanding of the research, its benefits and its risks. Informed consent is essential before enrolling a participant and consent is ongoing once enrolled.

Population is a group of individual persons (objects or items), from which samples are taken for measurement and experimental study. Research conclusions about the sample group are often generalized to apply to the entire population.

Sample is a subset of a population which is included within the study. Usually, the size of the sample is much less than the size of the population. The primary goal of much research is to use information collected from a sample to try to generalize or to characterize a certain population.

Sampling is the process by which a researcher chooses the sample from the entire population.

Sampling frame is the group of people from which you will draw your sample.

Selection bias is introduced by the *selection* of individuals, groups or data for analysis in ways that result in every possible subject NOT having an equal possibility of being selected. The result is that the sample is NOT representative of the population that will be analyzed.

Random assignment provides that each participant has the same opportunity to be assigned to any given group, such as the experimental group or the treatment group.

Generalize is inferring the results from a sample and applying it to a population. To statistically generalize, the sample must be selected randomly and be representative of the population.

Steeping some tea...

8.4 Population and sample

Stop and think about: Examine the sample sizes of the research reported in some of the articles you reviewed for your literature search.

Steeping some tea...

Eventually, as you examine the results of your study, you will want to make some comparison of your results with those of other researchers. This means that you will want your sample to represent the population to which you want to generalize. So, you need to collect and report important characteristics of your participants: age, education level, scores on a particular scale, etc.

Stop and think about: Consult previous articles to see which participant characteristics were important in the most relevant studies.

Steeping some tea...

8.5 Sampling procedures

Watch this 7-minute video to learn more about sampling strategies.

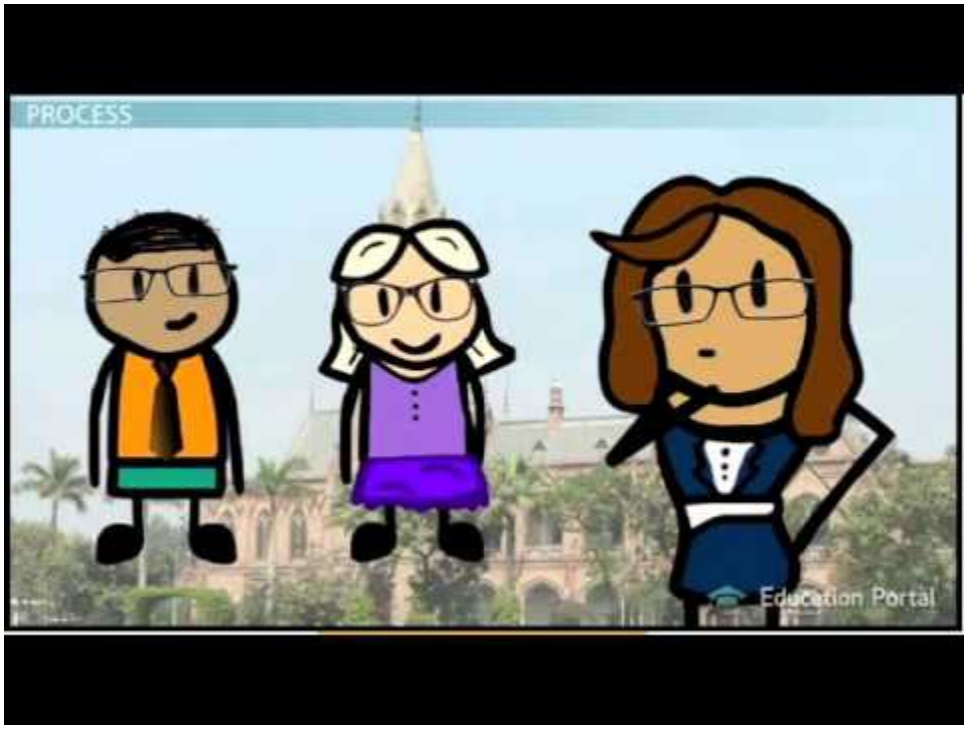

Figure 8.2 Sampling: What is Sampling? N. Boyd. 2014. Source: YouTube

The Sampling Process

Sampling is the process by which a researcher chooses the sample from the entire **population**.

1. Identify the population of interest. For example, you may be interested in college students, but you cannot survey every college student in the world.

2. Specify a sampling frame, which the group of people from which you will draw your sample. For example, you may decide that your sampling frame is every student at the university where you are studying. A sampling frame is not the entire population, but it's still a large group of people. You will not be able to study every student at your university, but it's a good place from which to draw a sample.

3. Specify a sampling method: randomly or non-randomly.

If your sampling frame has the same demographic characteristics as your population, you may want to randomly select your sample. A true **random**

sample is a subset of a population in which each subject has an equal chance of being selected for the study. This is accomplished by selecting participants by chance or random numbers (e.g., drawing names from a bowl).

However, the demographics of your university probably do not represent the entire world population of college students. Consequently, you may want to non-randomly select the sample so it is demographically closer to the larger population. Alternatively, you may want to carefully select your sample so that it does represent the sampling frame – and you may draw conclusions to your university population rather than the entire world of college students.

There are many methods for sampling. No method is perfect. No method is bad. For our purposes, it is possible to choose a method, describe its advantages and disadvantages, and report the results.

Cluster sample begins by dividing the population into groups (called clusters), randomly selecting some of the groups, and then collecting data from ALL members of the selected groups (e.g., exit polls).

Convenience sample is made up of readily accessible subjects (e.g., family members, students in the classroom, store shoppers, etc.). Also known as an availability sample.

Purposive sample is made up of cases or individuals who meet the requirements of the study's design and possess the required characteristics.

Representative sample is a subset of a population selected to accurately reflect the characteristics of the larger group. For example, a study of a classroom of 30 students in which 18 are males and 12 are females could generate a representative sample of five students: three males and two females.

Snowball sample (also known as referrals) is made up of referrals from subjects who identified other suitable subjects, usually in areas that are difficult to conduct research in.

Stratified sample is by dividing the population into at least two different groups with common characteristic(s), then drawing SOME subjects from each group. This results in a more representative sample.

Systematic sample is achieved by selecting a random starting point and then select every kth subject in the population.

Volunteer sample is composed of those responding to the researcher's call for participants.

4. Determine the sample size. In general, larger samples are better for statistical calculations. They also require more time and effort to manage. You will spend a lot of time if you have to tabulate and analyze 1,000 surveys. So, you need to make choices and balance the number that will provide adequate data with the number that will be manageable.

5. Implement the plan.

8.6 Recruiting subjects

Consider how you will recruit participants.

Stop and think about: Examine the recruiting strategies of the research reported in some of the articles you reviewed for your literature search.

Steeping some tea...

The text of a recruitment flyer should clearly state:

- That this is a research study being conducted by a (student, faculty member, etc.) at the university.
- The type of population you are looking for ("people age 20 and over who have been diagnosed with _____").
- The broad, overall focus of the study *in layperson's terms*; ("a study is being conducted to look at how people with _____cope with having it").
- What you will ask participants to do (fill out forms, etc.) And *how long it will take* ("about 90 minutes of your time").
- A phone number (and/or email address) where you can be reached.

8.7 Real-world application: Create a sampling plan

Using information from this module and from discussions with your mentor, describe your intended sample for subjects who would participate in your study.

Steeping some tea...

Here are some other questions to think about:

Type of sample: _____ simple random _____ stratified random _____ cluster random

_____ two-stage random _____ convenience _____ purposive _____ other

Generalizing to the following populations (external validity)...

To what accessible population?

_____

To what target population?

_____

If the sample will not generalize, why not?

_____

Generalizing to the following settings/ conditions (ecological validity)...

Generalize to what setting(s)?

_____

Generalize to what condition(s)?

_____

If the sample will not generalize, why not?

_____

8.8 Informed consent

One of the principles of research with human subjects is that they are fully informed and freely consent to participate in the investigation. This requirement is founded on the Respect for Persons principle described in an earlier module.

Checklist for informed consent text

Informed Consent is a voluntary agreement to participate in research and is required by any Institutional Review Board for ethical research with human subjects (see **Module 6**). "Consent" in this context means you are *asking the subjects' permission* to be in your study, whether you ask via: 1) a hard copy signed consent form; 2) a verbal consent text that you read to the participants; or 3) an email informational page or letter describing the study. It's a process that shares:

- an understanding of the research project
- information about the project's risks and benefits
- emphasis on the voluntary nature of participation
- steps about enrolling and about ending the subject's cooperation

The regulations (93rd United States Congress, 1974) require that the following information must be conveyed to each participant. Review this checklist to be sure you have included required elements in the text of your informed consent request:

1. a statement that the study involves research;
2. an explanation of the purposes of the research;
3. the expected duration of the participant's involvement;

4. a description of the procedures to be followed and identification of any procedures that are experimental;
5. a description of any reasonably foreseeable risks or discomforts to the participant;
6. a description of any benefits to the participant or to others which may reasonably be expected from the research;
7. a disclosure of appropriate alternative procedures or courses of treatment, if any, that might be advantageous to the participant;
8. a statement describing the extent, if any, to which confidentiality of records identifying the participant will be maintained;
9. instructions on whom to contact in the event of a research-related injury to the participant;
10. an explanation as to whether any compensation and medical treatments are available if an injury occurs; specifically, what the compensations are and if/when further information may be obtained;
11. instructions on whom to contact for answers to pertinent research questions and research participants' rights; and
12. statements that participation is voluntary, refusal to participate will involve no penalty or loss of benefits to which the participant is otherwise entitled, and the participant may discontinue participation at any time without penalty or loss of benefits to which the participant is otherwise entitled.

Consider the risks and benefits

Each research subject should be informed of the risks and benefits of their participation. Consult with your faculty mentor to determine your responses to these considerations:

A. Level of risk

1. This is an *exempt or an expedited* review: risks are minimal, meaning that the risks involved are no greater than those encountered in everyday life.

2. This is a *full* review: risks are more than minimal.

B. Potential risks to participants

1. Is there any possibility of <u>any risks</u> from participation in the study? (e.g., <u>fatigue</u> from filling out forms).
2. If you identified any additional risks, describe your plan for minimizing <u>each</u> risk. (e.g., "<u>fatigue</u>: participants will be told that they can stop and rest at any time, or may re-schedule the session."

C. Potential direct benefits to participants

1. Will participants receive any reimbursement or incentive for participating? (e.g., donated gift cards, children's book, pen and notepaper, child care, transportation reimbursement, etc.) If so, what is the reimbursement? (fill in)

   _____
2. Does the consent form contain language stating that all participants, regardless of whether they complete the entire questionnaire/interview or not, receive the reimbursement? Consent forms <u>must</u> contain this language. If you answered 'no' to the above, you must provide a rationale.

D. Potential indirect benefits to participants

1. Is there a potential benefit of an enhancement in the general knowledge of this study area? (fill in)

   _____
2. Example of text: While there may be no direct benefit to you from participating in this study, the indirect benefit of participating will be knowing that you helped researchers better understand how people cope with ___

8.9 Real-world application: Create a consent form

When you apply for review and approval by your institution's IRB, you will be required to describe the process and to provide any forms that you will use to document informed consent by participants in your investigation. Here is an example: Sample Consent Form for Use by Student Investigators, from the Psychology Department of St. Joseph's College, New York. Create your own consent form using this as an outline:

1. Invitation to participate
2. About the investigator
3. Purpose of the research
4. Procedures of the research
5. Potential risks or discomfort
6. Potential benefits
7. Confidentiality and data storage
8. Participation and withdrawal
9. Ethical review
10. Contact for more information
11. Participant agreement and signature

8.10 Journal entry

Date the next blank page (for your entry today). Write for 5 to 10 minutes about your thoughts on your sample and sampling technique.

- What did you learn?
- What has surprised you?
- What will you do differently from now on?
- How will your project conduct sampling?
- Why do you think it's important to obtain informed consent?
- What questions do you still have?

8.11 In summary

In this module, you have implemented two more steps related to the responsible conduct of research with human subjects. After completing this module, you should now:

- Know about the importance of selecting a sample that will enable researchers to generalize the study's results.
- Have a plan to sample the population related to the research investigation.
- Understand the importance of ongoing informed consent from human subjects.
- Have a plan to obtain informed consent from the subjects for your study.

Review

Steeping some tea...

Update your resume: Skills

MS Word, advanced level
SPSS, beginning level
Spanish as a second language, intermediate level

References

Boyd, N. 2014. [Video file]. Sampling**:** What is sampling? Accessed 11 May 2019.

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[1] Sandell, E. J. 2018. Research team at NCUR 2018 – 5. [Photograph]. Used by permission.

Module 9: Collect data

Module Contents

Figure 9.1 Research team at NCUR 2018 – 3. [1]

9.1 Introduction to the module

Whether you are conducting quantitative or qualitative or mixed methods research, accurate data collection is critical. In an earlier module, we worked on selecting appropriate data collection instruments. In this module, you will learn strategies to protect data integrity.

There are data collection processes that are typical of almost all disciplines, including social sciences, education, humanities, business, etc. Researchers may differ in their selection of methodology. However, research designs always emphasize accurate and honest collection of data.

In the methodology design, you should have decided:

- procedures that will be used to collect data (e.g., survey, in-depth interviews, focus groups, content analysis, etc.),
- how and when the procedures will be used, and
- instruments to collect information (e.g., questionnaire, interview guide, observation form, guide for a focus group moderator, etc.).

If you will need secondary data, describe the sources, content, and quality, so that it is clear that information is available.

If you need historical, journalistic, or other documentary sources, describe your use of acceptable techniques to collect and analyze the information.

If your choices for procedures and techniques are documented in the scholarly literature, describe the background of using those procedures and cite references.

For any investigation, you should create files with the instruments you will use (e.g., questionnaires, guides, registration forms, etc.). Also, you should document any revisions you make along the way.

9.2 Module learning goals

Undergraduates seeking to collect data appropriately should complete this module in order to:

- Determine protocols for data collection.
- Obtain informed consent from research subjects.
- Gather appropriate evidence.
- Assure data quality.
- Handle and store data securely.
- Add to your research journal.

9.3 Key terms

Data (plural) are any form of information, observations, or facts that are collected or recorded. It may take various forms: numbers, narrative, scales, or observations.

Data accessibility – describes the degree to which the data are obtainable.

Data collection - the procedures for gathering and measuring information on variables of interest, in systematic ways that lead to answers for research questions or to testing hypotheses.

Data handling - storing, archiving, or disposing of research data in safe and secure ways both during and after a research project.

Data hoarding – withholding access to data because of concerns such as ownership, security, economics, or other concerns.

Data instruments – tools or materials used to collect and measure variables of interest.

Data integrity - data which has not been altered in any undocumented or unauthorized process.

Data ownership - the "owner" of the data possesses and is responsible for the research information.

Data selection - determining the appropriate types and sources of data, as well as suitable instruments for collecting data.

Data source – origin of the research data.

Data type – classifying data as either qualitative or quantitative.

Derived data - information originally supplied in one form, but later converted to another form using an automated process that did not change the integrity of the data.

Drift – unintentional deviation or changes from the original research methods and protocols.

9.4 Data collection and human subjects

In this module, we want to consider the actual location of data collection, language proficiency issues, and interaction with participants in order to obtain informed consent.

Location of data collection

Think carefully about the actual location or context for collecting data. There are several “practical issues" which could dramatically influence your research results, including:
a. access to eligible participants,
b. privacy issues in neighborhood locations,
c. incentives and childcare to participants, and
d. accurate responses to sensitive topics.

Figure 9.3 illustrates the variations in structure and setting for data collection. Data collection approaches tending toward the upper-right are called “contextual” and involve at least some less structured and qualitative methods carried out in home and community settings. Each dot represents one example among many possible designs and methods.

Language proficiency issues

Think about: Occasionally, the tools or approaches for research do not really include every subject who appears in the sample because of their limited English or low literacy skills. These persons may have more difficulty with the

data collection instruments than those with better language skills. The meaning of questions or procedures may be confusing to people from various cultural groups.

Here are some suggestions to modify the collection procedures for persons with limited English language skills:

- Read the items and responses out loud to the respondent.
- Simplify the wording to match the respondent's reading level.
- Help the respondent learn to use the scales or forms of the questionnaires.
- Administer surveys in short segments, with just a few questions at a time.
- Set up surveys as informal interviews to make them more appealing and less like a test.
- Allow respondents enough time to complete the survey or questionnaire.

Obtain informed consent

Informed consent to participate in research was described in an earlier module. Now, it's time to plan specifically how you will interact with participants as you ask for their voluntary consent.

9.5 Accurate and appropriate data collection

Watch the 12-minute video, "T7-Data Collection," by Margaret Riel, Center for Collaborative Action Research.

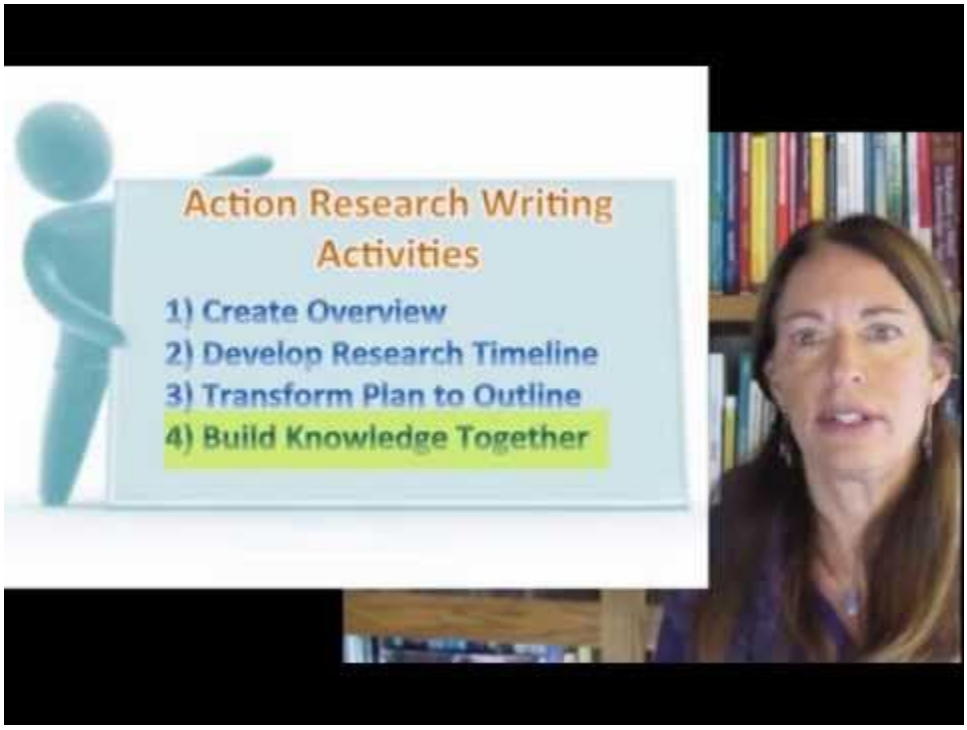

Figure 9.3 Data Collection. M. Riel. 2014. Source: YouTube.

There are several possible consequences that could occur if data is collected improperly. The consequences include:

- Inaccurate answers to research questions.
- Inability to repeat or validate the investigation.
- Compromised public policies.
- Wasted resources (time, money, and materials).
- Influencing others to implement unproductive studies.
- Harm to human subjects or animal subjects.

Errors in data collection might be made intentionally, with deliberate distortions. Or errors in data collection might be made unintentionally, with systematic errors or random errors.

You will reduce the likelihood of errors in data collection if you establish and follow clear instructions (also called **protocols**) for using your selected instruments (such as surveys) and formats (such as focus groups).

Most and others (2003) suggested using two approaches to enable **data integrity** and assure validity of research results: **Quality assurance** and **quality control**.

Quality assurance

Quality assurance requires an investigator to take actions *before* beginning data collection that prevent problems. You should be proactive about establishing standard **protocols** in a procedures manual that includes:

- Specific timing and methods for data collection.
- List of data to be collected.
- Identification of the person responsible for reviewing data.
- Step-by-step instructions on administering tests or leading focus groups.
- Specific content and strategies for training those who are responsible for data collection.
- Instructions to use, adjust, and calibrate equipment if necessary.
- Identification to document revisions in procedures that may develop during the project.
- Steps to check **drift** and to enhance the reliability of data collection.

Many of the research strategies in qualitative research are so specific to the research design that it's difficult to provide general instructions about research protocols. However, if you are implementing qualitative methodologies, the Institutional Review Board will expect to review your processes. This preparation will help you with quality assurance.

Quality control

Quality control involves actions *during* and *after* data collection. The procedures manual should also include:

- Identification of persons to notify if errors or protocol violations are detected.

- Steps to monitor the collection and handling of data, such as identifying inconsistencies, outliers, or invalid codes.
- Protocols for auditing records to find errors in individual or categories of data items.
- Expectations of comprehensive documentation in the research log or lab notebook.

Play the Data Collection Choose Wisely game from Northern Illinois University.

9.6 Accurate and appropriate data handling

Data handling is storing, archiving, or disposing of research data in safe and secure ways both during and after a research project. Your faculty mentor will provide protocols for data handling that address confidentiality, security, and retention of research data.

Type of Media

Think about: Consider the type of media that will be used to store data. Is the media reliable, non-degradable, and easily upgraded? Will the media last the required length of time? Will you be able to effectively retrieve the data? Is the media secure from alteration, erasure, loss, or access by unauthorized persons?

Non-electronic data handling systems include paper files, lab notebooks, and research journals. Electronic data handling systems include computer workstations, laptops, personal data devices, and storage media (CD, memory cards, etc.).

The “Data Management Guidelines Issued by British Medical Research Council” published on the ORI website (2003) states that: "If the data are recorded electronically, the data should be regularly backed up on disc; a hard copy should be made of particularly important data; relevant software

must be retained to ensure future access, and special attention should be given to guaranteeing the security of electronic data" (ORI website, 2003).

Procedures

Your faculty mentor should define the research protocols that identify persons authorized to store, share, archive, retrieve, and dispose of data. The authorizations should specify which part of the data, when they have access during the project, the purposes allowed, etc.

Your university's IT staff members can help you and your faculty mentor address issues about handling electronic data, such as protections with login and passwords, managing access privileges, updating virus protection, limiting physical access to equipment, removing data from old hardware, recovering data in emergencies, encrypting files, backing up copies in multiple secure locations, or disposing of data.

Under US Health and Human Services regulations, data and records must be maintained for a minimum of three years after the last grant expenditure report. Depending on the sponsoring agency's rules or guidelines, data may have to be maintained for longer periods.

You and your faculty mentor may need to plan in advance how you will dispose of research for data in a safe and secure manner. If you retain data beyond the required period, there may be unauthorized access to confidential or private data. (Note: This is more likely when faculty mentors leave a project, retire, or even die without proper data management protocols.)

Think about: If your research data was maintained on electronic media, could the information be reconstructed after the disposal of the storage media? If your research data was stored on film or a toxic form of media, would the disposal process pollute the environment?

Play the Data Handling Choose Wisely game from Northern Illinois University.

9.7 Real-world application: Plan for data handling

Think about: How, where, and time the data be kept, so that the data remain confidential and secure. Here is an example: "*Survey instruments will not be identified with names or ID numbers. The data will be kept in a lock file cabinet in the bedroom's closet of my home (located in Evansville) for a period of 3 years, and destroyed by December 2024. The consent forms will be kept in locked office, in a locked cabinet, for a period of 3 years, and destroyed by December 2024. Then, all data and consent forms will be destroyed with a paper shredder machine.* "

9.8 Journal entry

Date the next blank page (for your entry today). Write for 5 to 10 minutes about your thoughts on data collection. What did you learn? What is your protocol for data collection? What decisions did you make and why?

9.9 In summary

In this module, you have collected the data for your research. After completing this module, you should now have:

- Determined protocols for data collection.
- Obtained informed consent from research subjects.
- Assured data quality.
- Handled and stored data securely.
- Added to your research journal.

Review

Add to your resume: Honors and awards

Dean's List, College of Arts and Humanities, Minnesota State University, Mankato, Fall 2017.
Outstanding Member, Violence Awareness and Response Program, Minnesota State University, Mankato, Spring 2018.
Outstanding Oral Presentation, Undergraduate Research Symposium, Minnesota State University, Mankato, April 2018.

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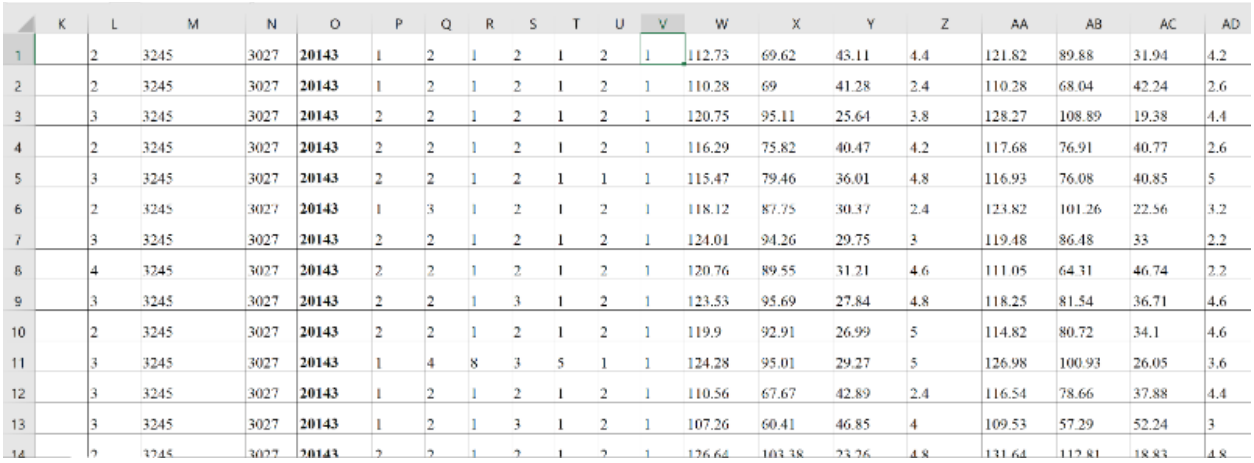
Image credits

[1] Sandell, E. J. Research team at NCUR 2018 – 3. [Photograph]. Used by permission.

Module 10: Analyze quantitative data

Module Contents



	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD
1		2	3245	3027	**20143**	1	2	1	2	1	2	1	112.73	69.62	43.11	4.4	121.82	89.88	31.94	4.2
2		2	3245	3027	**20143**	1	2	1	2	1	2	1	110.28	69	41.28	2.4	110.28	68.04	42.24	2.6
3		3	3245	3027	**20143**	2	2	1	2	1	2	1	120.75	95.11	25.64	3.8	128.27	108.89	19.38	4.4
4		2	3245	3027	**20143**	2	2	1	2	1	2	1	116.29	75.82	40.47	4.2	117.68	76.91	40.77	2.6
5		3	3245	3027	**20143**	2	2	1	2	1	1	1	115.47	79.46	36.01	4.8	116.93	76.08	40.85	5
6		2	3245	3027	**20143**	1	3	1	2	1	2	1	118.12	87.75	30.37	2.4	123.82	101.26	22.56	3.2
7		3	3245	3027	**20143**	2	2	1	2	1	2	1	124.01	94.26	29.75	3	119.48	86.48	33	2.2
8		4	3245	3027	**20143**	2	2	1	2	1	2	1	120.76	89.55	31.21	4.6	111.05	64.31	46.74	2.2
9		3	3245	3027	**20143**	2	2	1	3	1	2	1	123.53	95.69	27.84	4.8	118.25	81.54	36.71	4.6
10		2	3245	3027	**20143**	2	2	1	2	1	2	1	119.9	92.91	26.99	5	114.82	80.72	34.1	4.6
11		3	3245	3027	**20143**	1	4	8	3	5	1	1	124.28	95.01	29.27	5	126.98	100.93	26.05	3.6
12		3	3245	3027	**20143**	1	2	1	2	1	2	1	110.56	67.67	42.89	2.4	116.54	78.66	37.88	4.4
13		3	3245	3027	**20143**	1	2	1	3	1	2	1	107.26	60.41	46.85	4	109.53	57.29	52.24	3
14		2	3245	3027	**20143**	2	2	1	2	1	2	1	126.64	103.38	23.26	4.8	131.64	112.81	18.83	4.8

Figure 10.1 Data spreadsheet [1]

10.1 Introduction to the module

This module includes discussion on the procedures involved in analyzing quantitative data. You may draw on a variety of resources for analyzing your data. First, consider your own expertise. Next, even if you're working on an individual project, colleagues with complementary analytical expertise can be consulted for this stage of the project.

Data analysis is the attempt to fully and accurately summarize and represent the data that has been collected. The analysis process for a specific research project will be determined within the research design phase. The type of data you collected will determine your method of data analysis: quantitative or qualitative or mixed.

If your data is in categories and counts, then you may use **quantitative data analysis**. For example, multiple choice, true/false, and yes/no options can all be analyzed quantitatively.

If, however, your data require content analysis to identify themes and sub-themes, then you will use **qualitative data analysis** (addressed in **Module 11**). For example, a semi-structured interview or a focus group allows participants to expand their answers with ideas and topics of their own concern.

Many studies will include both types of analysis. This is called a **mixed methods** approach. For example, a questionnaire may include several types of questions. Multiple choice items can be easily quantified. Open-ended or free-text items may be analyzed qualitatively.

10.2 Module learning goals

Undergraduates seeking to analyze data appropriately should complete this module in order to:

- Understand how quality data analysis might help investigators to identify impacts of programs to better meet outcome objectives.
- Know the steps involved in basic data analysis for quantitative research.
- Know the difference between results and interpretation of results.
- Analyze evidence using scholarly conventions.
- Seek feedback on the analysis to increase the trustworthiness of findings.
- Add to your research journal.

10.3 Key terms

Because there are so many key terms related to processes of data analysis, this module's key terms are defined in pop-up comments linked to vocabulary words highlighted in blue.

10.4 Analyze quantitative data

Deductive analysis is the process of exploring a known theory or phenomenon to test if that theory is valid in specific circumstances.

Quantitative data analysis is a type of deductive analysis. Quantitative researchers tend analyze data, and then they accept or reject a hypothesis, thus using the deductive analysis process.

Watch this 14-minute video about analyzing quantitative data.

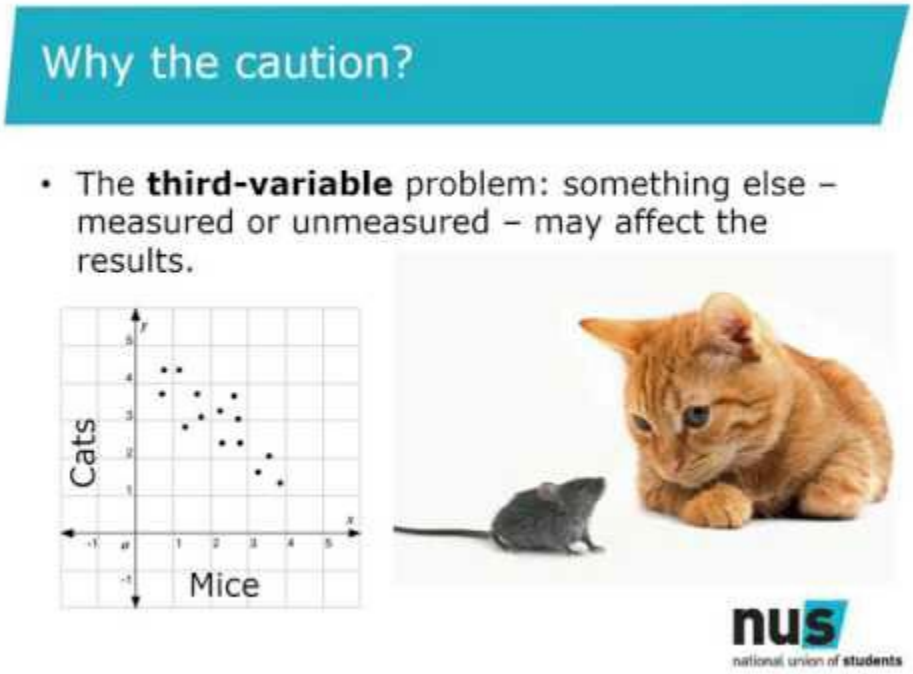


Figure 10.2 Quantitative data analysis. K. Little. 2016. Source: YouTube.

Quantitative research usually generates data in numbers that need to be summarized, described, and analyzed. The data may be illustrated and explored with graphs and charts, performing cross tabulations, and calculating means and standard deviations.

Steps in quantitative data analysis

Although there are various methods of study, quantitative data analysis usually includes these steps:

Step 1: Identify software for data entry and analysis manager (e.g., SPSS, Qualtrics).

Step 2: Review data for completeness and accuracy. Assign a unique identifier to each subject and questionnaire, etc. Remove records that are incomplete or do not make sense. Be sure to keep a record of your decisions for later reference.

Step 3: Code data. Enter the data, by hand or by computer, such as with Excel spreadsheet, Microsoft Access database, or SPSS statistical software. Code data according to the data dictionary that you created in an earlier module.

Step 4: Analyze data as planned. Describe and summarize the data in words and visually. Organizers may include line chart, bar chart, histogram, scatterplot, boxplot, pie chart, area chart, stem-and-leaf display, cartogram, graphs, spreadsheets, or tables. What do you see? Look for groups or patterns.

Step 5: Interpret the data carefully for support (or lack of support) for your research questions or hypotheses. Compare variables for similarities and differences. Identify relationships between variables. Forecast future outcomes.

Types of statistics

There are two types of statistics used for quantitative research: descriptive and inferential. Watch the 7-minute video, by The Organic Chemistry Tutor, **Descriptive statistics vs. inferential statistics.**

Descriptive statistics describe the results using numbers and graphs.

Frequency count: Organizes the information to describe the scores or numbers that were attained and how many times each score or number was attained. This answers the question, "How many individuals checked each answer?"

Percentage: A rate, number, or amount in each hundred, expressed in relation to a whole. This answers the question, "What proportion of people answered in a certain way?"

Measures of central tendency

Mean: The arithmetic average of a set of scores or numbers. This answers the question, "What is the average number or average score?"

Mode: The score or number attained most frequently. This answers the question, "What is the most frequent response received?"

Median: The point at which 50% of the scores or numbers are above and 50% are below. This answers the question, "What is the middle value in the range of values or scores?"

Measures of variability

Range: In a set of scores or numbers, the difference between the highest and lowest score or number. This answers the question, "What is the range in answers or scores?"

Variance: A mathematical procedure to describe the spread among a set of numbers or scores. This answers the question, "To what degree are the scores bunched together or spread out?"

Standard deviation: The square root of the variance. This is the most frequently used index to describe variability or the dispersion of scores. This answers the question, "To what degree did the response vary from the group mean?"

Inferential statistics are used to calculate a p value, which is the probability that the event is likely to occur. Statisticians have accepted that the *p* value must be within a "critical" value (usually less than 0.05) in order to be significant in statistical terms. This does not determine “value” or “importance” of a program. This level of statistical significance represents that there is a 1 in 20 probability that the observation is actually wrong, but that is considered an acceptable level of error. In other words, a statistical significance suggests that the results were or were not caused by chance or

sampling error. When $p < .05$, you may be reasonably certain that less than 5% of the difference may be due to chance or sampling error.

There are many tests of the statistical significance of the distribution of scores. Some of the most common for social and behavior sciences and education include t-tests and ANOVA. Your faculty mentor and statistics consultant will be able to guide you through choosing the tests to use.

Independent samples t-test

T-tests report the likelihood that the difference between two different means is statistically significant. **Independent samples t-test** is used to compare nominal variables that do not influence each other. The test output provides descriptive statistics, t-value test statistics, and p-value (significance level).

Dependent (or paired) samples t-test

Again, t-tests report the likelihood that the difference between two different means is statistically significant. **Dependent samples t-test** is used to compare means from a continuous dependent variable (such as ratings on an interval scale). The test output provides descriptive statistics, t-value test statistics, and p-value (significance level).

One-way analysis of variance (ANOVA)

ANOVA reports the likelihood that the difference between three or more means is statistically significant. There is one categorical variable and one continuous variable. The test output provides f-value test statistics and significance level. If the initial output reveals significant differences between some means, additional tests should be run in order to identify where the differences are.

10.5 Interpret results of analysis

The last step of data analysis is data interpretation. Data must be interpreted because data do not speak for themselves. The analysis enables to researchers to describe the meaning behind the numbers. Interpretation attaches meaning to the data. [You should seek further advice for this step from your faculty mentor, other experts within your organization, computer package manuals (e.g., SPSS, Nvivo, *R,* MaxQDA) and methodology books.]

Methods to interpret the findings vary greatly, depending on the research type (i.e., qualitative or quantitative research) and methods of analysis (e.g., ANOVA or grounded theory). The same data may be interpreted in several different ways. Others may help you with this step. It's valuable to hear how different people might interpret the same information. Invite key stakeholders to a meeting to discuss the data. Ask the research subjects themselves what they think. Examine scholarly articles from your literature review to see how other academics have interpreted similar results.

Data visualization will help in data interpretation. Describe and summarize the data visually in addition to words. Organizers may include line chart, bar chart, histogram, scatterplot, boxplot, pie chart, area chart, stem-and-leaf display, cartogram, graphs, spreadsheets, or tables. What do you see? Look for groups or patterns. Here is a 18-minute video presentation, **Introduction to Table & FIgure Design**. from the Center for Excellence in Scholarship and Research at Minnesota State University, Mankato, MN. For more about data visualization, see **SAS Data Visualization**: What it is and what it does. Here are some examples:

Question: What is your favorite season of the year?

Table chart:

Season	Number of responses	Percentage of responses
Fall	4	.20
Winter	5	.25

Spring	3	.15
Summer	8	.40
Total	20	1.00

Bar graph:

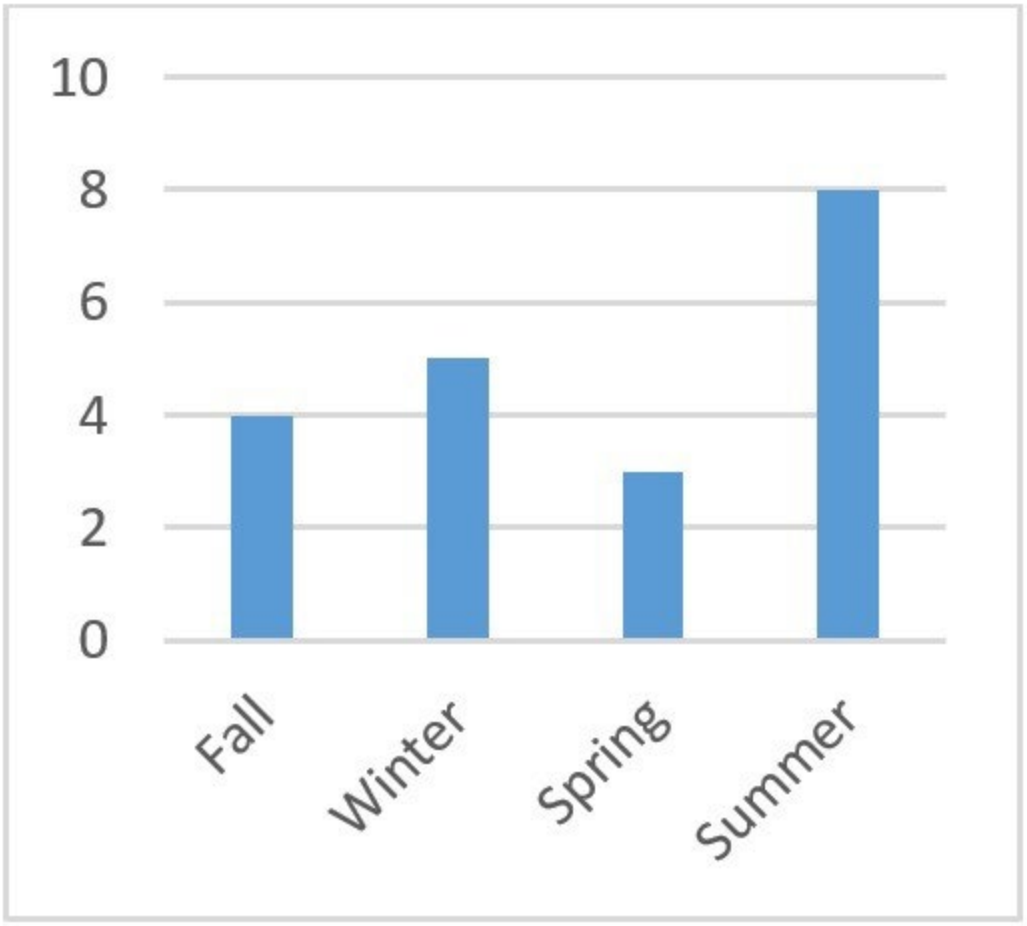


Figure 10.3

Bar graph [2]

Pie chart:

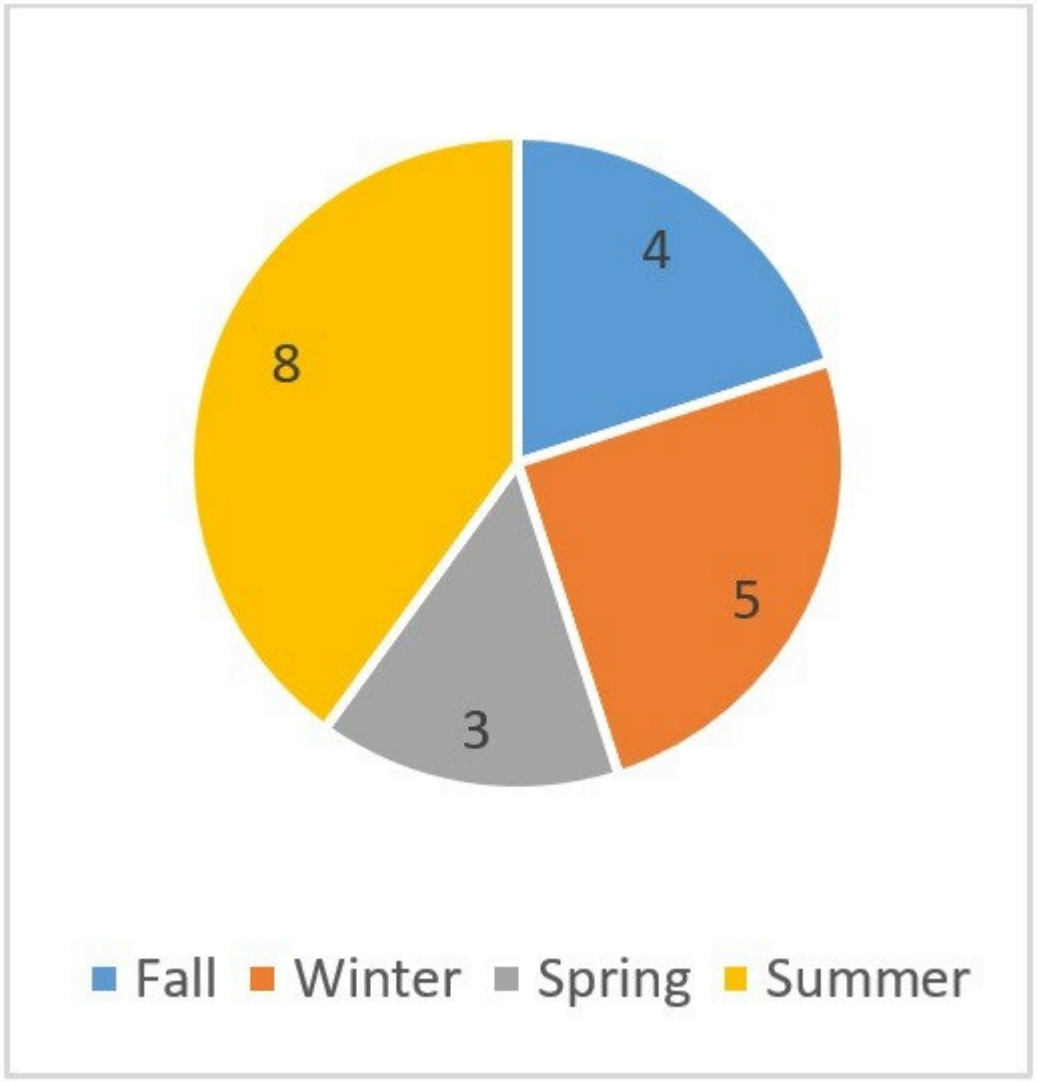


Figure 10.4

Pie chart [3]

10.6 Real-world application: Plan for quantitative data analysis

Steeping some tea...

Steeping some tea...

Steeping some tea...

Steeping some tea...

Steeping some tea...

10.7 Journal entry

Date the next blank page (for your entry today). Write for 5 to 10 minutes about your thoughts on the analysis of your quantitative data.

- Re-state your research question or hypothesis.
- What did you find in comparison to what you thought you would find?
- What relationships among variables do you see:
- What does not make sense to you?
- Are there areas that you find interesting, but do not relate directly to your research question?
- Have you had to revise your protocol because of what you learned in this module? What did you decide? Why?

10.8 In summary

In this module, you have learned some basis data analysis methods and strategies. After completing this module, you should now:

- Understand how quality data analysis can help identify impacts.
- Know the steps involved in basic data analysis for quantitative research.
- Know the difference between results and interpretation of results.
- Understand the value of feedback on your data analysis to increase the trustworthiness of findings.
- Have added to your research journal.

Review

Steeping some tea...

Add to your resume: Grants

Current Research (*chronological order; most recent one first)*
Principle Investigator: Dr. Elizabeth Sandell
Funding Organization: Minnesota State Foundation
Amount Awarded: $500.00
Period of Grant Award: Academic year 2020
Title of Project: Enhancing intercultural competence among undergraduate students.
Role on Project: Research Assistant / Student PI

Completed Research *(chronological order; most recent one first)*
Principle Investigator: Dr. Elizabeth Sandell
Funding Organization: Minnesota State Foundation Amount Awarded: $500.00
Period of Grant Award: Academic year 2013
Title of Project: Predictive variables for enhancing intercultural competence among undergraduate students.
Role on Project: Research Assistant / Student PI

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[1] Sandell, E. J. 2019. Data spreadsheet. [Photograph]. Used by permission.

[2] Sandell, E. J. 2019. Bar graph. [Photograph]. Used by permission.

[3] Sandell, E. J. 2019. Pie chart. [Photograph]. Used by permission.

Module 11: Collect and analyze qualitative data

Module Contents

Figure 11.1 Visualization as a word cloud [1]

11.1 Introduction to the module

This module includes discussion on the procedures involved in analyzing qualitative data. The analysis process for a specific research project will be determined within the research design phase. The type of data you have collected (i.e., quantitative or qualitative or mixed) will determine your method of data analysis.

If you collected data with interviews or focus groups of observations, you will need to analyze the data for themes and sub-themes. Therefore, you will use **qualitative data analysis** (in this module). You will use **quantitative data analysis** (see **Module 10**) when your data is filled with numbers and categories.

11.2 Module learning goals

Undergraduates seeking to analyze qualitative data appropriately should complete this module in order to:

- Understand how qualitative data analysis can help you understand how your interventions help your program meet its objectives.
- Know the steps involved in basic data analysis, including qualitative research.
- Know the difference between results and interpretation of results.
- Analyze evidence using scholarly conventions.
- Increase the trustworthiness of your findings by involving others in the analysis.
- Add to your research journal.

11.3 Key terms

Because there are so many key terms related to processes of data analysis, this module's key terms are defined in pop-up comments linked to vocabulary words highlighted in blue.

11.4 Analyze qualitative data

Inductive analysis looks at observed data (e.g., focus groups, interviews, etc.) and organizes the observations into categories or groups or themes.

Watch this 3-minute video about using Inductive analysis to interpret [qualitative] data.

Figure 11.2 Inductive analysis for interpreting data. A. P. Johnson. 2018. Source: YouTube

Qualitative data analysis helps you to see relationships between various groups, categories, or themes that relate to your respondents. You may find implications for policy or practice from the data, or qualitative analysis may help interpret findings from previous studies.

Steps in qualitative data analysis

There are several steps that are common in qualitative data analysis. Keep in mind that, at each step, you should record memos to yourself so that you remember (1) decisions and choices you made; (2) your logic behind defining a theory that explains the results; and (3) you remember how the materials fit within definitions of key terms or phrases.

Step 1: Repeatedly read and listen to the material to familiarize yourself with the data.

Step 2: Transcribe interview or other non-written material.

Step 3: Organize and index data for easy identification, storage, and retrieval. You can do this by hand or with computer programs such as NVIVO - formerly Nud*ist). Organize all the forms, questionnaires, paperwork, audiotapes, etc. in one place. Assign an identifier to each form, observation, questionnaire, etc. Remove records that are incomplete or do not make sense. Keep notes of your decisions for later reference.

Step 4: Anonymize sensitive data.

Step 5: Code data (may be called indexing).

Step 6: Identify themes.

Step 7: Develop provisional categories of data.

Step 8: Explore the relationships between categories.

Step 9: Refine topics, themes, and categories.

Step 10: Interpret the data to see how they relate to your original research questions or hypotheses. Compare variables for similarities and differences. Identify relationships between variables. Forecast future outcomes. Develop your theory and incorporate pre-existing knowledge you found in your literature search.

For more information on qualitative data analysis, see **BetterEvaluation**.

Methods to analyze qualitative data

There are many methods to analyze qualitative data. Some of the most common for social and behavior sciences and education include content analysis, narrative analysis, discourse analysis, and grounded theory. Your faculty mentor and statistics consultant will be able to guide you through choosing the procedures to use in order to answer your research questions.

Content analysis: for documented information such as media, written texts, or artifacts. Usually used for interviewee responses.

Narrative analysis: for material from various sources, such as interviews, observations, or questionnaires. Usually used for stories and experiences shared by subjects.

Discourse analysis: for the social context (e.g., daily environment, school environment, etc.) in which the researcher and respondent communicated

Grounded theory: for causes of the phenomenon under study. Usually used for several cases among different settings. Additional cases are added until researchers find an explanation that fits all cases in the sample.

Analyzing Data from Focus Groups – The “Scissor-and-Sort” Technique

The “scissor-and-sort” technique, also known as the cut-and-paste method, is a fast and cost-effective method to analyze a transcript of an observation, interview, or focus group discussion. This cutting and sorting process is simplified by any computer with a word-processing program.

This process has several stages:
a. determine which segments of the transcript are important,
b. develop a categorization system for the important topics,
c. select representative statements regarding these topics from the transcript, and
d. develop an interpretation of what it all means.

The “scissor-and-sort” technique is a very useful and efficient approach to text analysis. However, the process may rely heavily on the judgment of a single reviewer who might experience data "drift," subjectivity, and bias. Two

or more analysts could independently code the focus group transcript to enhance the reliability of coding, at least with respect to major themes and topics.

Whether used by one analyst or multiple analysts, and whether used with hard-copy or in a word-processing program, the first part of the process is to **code** the transcription of the focus group. This coding exercise may require several passes through the transcript as categories of topics become clear to the data analysts.

Step 1. Transcribe the focus group discussion into written form.

Step 2. Identify sections that are related to the research question(s). Use underlining and/or highlighting to identify these important sections.

Step 3. Develop a code or classification system for major topics. Identify material in the transcript related to each major topic. Use color-coded brackets or symbols to mark different topics within the text. The only requirement is that the material be relevant to the particular category with which it has been identified.

Step 4. Sort or group the coded sections of the transcript. Sort each piece of coded material, so that all material related to a particular topic is grouped together.

Step 5. Write a brief introduction for each topic. The various pieces of coded text are used as supporting materials in an interpretative analysis.

11.5 Interpret results of analysis

The last step of data analysis to interpret the findings. **Data interpretation** methods depend on the type of data collection (i.e., qualitative or quantitative research) and methods (e.g., ANOVA or grounded theory). Interpretation is the process of attaching meaning to the data.

You should seek further advice for this step from your faculty mentor, other experts, software manuals (e.g., SPSS, Nvivo) and methodology books. Invite key stakeholders to a meeting to discuss the data. Ask research subjects what they think. Examine scholarly articles from your literature review to see how other academics have interpreted similar results.

Data organizers may help in data interpretation. Describe and summarize the data visually in addition to words. Organizers may include word clouds, mind-maps, Venn diagrams, hierarchical charts, sociograms, geovisualizations, explore diagrams, comparison diagrams, project maps, etc.

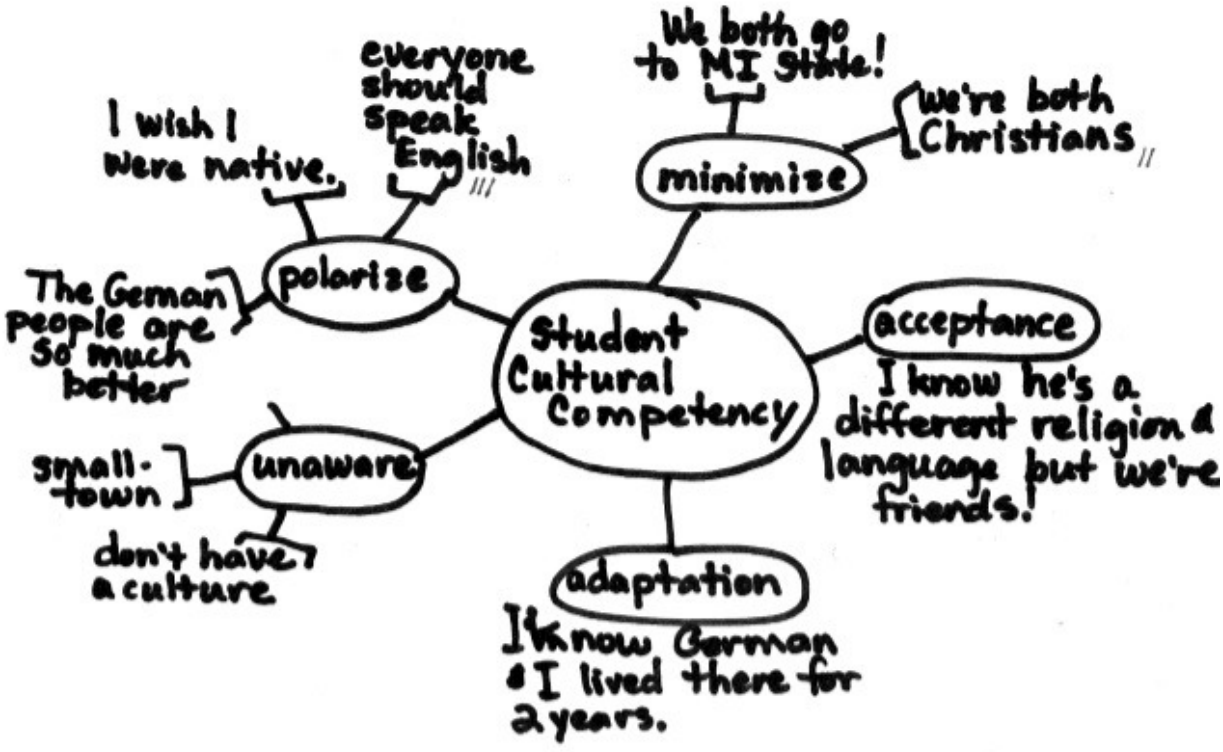

Figure 11.3 Qualitative mind map [2]

What do you see emerging from your own data when you use data organizers? Look for groups or patterns.

11.6 Real-world application: Plan for qualitative data analysis

Steeping some tea...

Steeping some tea...

Steeping some tea...

Steeping some tea...

11.7 Journal entry

Date the next blank page (for your entry today). Write for 5 to 10 minutes about your thoughts on the analysis of your qualitative data.

- Re-state your research question or hypothesis.
- What did you find in comparison to what you thought you would find?
- What relationships among variables do you see?
- What does not make sense to you?

- Are there areas that you find interesting, but do not relate directly to your research question?
- Have you had to revise your protocol because of what you learned in this module? What did you decide? Why?

11.8 In summary

In this module, you have learned some basis data analysis methods and strategies. After completing this module, you should now:

- Understand how to identify the impacts of your program or interventions to better meet objectives.
- Know the steps involved in basic data analysis, including qualitative research.
- Know the difference between results and interpretation of results.
- Understand the value of seeking feedback on your analysis to increase the reliability and validity of findings.
- Have added to your research journal.

Review

Steeping some tea...

Add to your resume: Community service and engagement

Member, Cultural Understanding, Learning, and Teaching, Minnesota State University, Mankato, MN, Fall 2017 to present.

Tutor, Somali immigrants, Adult Basic Education, Lincoln Community Center, Mankato, MN, Fall 2018.

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Image credits

[1] Sandell, E. J. 2019. Visualization as a word cloud. [Photograph]. Used by permission.

[2] Sandell, E. J. 2019. Qualitative mind map. [Photograph]. Used by permission.

Module 12: Write literature review

Module Contents

Image credits

Figure 12.1 Research team at URS 2013 - 4 [1]

12.1 Introduction to the module

During your work in **Module 5**, you searched for scholarly or research articles related to your research questions. In this module, you will expand your collection of relevant articles and **synthesize** ideas to present the current state of knowledge about your topic.

Literature reviews serve several purposes:

- To improve your own understanding and expertise.
- To demonstrate your knowledge of your discipline.
- To bring readers up to date.
- To set the stage for your research project in the context of recent scholarship.

One goal in reviewing scholarly literature is to enhance your own understanding of a particular topic. You are answering this question, “What do we know or not know about this issue?” Your literature review should reflect on several different scholarly sources to demonstrate your knowledge.

A literature review presents a synthesis of different subtopics to come to an understanding of the current knowledge on a larger topic. The process is similar to a jigsaw puzzle. The individual pieces (concepts and findings) are organized to reveal the whole (state of knowledge).

Finally, your review should present where the current scholarly knowledge overlaps and where it falls short. This provides you with some of the rationale and value for your own investigation.

Note: A literature review is not simply a summary. It is a presentation of scholarly understanding around several subtopics. Analyze several other investigations and organize your analysis according to those subtopics.

12.2 Module learning goals

Undergraduates seeking to place their own research within the context of scholars in their field of study should complete this module in order to:

- Learn how to read a research journal article.
- Organize scholarly articles related to your research project.
- Prepare your logical argument.
- Outline and write your literature review.
- Add to your research journal.

12.3 Key terms

Literature is those major works that have been reviewed by scholarly peers.

Peer-review is the evaluation of scientific, academic, or professional work by other professionals and academics working in the same field.

Review is simply a way of looking at a question, problem, or hypothesis to capture major concepts.

Synthesis combines two or more elements to form a new whole. In a literature review, the "elements" are the findings from other investigations that you gather and read; the "new whole" is the conclusions you establish from those findings.

12.4 How to read a scholarly article

Keep in mind that reading a peer-reviewed scholarly research article is not the same as reading a popular magazine article or a work of fiction. You need not read every word. However, you should plan to read each relevant article at least three times in order to answer questions and to add material to your literature review. Watch this 17-minute video about how to read a scholarly article.

Figure 12.2 How to Read a Scholarly Journal Article. PlantAgriculture. 2013. Source: YouTube.

Each reading will focus on specific components of the article:

Now, keep in mind that reading a peer-reviewed scholarly research article is not the same as reading a popular magazine article or a work of fiction. You need not read every word. However, you should plan to read each relevant article at least three times in order to answer questions and to add material to your literature review. Each reading will focus on specific components of the article:

First Reading: abstract, conclusion, figures and tables (10 - 15 minutes or less) to find key terms, research questions and conclusions, future investigations, quality of figures and tables, and relevance to your research question. (If yes, proceed to Second Reading.)

Second Reading: introduction or literature review, results, and discussion (60 minutes or less) to learn what is already known about the topic, locate other investigations, evidence found by the researcher, and comparison of results with other studies.

Third Reading: methods (design and analysis), results (evidence), and discussion (arguments and conclusions). During the third reading, ask these questions:

- What specific topic did the authors research?
- What was already known about the topic?
- What were the limitations of this study?
- Did the results apply broadly or are the results limited to specific situations?
- Do the data support the conclusions?
- Do the conclusions conflict or support the findings of others?
- Do you agree with what the authors are saying?
- How does the article contribute to answering your research question?

Finding answers to these questions will improve your understanding of the article and help you think critically about the topic.

12.5 How to organize scholarly articles

A **synthesis matrix** may be a very useful tool for you to organize the scholarly work that you locate. The synthesis matrix is a chart that helps you to sort and categorize the different arguments presented on a topic. Down the side of the chart, use the cells to record the articles and sources. Across the rows of the chart are cells to record the main points of argument on the topic. As you examine your first source, you will work horizontally in the row belonging to that source. Record as much information as possible about each significant idea presented in the source. Follow a similar pattern for the remaining sources.

Here is a 32-minute video about how to **create a literature review matrix** by using Google Drive.

Here is a link to one example of a **literature review matrix**.

During your reading of each article, add notes and sentences to the matrix. Try to write this with our own words as much as possible. Avoid quoting sections of the paper.

After reading a few articles, you will begin to notice that certain topics and themes are emerging. On your matrix, make a column for each one of these themes. For each article that had research finding addressing that theme, fill in the findings here. After you are done, read down the column for each theme to understand what the literature has to say about that topic.

As you write your review, work vertically in the column belonging to each theme or point discussed. When you combine the information presented in each column, each section of your paper will take form. Some of the sources may not cover all of the main ideas, but that can be useful also. Gaps on your

matrix could provide clues about the gaps in the current state of knowledge on your topic.

By the time you are finished, you will have a beginning of your report written in your own words.

12.6 Prepare your outline for the literature review

Watch this 6-minute **step-by-step tutorial** for Part I, writing a literature review.

Watch this 8-minute video about **organizing materials** for Part 2, for your literature review.

In general, a typical outline for a literature review may look like this:

I. Introduction
A. Introduce the research topic
B. Cite real-life examples

II. Definitions of terms
A. Contrasting definitions
B. Scholars' definitions from previous research
C. Different forms or illustrations of the terms

III. Review previous research
A. Relevant theories
B. Previous conclusions
C. Studies of similar populations'
D. Note differences among previous studies
E. Brief summary of conclusions of previous research
F. Gaps in research studies

IV. This study's focus
A. Purpose of the study (to fill a gap)
B. The plan is to …

For more ideas, watch this 6-minute video tutorial about **outlining and writing the literature review**.

Steeping some tea...

12.7 Real-world application: Write your literature review

Write your literature review. Transitional words and phrases are useful as you synthesize and compare/contrast your results with other scholarly work. This **link** will take you to a nice video from Fresno State University.

Then, use this checklist to review your literature review:

- Presented in appropriate academic style?
- A minimum of 15 to 20 references?
- An abstract 100 to 200 words long?
- The abstract specifies the central focus of the review?
- The abstract clearly describes what is covered in the review?
- The abstract gives a brief summary of the conclusions reached?
- The first page indicates what the literature review is about?
- Background information about the topic is *briefly* provided?
- The majority of articles were actually empirical studies?

- Divided into appropriate sub-sections?
- Each sub-section is well-organized?
- The sequence of sections is organized logically?
- A brief summary at the end of each sub-section?
- No spelling or grammar mistakes?
- Active voice used throughout?
- Summary in conclusion?

12.8 Formatting for bibliography (APA, MLA, Chicago)

In a scholarly publication, the reference list or reference page is a list of books, journal articles, and other sources cited in your report. This list provides enough information for readers to locate these sources if necessary. In your final manuscript, the reference list should include all references cited in the document and only the references cited in the document. Remember that references appear at the end of the document, whether it's a proposal, report, or article.

Watch the 10-minute video, **Using APA style for references and citations**,

Information needed for accurate citations should be accessible in the database listings. If for some reason you find an article that does not have the digital object identifier (doi), you must denote the website from which you retrieved the article. References should be alphabetized and formatted according to manuscript style guidelines determined by the publisher. Please refer to a resource such as the OWL at Purdue for resources or consult with the style manual for the appropriate format. The style manual will indicate the proper formatting for indenting lines, spaces between references, and reference elements (e.g., authors and initials, publication date, etc.). If you use RefWorks, just a few clicks (seriously!) will create your reference list for you in whichever style format you need. Hint: You still may have to proof-read the reference list and correct errors (such as uppercase vs. lowercase, etc.).

Steeping some tea...

12.9 Journal entry

Date the next blank page (for your entry today). Write for 5 to 10 minutes about your thoughts on situating your study within the context of the scholarly work of others. How did the others help you organize the logic behind your argument about your results?

12.10 In summary

After completing this module, you should now have:

- Learned how to read a research journal article.
- Organized scholarly article related to your research project.
- Prepared your logical argument.
- Outlined and written your literature review.
- Added to your research journal.

Review

Steeping some tea...

Add to your resume: Affiliations

Member, Cultural Understanding, Learning and Teaching [recognized student organization], Minnesota State University, Mankato.
Member, Minnesota Association for the Education of Young Children.
Secretary, Omega Theta Chapter, Kappa Delta Pi International Honor Society in Education, [recognized student organization], Minnesota State University, Mankato.

References

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Image credits

[1] Sandell, E. J. 2015. Research team at URS 2013 - 4. [Photograph]. Used by permission.

Module 13: Discuss results

Module Contents

Add to your resume: References

References

Image credits

Figure 13.1 Research team at URS 2016 – 2 [1]

13.1 Introduction to the module

Data analysis brought you to results about your research questions or hypotheses. These results may be stated as your conclusions. Discussion about your conclusions explains what they mean. The conclusions will be the basis for your recommendations or plan of action.

Figure 13.2 Writing the Results and Discussion Sections. R. Thibodeau. 2014. Source: YouTube.

The discussion section of your report may be the most important part of your report. This is where you bring *yourself* and your own critical thinking to present the meaning behind your research. This section is no longer objective reporting about information. This is an interpretation of your findings. Here are some elements that the discussion section of your report should present:

1. Creative solutions based on synthesizing the findings.

2. Deeper understanding of the problem you have investigated.

3. The position of your research results in relation to previous studies.

13.2 Module learning goals

Undergraduates seeking to discuss the results of their research project appropriately should complete this module in order to:

- Understand how the meaning of your findings adds to the usefulness of your investigation.
- Know the elements that should be included in the discussion of results.
- Consider the connections with previous research results related to your study.
- Understand the value of addressing limitations in order to increase the trustworthiness of findings.
- Explain the meanings of your own findings.

13.3 Key terms

Discussion is used in a research report to interpret and describe the value of your results, particularly related to previous investigations.

Limitations are used in a research report to describe qualities or characteristics of the study design that may have influenced the findings and limit the generalization of the results.

Recommendations from a research investigation are suggestions for best practices or actions to take in certain situations.

13.4 Rules for writing your discussion

Using first-person too often might distract the reader.

Use subheadings to help organize the discussion.

Do not simply repeat your statements of results and do not introduce any new results.

Do not be wordy or repetitive. Make your points succinctly.

Keep the same key terms, present verb tense, and writing style that you used in your introduction to the research problem.

Provide context for your study by briefly describing the questions or hypotheses that were addressed. Restate your results into the language of conclusions, usually within a single paragraph.

The sections of the Discussion section need to flow directly from the original study's research questions or hypotheses. Research questions --> methods --> results of data analysis --> discussion --> recommendations

13.5 Explain the findings

This section of your work is for the findings that emerged from the data analysis. Use a logical sequence, perhaps in the order of your research questions. Illustrate key findings with images such as figures, charts, photos, maps, tables, etc.

In the results section, avoid:

- interpreting your results (this goes in a later section)
- repetition of background to your study (this goes in an earlier section)
- ignoring any negative, biased, or inconclusive results
- raw data (this could go in an appendix)
- subjective statements (this goes in the discussion section)
- repeating the same data more than once

If your study had more than one research question or more than one hypothesis, you might find it easier to present one result and then explain it, before presenting the next result, then explaining it, and so on. This helps the reader to better understand each finding.

At the conclusion of this section, add a brief conclusion that ties each finding together. This creates a bridge to the section in which you will discuss the findings.

13.6 Explain the meaning of the findings

Make a list of things you have come to believe as a result of your study. Notes in your research journal could be helpful with this. Describe the lessons you learned. Were the results expected or unexpected? Were there unusual trends or patterns?

Here are some phrases that may be useful in your report of results and findings:

Another promising finding was that __
From the results, it is clear that __
It leads to good results, even if the improvement is negligible.
Our findings on __ at least suggest that __
Our results demonstrated that __
At this stage of understanding, we believe__
The results demonstrate two things. First, __. Second, __
The results of the experiment found support for the __
The results now provide evidence to __
This delivers significantly better results due to __

Steeping some tea...

13.7 Relate findings to similar studies

Connect your conclusions with the current academic and professional knowledge about your topic based on what you included in your literature review. Describe how your results complement or contradict findings in

previous investigations. Note exactly how your study responded to a previous dilemma or gap in the research.

Here are some phrases that may be useful in your report of findings in relation to similar studies:

A similar conclusion was reached by __
A similar pattern of results was obtained in __
Contrary to the findings of __, we did not find __
Even though we did not replicate the previously reported __, our results suggest that __
In line with previous studies __, it can be concluded that __
Overall, these findings are in agreement with findings reported by __
These basic findings are consistent with research showing that __
These results go beyond previous studies, showing that __
We have verified that using __ produces similar results to previous studies.
When comparing our results to those of past research, it must be pointed out that __

Steeping some tea...

13.8 Consider alternative explanations

Think beyond your hypothesis, assumptions, and biases. There may be alternative explanations for the results.

Here are some phrases that may be useful in writing about explanations for your results:

It is by now generally accepted that __
A popular explanation is that __
It is important to highlight the fact that __
It is interesting to note that __
It is unlikely that __
In contrast, this makes it possible to __
This is important because there is __
This implies that __ is associated with __
There were also some important differences in __
This may alter or improve aspects of __

Steeping some tea...

13.9 Acknowledge the limitations

Really, any investigation will have some limitations. Your study may have limitations on the results, due to the sampling technique or data collection strategies, subject mortality, location, history, instruments, testing procedures, subjects' attitudes, subjects' maturation or regression, methodology implementation, etc.

Understand the claims that you CANNOT make. For example, you cannot claim causation unless you have implemented a true experimental design. You cannot generalize to a population without a random sample and a response rate above 60%.

Comment on how the limitations might affect the validity of your results. Better to acknowledge the limitations within your work rather than allow your reviewers to find the problems. Keep in mind that you do not have to discuss every single limitation imaginable… just a few! Include some comments about how you think the limitations occurred (for example, if you had added a survey question, more information may have been found).

Here are some phrases that may be useful in your report of limitations:

A major source of limitation is due to __
An apparent limitation of the method is __
Another limitation in __ involves the issue of __
It presents some limitations, such as __
One concern about the findings of __ was that __
One limitation of our implementation is that it is __
One limitation of these methods, however, is that they __
Regarding the limitations of __, it could be argued that __
The main limitation is the lack of __

Steeping some tea...

13.10 Suggest further research

Additional research might overcome the limitations you have identified or issues that were raised during but not addressed by your study. Every experiment is limited in nature. This creates the opportunity to test a new hypothesis or related concept. Explain how the results may lead to a different,

but related question that would expand knowledge in your field. What resources will be needed for the next study? What different outcomes will you expect next time based on what you learned from this process?

Here are some phrases that may be useful as you make suggestions for further research:

In addition, several questions remain unanswered.
In future work, investigating __ might prove important.
It is difficult to explain such results within the context of __
Therefore, it remains unclear whether __
Future research should consider the potential effects of __ more carefully, for example __
Future research on __ might extend the explanations of __
This is very much the key component in future attempts to overcome __
This assumption might be addressed in future studies.

Steeping some tea...

13.11 Propose recommendations

The recommendations section describes what you think would be an effective plan of action based on your findings. Suggest some research-based best practices that could improve situations. Tell the reader how your results might be useful. What future activities could be conducted based on the results of this study? What should be continued? Who should do it? When?

How? What changes should be made? In curriculum? In partnerships? Who will implement these changes? When? How?

Here are some phrases that may be useful as you make suggestions for future improvements:

It is necessary to construct __
It is imperative to establish __
The integration of __ and __ will improve __
In order to achieve __, it is advisable to __

13.12 Real-world application: Writing the results section

The results section should follow an outline based on your research questions or hypotheses. Use the following chart to enter your research questions/hypotheses, the related results, and the explanation.

Research question or hypothesis	Related results from the data analysis (in data)	Explanation of the results (in words)

13.13 Journal entry

Date the next blank page (for your entry today). Write for 5 to 10 minutes about your thoughts on the results of your study. Interpretation involves identifying lessons you learned from the data. Use your journal entry to respond to some of these questions.

- What did you learn about the treatment? About the subjects?
- Were there any ‘ah-ha’ moments? What was new?
- What was expected or anticipated compared with results that surprised you?
- Were there ideas that you didn’t understand or that puzzled you?
- Where is further study warranted?

- What happened? What should happen next?
- Did the intervention achieve its goals? Why? Why not?
- Did something confound the study?

13.14 In summary

In this module, you have learned some basic methods and strategies to discuss the results of your study. After completing this module, you should now:

- Understand how the meaning of your findings adds to the usefulness of your investigation.
- Know the elements that should be included in the discussion of results.
- Consider the connections with previous research results related to your study.
- Understand the value of addressing limitations in order to increase the trustworthiness of findings.
- Be able to describe the meanings of your own findings.

Review

Steeping some tea...

Add to your resume: References

Ask 3 to 5 individuals if they are willing to serve as professional or academic references for your work or your studies. Then, add:

Name of Reference, Degree of Reference
Title, University Name or Organization
Street Address, City, State, Zip Code
Telephone and Email

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Image credits

[1] Sandell, E. J. 2015. Research team at URS 2016 - 2. [Photograph]. Used by permission.

Module 14: Disseminate results -
Make presentations and posters

Module Contents

Review

Add to your resume: Presentations

References

Image credits

Figure 14.1 Research team at URS 2013 - 2 [1]

14.1 Introduction to the module

Undergraduate students may choose to present their research at a conference, symposium, or other research-related event or forum. To share your research with others, you may want to consider presenting your work at an event or conference on- or off-campus. There are a variety of possible formats, such as a poster, an oral presentation, a creative work, or written and included in conference proceedings. If you are looking for academic dissemination so your work is noticed by as many as possible, an oral presentations will get the attention of more people in a room. However, if you are aiming for a discussion to help develop your ideas and identify new directions for your work, the poster presentation is probably better, since it allows more time for proper debate and discussion.

On-campus research events

Talk to your academic adviser and professors about presentation opportunities offered on-campus through departments and colleges. Depending on the quality and significance of the work, your supervisor may recommend that you submit it for presentation at a regional or national conference specific to your professional field or discipline.

Senior Symposia: Some departments or colleges sponsor events for graduating seniors to present their capstone projects.

Honors Capstone Meetings: College and university Honors programs may hold sessions that feature capstone projects from participants.

Undergraduate Research Symposia: Many universities hold conferences with sessions covering a range of topics including literature, science, history, creative writing, music, health care, engineering, philosophy, business, and politics. Here are some examples:

Undergraduate Research Conference at Boise State University

Celebrate Undergraduate Research and Creativity at Colorado State University

Off-campus research events

You may want to apply for presentation at the National Conference on Undergraduate Research (NCUR). This is sponsored by the **Council on Undergraduate Research** (CUR) to promote undergraduate research, scholarship, and creative activity in all fields of study. NCUR welcomes presenters from all institutions of higher education and from all academic disciplines.

General Tips: As a presenter at any conference, you should wear professional attire. You may be standing for a long time, so it is also important to wear comfortable clothing and shoes. To convey your ideas effectively, you need to speak with confidence. A confident voice has high volume, slow speed, and no fillers (like "right," "uh," "like," "you know," and "okay").

In a slide show presentation, do not just copy and paste photos from the web. It is not appropriate to use someone else's photos unless they have published them under a license that allows you to do so. Many photos published under (CC) **Creative Commons** licenses can be used for academic purposes with minimal restrictions. Be sure to cite the photo source.

14.2 Module learning goals

Undergraduates seeking to share their research with others should complete this module in order to:

- Understand the value and approach to presentations at scholarly conferences.
- Consider possible settings in which to make your undergraduate research presentations.
- Learn about making oral, poster, and creative presentations.

- Determine how to share your results with others.
- Complete an outline related to your presentation.

14.3 Key terms

Oral presentation simply involves explaining something to an audience. Oral presentations come in a variety of formats, from multimedia projects to group work to speeches.

Poster presentation provides research information, usually peer-reviewed work, in a paper poster that conference participants may view. A number of such posters are presented during a period called a "poster session."

Creative research presentation reports on projects that “produce new knowledge through an interrogation or disruption of form [as opposed to] the creative production that refines existing knowledge through an adaptation of convention. It is often characterized by innovation, sustained collaboration and inter-disciplinary or trans-disciplinary or hybrid praxis, challenging conventional rubrics of evaluation and assessment within traditional academic environments” (Tisch School of the Arts, 2019).

Conference proceedings are the collection of academic papers or presentations published as a result of an academic conference. Proceedings contain the research contributions at the conference and are usually distributed as printed volumes or in electronic form after the conference has ended.

14.4 Conference oral presentations

Students may choose to communicate and present their work in the form of an oral presentation. Oral presentations are more formal than poster presentations and you can practice your public speaking skills and display your expertise. Some professors prefer that their students conduct oral

presentations rather than poster presentations, so students will be better prepared for graduate study and beyond.

Figure 14.2 Undergraduate Research Sessions at 2014 Society of Physics Students, Denver, CO. Source: YouTube.

Outline for oral presentations

1. Introduction: What started your study? Why do you care? Why should we care? Anything surprising, interesting, funny, or important to share about your study? (1 minute)

2. Literature Review and Background: Who are the key authors? What have they already reported in regards to this research? What gaps does your study fill? (2 minutes at most)

3. Method: What did you do and why? What are your research questions or hypothesis? (1-2 minutes)

4. Results: This is the most important section! What did you discover? Why is it important? How does this study advance your field? How do your results

change things? Did you answer your research questions or your hypothesis? What did you learn? (7-8 minutes)

5. Conclusion: What are the implications of your study? Will you pursue this area further? What are the drawbacks or flaws to your study? What would you do differently? (1-2 minutes)

Here is an **outline** for a presentation with about 20 slides.

Guidelines for oral presentations

1. Follow the graphic standards when using your university's logos and colors. It is recommended that you use logos in the EPS format.
2. Practice your presentation several times to make sure you are familiar and comfortable with the content.
3. Prepare for the time allocated for each presentation.
4. Save your presentation to your university server and to a personal USB. Send it to yourself via email as back up.

Tips for presentations with slides

1. Introduce your study in a thoughtful and provocative manner.
2. Do not use more than 10 to 20 slides. Fewer is better than more. Consider that each slide might take about 1 minute to present.
3. Use pictures and visuals to enhance your message. Avoid too much text.
4. Be mindful of color choice in text and background—make sure the audience can see everything!
5. Double check to make sure graphs, figures, tables, and the overall system is compatible.
6. Do not put your speaking outline on the PowerPoint.
7. Remember; you are not required to use a PowerPoint!

At the oral presentation

1. Arrive 30 minutes before the beginning of your session.
2. Upload projects onto the provided computer.
3. Often, moderators are assigned to each session. This person is likely to be a faculty member, may help you set up, and introduce you to the audience.
4. Speak loud enough, clear enough, and slow enough!
5. Do not read your presentation to the audience!

Here are some additional ideas:

How to Engage Your Audience from Hamilton College, Clinton, NY

14.5 Conference research posters

For many disciplines, a research poster is more valued that an oral presentation. Some poster sessions display both completed projects and those that are clearly not quite finished.

Figure 14.3 2019 Undergraduate Research Symposium. Florida State University, Tallahassee, FL. 2019. Source: YouTube.

Contents for poster presentations

Because of limited space, a poster needs to focus on one core idea. Before you design your poster, write about 100 words to summarize the purpose and findings of your investigation. The poster should present this message visually. Make an impact with your focus. Do not waste space on minor details.

Tips for poster presentations

In general, most posters communicate information with visual elements to separate different sections of the poster and direct the viewers' attention to key findings.

- Use lots of white space. Limit use of color.
- Align and evenly spaced elements.
- Do not use more than two attractive, easy-to-read fonts, such as Helvetica, Times New Roman, Trebuchet, Century Gothic. Sans serif fonts (e.g., Helvetica) usually are easier to read than serif fonts (e.g., Cambria).
- Consistently use minimal outlines, boxes, color backgrounds, and gradients. Be aware that some people cannot discern the differences between several colors.
- Follow graphic standards when using university, wordmarks, logos and colors.
- Use larger lettering for the poster’s title and author.
  Use **bold** or *italicized* type sparingly and only to emphasize certain text. Do not underline or use upper case.
- Keep sections of text fewer than 10 lines long.
- Use bullet points instead of full paragraphs of text.
- Generally, dimensions for conferences in the US are 46” to 50” wide x 36” to 40” high.

- Use visual aids such as images, charts, figures, timelines, and diagrams to make your poster less text-heavy and more visually appealing instead of just listing the data in a table.

Printing and transporting the poster

Consult your faculty mentor prior to submitting your poster for printing to be sure it's ready, clear, and professional. Transport your poster in a long plastic bag, or a plastic tube. Bring these things with you to the poster session:

1. Your poster.
2. A sign that reads "Will be back in 5 minutes."
3. A notepad and pen to record information.
4. A signup sheet so you can later contact interested visitors.
5. Business cards (optional).

At the poster session

Have a one- or two-minute mini-speech (the "elevator talk") ready to go. When people begin looking at your poster, don't wait for them to ask a question. Just say, "Would you like to hear about my research for a minute or two?" Offer to answer questions, and if you don't know an answer just admit it and speculate with the people or ask what they might do.

Here are some additional ideas:

Poster Sessions from Colorado State University, Fort Collins, CO

Poster Presentations from University of Leicester, Leicester, UK

14.6 Conference creative research presentations

Possibilities for creative works include poetry, visual art, screen play, song, performance, story, *YouTube* movie, photo

collection, *Facebook*, *Pinterest* collection, *Tumblr*, or *Twitter*. The specifics of your own presentation, of course, will be dependent on the genre and approach of your project. Work with your mentor to determine the best way to share your results.

Figure 14.4 2017 Undergraduate Fine Art Degree Show, Newcastle University, Newcastle Upon Tyne, England. Source: YouTube.

Contents for creative research project exhibit

A report, paper, performance, exhibit, or presentation about a creative project will include:

1. Clear statement of the problem or question to be resolved.
2. Clear summary of methods, results, and conclusions.
3. Background research that reflects on the significance of the problem.
4. Description of the creative process.
5. Quality presentation of the creative product.
6. A logical explanation for the outcomes.
7. Clear implications for future work.

Here are the titles of several examples of creative research project presentations:

Conversation with Jane Austen: A creative writing proposal.

Presenting the work of Gordon Parks in his hometown: a study of Twin Cities culture and theatre.

History of the stage manager in theatre arts.

14.7 Conference proceedings

You may want to prepare your research report in order to publish it in the conference proceedings, *after* presenting at the conference. This is another way to disseminate your experience and knowledge. Here is a web link for the **NCUR Proceedings.**

14.8 Real-world application: Outline your presentation

Write two to four sentences about each of the elements of your presentation. Be concise.

Steeping some tea...

Steeping some tea...

Steeping some tea...

Steeping some tea...

Steeping some tea...

14.9 Journal entry

Date the next blank page (for your entry today). Write for 5 to 10 minutes about your thoughts on making presentations and/or posters about your study.

- Who do you want to talk with about your project?
- Why would you choose a presentation? A poster?
- What conferences are likely to show interest your work?

14.10 In summary

In this module, you have completed at least one more step related to scholarly research. After completing this module, you should now:

- Understand the value and approach to presentations at scholarly conferences.
- Have considered possible settings in which to make your undergraduate research presentations.
- Learned about making oral, poster, and creative presentations.
- Determined how to share your results with others.
- Have completed an outline related to your presentation.

Review

Steeping some tea...

Add to your resume: Presentations

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Holstein, Germany.

Gangoso-Aguila, A. F., Arndt, J., et al. (2018, April). Impact of Service Learning on the Inter-Cultural Competency of Pre-Service Teachers. Presented at the 2018 National Conference on Undergraduate Research, Edmond, Oklahoma. https://cornerstone.lib.mnsu.edu/eec-presentations/1/

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[1] Sandell, E. J. Research team at URS 2013 – 2. [Photograph]. Used by permission.

Module 15: Disseminate results -
Write abstracts and articles

Module Contents

Image credits

Figure 15.1 Research team at WCUR 2019 – 9. [1]

15.1 Introduction to the module

How will you disseminate the results of your projects beyond your classroom? Written material can be easily disseminated in a variety of ways by hard copy or on-line: abstracts, scholarly journal articles, full and comprehensive reports, newsletters and brochures, news releases, professional journals and magazines.

One of the main decision-making points is to determine the audience for your written material. Sometimes we call them 'stakeholders.' These are people, groups, or institutions who may be extremely interested in your results. They

may have contributed time, energy, ideas, or financial support. They may want to implement your recommendations. Audiences may include:

- other undergraduate students in your college or university
- foundation board members
- your hometown community
- administrators of your college or university
- policy-makers
- graduate school admissions committees

The most useful reports will include the specific information in formats that will be understood by the audience receiving the reports. Various groups will have different perspectives on the meaning and importance of your findings. It is likely that reports to one particular group or audience will look different than reports to other groups.

Before developing a specific report, consider:

- Who is the audience for this report? What type of audience do you want to reach?
- What type of audience are you looking to reach?
- What does the audience need to know? Which aspects of your topic would be the most interesting to that audience?
- Will your ideas be popular or controversial among your audience?
- What report format best reaches this audience?
- What are the requirements or standards for that report format?

This 8-minute video will give you background about the possibilities and processes of publishing as an undergraduate.

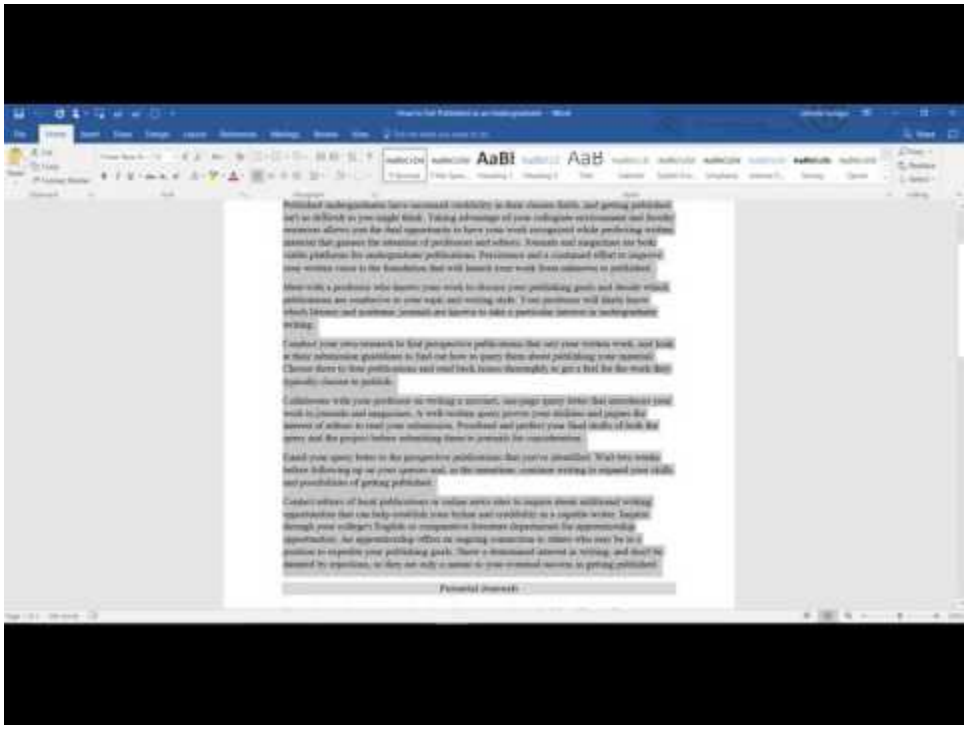

Figure 15.2 How to Publish as an Undergraduate Student. C. Zuniga. 2017. Source: YouTube.

Your written materials are going to encourage further discussions on particular topics, and your paper will serve as your admission into a select academic community. This is just the beginning. The more you become involved with that community, the more you will understand the expectations of your audience.

15.2 Module learning goals

Undergraduates seeking to share their research with others should complete this module in order to:

- Understand the value and approach to academic writing of research reports.
- Consider possible undergraduate research publications.
- Practice using the academic styles related to scholarly publications.
- Learn about writing abstracts and scholarly articles.
- Complete an abstract related to your reporting.

15.3 Key terms

A style guide or **style manual** is a set of standards for writing documents, either for general use or for a specific publication, organization or field. Style guides provide uniform formatting across multiple documents. The standards assist readers in accessing the material in consistent ways.

An abstract is a concise summary of your research or creative project.

Scholarly journal articles are written by scholars or professionals who are experts in their fields and reviewed by their peers (other scholars or professionals). These articles often include research results.

15.4 Style guides

A style guide or **style manual** provides uniform formatting across multiple documents. The standards assist readers in accessing the material in consistent ways. For any publication, it's important to get the editor's manuscript guidelines that specify acceptable style and format. If you do not follow the editor's manuscript guidelines, the editor may simply refuse to review your submission. Here is an example -- the JUIS submission guidelines:

Here is an example of one publication's guidelines:

To submit your work, email it as an attachment to juis@global.wisc.edu, following these guidelines:

1. Use 12-point Times New Roman font.
2. Double-spaced text.
3. File in .docx format.
4. No author-identifying information should be present in text.

5. Follow the **Chicago Manual of Style** for all citations. Please use Indo-Arabic numerals, not Roman.
6. Convert all your citations and footnotes to end-notes. (You may wait for our decision process before conversion.)
7. Include an abstract of no more than 100 words.

Note that these submission guidelines have specified the style manual to be followed and the length of the abstract (which is shorter than mentioned earlier in this module).

Be sure to ask your mentor for the preferred style used by your discipline. Here are links to information about some of the more common style manuals used in the US.

- ***The Chicago Manual of Style***, Chicago: University of Chicago Press.
- ***A Manual for Writers of Research Papers, Theses, and Dissertations***, *Chicago Style for Students and Researchers*, by Kate Turabian. Often referred to as "Turabian."
- ***Modern Language Association Handbook for Writers of Research Papers***, by Joseph Gibaldi. Often referred to as "MLA."
- ***Publication Manual of the American Psychological Association***, by the American Psychological Association. Often referred to as "APA."

15.5 Abstracts

An **abstract** is a concise summary of your research or creative project. You may have more than one version of your abstract, depending on the purpose, e.g., conference proposals, journal articles, grant applications, etc.

Generally, an abstract should be between 100 to 250 words, not including the title, names of authors, and their affiliations. The abstract details only the

most important parts of your project. Devote about one or two sentences to summarizing each section of your project:

1. Problem statement: Describe the question or problem or concept that you investigated.
2. Significance: Describe why the reader should care about this problem. What practical, theoretical, or artistic gap is your research going to fill? What does your reader need to understand about why you conducted this investigation or creative activity?
3. Methods or procedures: Mention relevant details about the methods that you used. How did you perform the study? What methods did you use (e.g., surveyed 100 students, compared 5 programs, etc.)? Make sure that your methods would logically lead to the results.
4. Results or products: Describe your most significant findings. What did you accomplish? What did you learn, invent, or create? If you have not yet finished your project, describe your predicted results in one sentence.
5. Conclusion or implications: Describe the larger implications of your results. Make sure your results would logically lead to your conclusions.

Use key phrases and words throughout the abstract. Others will use those key words in searching online databases, just as you did when you worked on your literature review. You want your article to show up in their search results. Incorporate 5 to 10 words or phrases that are key to your research. For example, if you're writing a paper on the cultural differences in clinical depression, be sure to use words like "depression," "cross-cultural," "culture-bound," "mental illness," and "societal acceptance." These might be search terms people use when looking for a paper on your subject.

For more ideas about writing your abstract, watch this 11-minute video, Tips for Writing an Abstract, with Whitney Curds-Ogilvy (2017).

15.6 Scholarly articles

As you learned in your own literature search and literature review, **scholarly articles** are written by scholars or professionals who are experts in their fields and reviewed by their peers (other scholars or professionals). These articles often include research results. Now that your own investigation is complete, you can write your own scholarly article!

In general, journal articles have several common elements, although the outline might not reflect the order in which you did the work. And the order of these elements in an article will vary according to the requirements of the publisher. You should always follow the publisher's manuscript guidelines for content, order, length, and style as you write your article. Here is a list of the common elements of scholarly journal articles:

1. Title: Describe the subject matter or summarize the results.
2. Authors: List the primary researcher as first author. Add others who have contributed significantly to the work.
3. Abstract: One paragraph of about 250 words that gives a preview of the article, without any abbreviations, citations, or footnotes.
4. Introduction: One to four paragraphs that summarize related literature and end with the specific research problem or question addressed by your investigation.
5. Significance: Lead the reader through the logic of the study and its value to the field.
6. Materials and Methods: Provide enough detail that any other investigator might be able to repeat the study, such as information about population, sampling, consent, instruments, and the design for data analysis.
7. Results: Summarize in text the main findings from the data analysis specifically in response to the original research questions. This section should NOT include discussion points or your ideas about causes or

impacts. Include tables and graphs if necessary to present the results in understandable ways.

8. Discussion: Present your responses to questions such as: How did the results answer the original research questions? Did the results support your hypothesis? Why or why not? How do the results compare with results of other investigations? Are there alternative explanations for your results?
9. Recommendations: Describe what you think should happen as a consequence of your study results. What additional studies might be needed to respond to the questions?
10. Conclusion: Briefly present your conclusion, with some emphasis about how it's relevant to your discipline.
11. Acknowledgments: Express appreciation to folks who contributed to the study, such as reviewing the study design, comments on your analysis, helping with experiments, or funding for instruments, travel, or other expenses.
12. References: Lists the resources in alphabetical order, in style and format accepted by the publisher.
13. Notes: Includes other information as needed by the publisher or financial supporters.

There are many publishers of articles by undergraduate researchers. Some universities publish journals for their own undergraduates. For example:

Journal of Undergraduate Research (JUR), (Minnesota State University, Mankato)

You might choose to submit your materials to a journal that features exclusively work from undergraduate students, no matter their campus, subject, discipline, or professional field. Here is a list of examples:

Journal of Undergraduate Research (JUR) (Colorado State University, Fort Collins)

American Journal of Undergraduate Research (AJUR) (Oswego State University of New York)

Reinvention: an International Journal of Undergraduate Research (IJUR) (Monash University and University of Warwick)

Or, you might choose to submit your manuscript to a journal that is specific to your subject, discipline, or professional field. Here is a list of examples:

RURALS: Review of Undergraduate Research in Agricultural and Life Sciences (University of Nebraska-Lincoln)

Journal of Undergraduate Chemistry Research (Virginia Military Institute)

Undergraduate Journal of Psychology (University of North Carolina-Charlotte)

The Journal of Undergraduate International Studies (JUIS) (University of Wisconsin-Madison)

For more ideas about writing your journal article, watch this 12-minute video, **How to Write a Scientific Journal Article**, with Lisa Lines (2017).

15.7 Real-world application: Write your abstract

Write two to four sentences about each of the elements of your abstract. Be concise and limit the abstract to between 100 and 250 words.

Steeping some tea...

Steeping some tea...

Steeping some tea...

Steeping some tea...

Steeping some tea...

15.8 Journal entry

Date the next blank page (for your entry today). Write for 5 to 10 minutes about your thoughts on writing abstracts and/or articles about your study. What publications are likely for your work?

15.9 In summary

In this module, you have completed at least one more step related to scholarly research. After completing this module, you should now:

- Understand the value and approach to academic writing of research reports.
- Be aware of several possible undergraduate research publications.
- Know steps in writing abstracts and scholarly articles.
- Have practiced using the academic styles related to scholarly publications.
- Have completed an abstract related to your research.

Review

Steeping some tea...

Add to your resume: Relevant coursework

Intercultural communications, 4 credits, Spring 2019.
Human Relations in a Multicultural Society, 3 credits, Fall 2018.
Research in Education, 4 credits, Fall 2018.

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Image credits

[1] Sandell, E. J. 2019. Research team at WCUR 2019 – 9. [Photograph]. Used by permission.

Glossary

Action research is "systematic observation of one's own classroom or teaching practice with the purpose of understanding and improving the quality of instruction and enhancing learning (Johnson, 2018)." (module 3)

Analysis procedures are performed on data that may include coding, summarizing, or statistical analysis. (module 8)

Applied research is carried out for practical applications and problem-solving functions. (module 1)

Attitude is the opinion or feeling that the participant changed as a result of completing the program.

Basic research is carried out to discover something simply for the sake of knowledge to improve our understanding of the world, and for academic rather than commercial purposes. (module 1)

Case study gives detailed consideration to the development or change of a particular person, group, or situation over a period of time. (module 6)

Confidentiality is a situation where the identities of the respondents are protected and not made public by the researcher. (module 5)

Confounding variables influence both the dependent *variable* and independent *variable*, causing a false or misleading association. (module 1)

Control group of subjects is similar in characteristics to the treatment group, but is not exposed to the same treatments, conditions or situations. (module 1)

Convenience sample is made up of readily available subjects used in a research study. Also: Availability sample. (module 7)

Causal-comparative study (module 6)

Correlational research (module 6)

Survey research (module 6)

Evaluation research (module 6)

Content analysis (module 6)

Historical study (module 6)

Correlation and causation

Correlation coefficient

Data is simply information. It may take various forms: numbers, narrative, scales, or observations. (module 7)

Dependent variable is influenced by the treatments, conditions or situations (the independent variables) that the researcher seeks to explain. These are always measured or observed, not manipulated. (module 1)

Descriptive study provides a description of the researcher's observations, findings, results of data analyses, what people said during interviews, etc., of a phenomenon under study. (module 6)

Ethnography is a qualitative research methodology used to observe people in their natural and uncontrolled social and cultural settings. (module 6)

Evaluation research is carried out to gauge the relevance, suitability and effectiveness of a specific (public relations or other) campaign or program, being implemented. Also: program evaluation. (module 1)

Experimental research studies *the effect of a particular approach or treatment*. The experimental research design identifies conditions or situations about which the investigators want to reach some conclusions. Usually, the researchers create a controlled, artificial environment, so they can safely manipulate the situation. (module 1)

Experimenter bias (also called observer bias or research bias) is the tendency for investigators to see what they expect to see or what they want to see. When a researcher studies a certain group, they usually come to an experiment with prior knowledge and subjective feelings about the group being studied.

Falsifiability is the capacity or possibility for some proposition, statement, theory or hypothesis to be proven wrong. That capacity is an essential component of the scientific method and hypothesis testing.

Replication research refers to the repetition of a *research* study, generally with the same methods but with different situations and different subjects, to determine if the basic findings of the original study can be applied to other participants and circumstances.

Focus group is a qualitative data collection method using a group interview of 6-12 people to gather their opinion on a specific social, political, or environmental issue.

Formative research is research that occurs before a program is designed and implemented, or while a program is being conducted. (module 1)

Hypothesis is the tentative conclusion that the investigators expect to reach. The hypothesis is created as a formal statement made about the predicted

relationship between variables in a research study, which is directly tested by the researcher. Generally linked to deductive reasoning. (module 1)

Independent variables are the treatments, conditions or situations that the investigators manipulate to influence the dependent variable (people, animals, plants or things). (module 1)

Informant helps a researcher in a field study by helping them gain access to the setting, introduce them to the members of the setting, answer questions the researcher may have and provide clarifications. Often it is a member of the setting.

Informed consent is agreement to participate in research, with full knowledge of the possible risks and benefits. (module 5)

Interval data involves ranking objects or individuals on a variable, with assuming equal distance between ranks and without an absolute zero. (module 6)

Summated ratings approach, also known as the Likert scale, uses an interval scale prepared by the researcher to address the concept under examination. The numbers given by a respondent to each of the statements on the interval scale are added to obtain a composite score.

Literature review is an examination of the existing research publications on the topic area of a new study, to discuss the existing researchers' theorizing, research designs, data collection methods, findings, strengths, limitations and contexts as relevant to the new one. This also includes the investigator's own views and observations, and alternative explanations of the findings as to what other factors may have given rise to those findings. (module 4)

Literature search is the process of locating existing research publications on the topic area of a new study. (module 4)

Mean is the mathematical average of a group of numbers. The mean is calculated by summing the total of all events and dividing by the number of subjects. (module 8)

Mentor is a faculty supervisor who takes on the responsibility of teaching the beginning researcher the skills, knowledge base, and culture of that discipline. (module 2)

Mentee is a person who is advised, trained, or counseled by a mentor. (module 2)

Methodology is the strategic plan of action, process or design used in a research study, e.g. experimental research, ethnography. (module 6)

Methods are the various data collection and analysis techniques, practices and procedures followed in research, e.g. survey questionnaires, focus groups. (module 6)

Nominal data involves two or more categories. Nominal data is often used for demographic data. (module 6)

Ordinal data involves ranking objects or individuals on a variable, without assuming equal distance between the ranks. Ordinal data is often used for satisfaction data. (module 6)

Outcomes are changes for participants during or after their involvement with an intervention. Outcomes could involve knowledge, skills, behaviors, attitudes, values, conditions, or status.

Participant observation is a technique of research in which an investigator (the *participant* observer) studies a group by sharing in its activities.

Participatory or action research has a problem-solving function for social justice to benefit people who are powerless or marginalized. Participatory

action research involves community members as co-participants to make their own decisions and take action, to improve their own lives. (module 1)

Population is a group of individual persons (objects or items), from which samples are taken for measurement and experimental study. (module 7)

Primary sources are scholarly publications written by those who conducted the research. Such sources are generally published as academic works, such as journal articles, books, etc. (module 4)

Program evaluation collects information in order to judge the value or usefulness of specific, ongoing programming. Usually, it occurs in community settings that cannot and probably do not want to control for number of participants or to randomly select those who receive services. Carried out to gauge the relevance, suitability and effectiveness of a specific (public relations or other) campaign or program, being implemented. Also: evaluation research. (module 1)

Purposive sample is made up of cases or individuals who meet the requirements of the study's design and possess the required characteristics. (module 7)

Quantitative research produces data in numerical form and is usually analyzed using descriptive and inferential statistics. (module 6)

Quantitative data is numerical and can be counted, e.g., responses to close-ended questions in a survey. (module 6)

Qualitative research produces evidence in textual, verbal, or visual form and is most often analyzed qualitatively, but it can also be analyzed quantitatively. (module 6)

Qualitative data is not numerical and is embedded in their context, e.g., responses to open-ended questions in a survey or opinions of people. (module 6)

Random assignment provides that each participant has the same opportunity to be assigned to any given group, such as the experimental group or the treatment group. (module 7)

Random sample is a subset of a population in which each subject has an equal chance of being selected for the study. (module 7)

Ratio data sets involve equal intervals between values and an absolute zero value. For example, ratio scales may be used for temperature, height, weight, time, distance, and speed. (module 6)

Recursive process - steps that are completed, revisited, and then completed again. (module 3)

Representative sample is a subset of a population selected to accurately reflect the characteristics of the larger group. For example, a study of a classroom of 30 students in which 18 are males and 12 are females could generate a representative sample of five students: three males and two females. (module 7)

Research is a systematic investigation used to collect data to answer questions posed by scientists, to establish consistent understandings, to reach new conclusions, and to contribute to the general knowledge base. Different types of research provide different understandings and conclusions. (module 1)

Research problem is a statement about a concern, a situation, an issue, or a question in academic literature. (module 3)

Research question/s are the overall questions, problems, or topics that the researcher wants to answer. The questions are used to define and organize the investigation. Data is then collected to examine the research question/s. The questions are generally linked to inductive reasoning. (module 1)

Research topic is a subject or issue in which an investigator is interested. (module 3)

Sample is a subset of a population which is included within the study. Usually, the size of the sample is much less than the size of the population. The primary goal of much research is to use information collected from a sample to try to generalize or to characterize a certain population. (module 7)

Scholarly sources are materials written by experts in a particular field that inform others about recent research and conclusions (also referred to as academic, peer-reviewed, or refereed sources). (module 3)

Science is a body of knowledge about a specific discipline or subject area. Also, science is a systematic process to examine and organize the world around us. (module 1)

Secondary sources are summaries of existing research, literature reviews, analyses, commentaries, opinions, textbooks, etc. written by people who did not carry out the original research. Such sources help to identify the key research studies, theories and scholars in the area of investigation. (module 4)

Selection bias is introduced by the *selection* of individuals, groups or data for analysis in ways result in every possible subject having an equal possibility of being selected. The result is that the sample is not representative of the population intended to be analyzed. (module 7)

Snowball sample (also known as referrals) is made up of referrals from subjects who identified other suitable subjects, usually in areas that are difficult to conduct research in. (module 7)

SPSS Statistical Package for the Social Sciences: the computer software commonly used in the quantitative analysis of data. (module 8)

Statistical significance is used to describe if the scores or means were of significance in statistical terms. This does not determine “value” or “importance” of a program. (module 8)

A style guide or **style manual** is a set of standards for the writing and design of documents, either for general use or for a specific publication, organization or field. Style guides provide uniform formatting across multiple documents. The standards assist readers in accessing the material in consistent ways.

Subject is a person studied in a research project; may receive a treatment and may change in some way. (module 7)

Summative research is conducted at the end of a project and is used to determine the project's success. It can also gauge customer satisfaction or aid in the development of future projects. Also: conclusion research. (module 1)

Theory is based on several related hypotheses that form *an organized set of ideas* that describes, explains, and predicts behavior. (module 1)

Treatment group is the group of participants or objects that experience the particular treatments, conditions or situations that are of interest to the researchers. (module 1)

Variable is the observable or measurable counterpart of a construct describing how a researcher will measure the construct. It has a set of values assigned to it and can be either quantitative or qualitative. (module 1)

Volunteer sample is composed of those responding to the researcher's call for participants. (module 7)