



POLYTECHNIC UNIVERSITY OF THE PHILIPPINES
COLLEGE OF COMPUTER AND INFORMATION SCIENCES
DEPARTMENT OF COMPUTER SCIENCE | DEPARTMENT OF INFORMATION TECHNOLOGY

FUNDAMENTALS OF RESEARCH

INSTRUCTIONAL MATERIAL FOR STUDENTS

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Appendices

Group Project Requirement: Deadline: January 4, 2021. Name the file as your YR & SEC. LNames

1. Form 2 members per group, choose a major topic from the list below:
 - a. IT Major Topics
 - i. ISD Information System Design
 - ii. BPO Business Process Outsourcing
 - iii. Network
 - b. CS Major Topics

- i. NLP Natural Language Processing
 - ii. CI Computational Intelligence
 - iii. AI Artificial Intelligence
 - iv. HCI Human Computer Interaction
 - v. DSP Digital Signal Processing
 - vi. ML Machine Learning
- 2. Research subtopics of your chosen major topic and identify keywords to be included.
- 3. Produce Chapters 1 -3 with the following appendices:
 - a. Appendix A – References (ACM format)
 - b. Appendix B – Curriculum Vitae of 2 Researchers
 - c. Appendix C – Questionnaire to be utilized in the treatment of data gathered
 - d. Appendix D – Expected List of Respondents

**RESEARCH IS
FORMALIZED
CURIOSITY. IT IS
POKING AND PRYING
WITH A PURPOSE.**



QUOTEHD.COM

Zora Neale Hurston
American Anthropologist
1891 - 1960

CHAPTER 1: The Problem and Its Background

LEARNING OBJECTIVES:

At the end of this chapter you should be able to:

- Explain the meaning and nature of research
- Explain the importance of research
- Enumerate the characteristics of research
- Describe the research process
- Identify the types of researches according to different classifications
- Describe the difficulties encountered in research
- Cite sources of research topics
- Identify the characteristics of a good research topic
- Describe what is a thesis
- Describe the general outline for a thesis paper

READING MATERIALS:

MEANING OF RESEARCH

Research is defined as a “structured inquiry that utilizes acceptable scientific methodology to solve problems and creates generally acceptable knowledge” (Grinnell, 1993). It is about confirming that what you assume or think is based on science. The results of the findings is not necessarily imposed to anyone. Another researcher may accept or reject it; he/she just have to prove his points or views by conducting related research to come up with scientific proof. Research is generation of new knowledge to add up to what is known today.

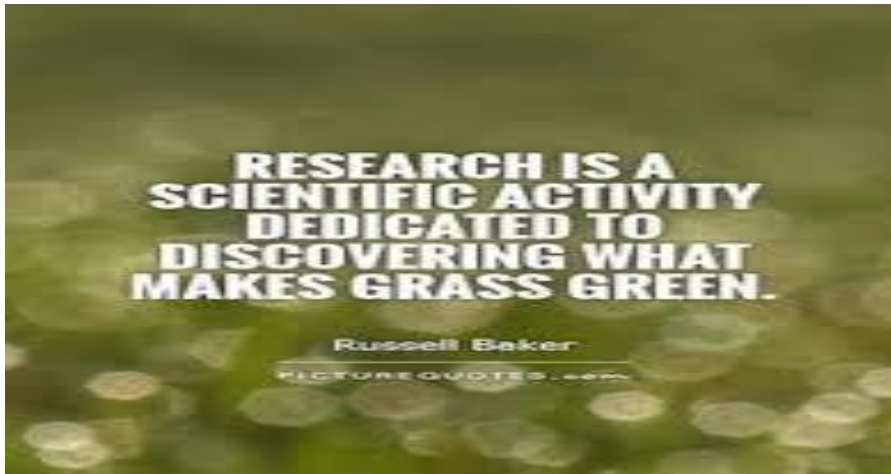


Image source: pinterest.com

NATURE OF RESEARCH

Research, as a scientific method of inquiry involves systematic processes (as illustrated in Figure 1), right methods and techniques, and appropriate tools.

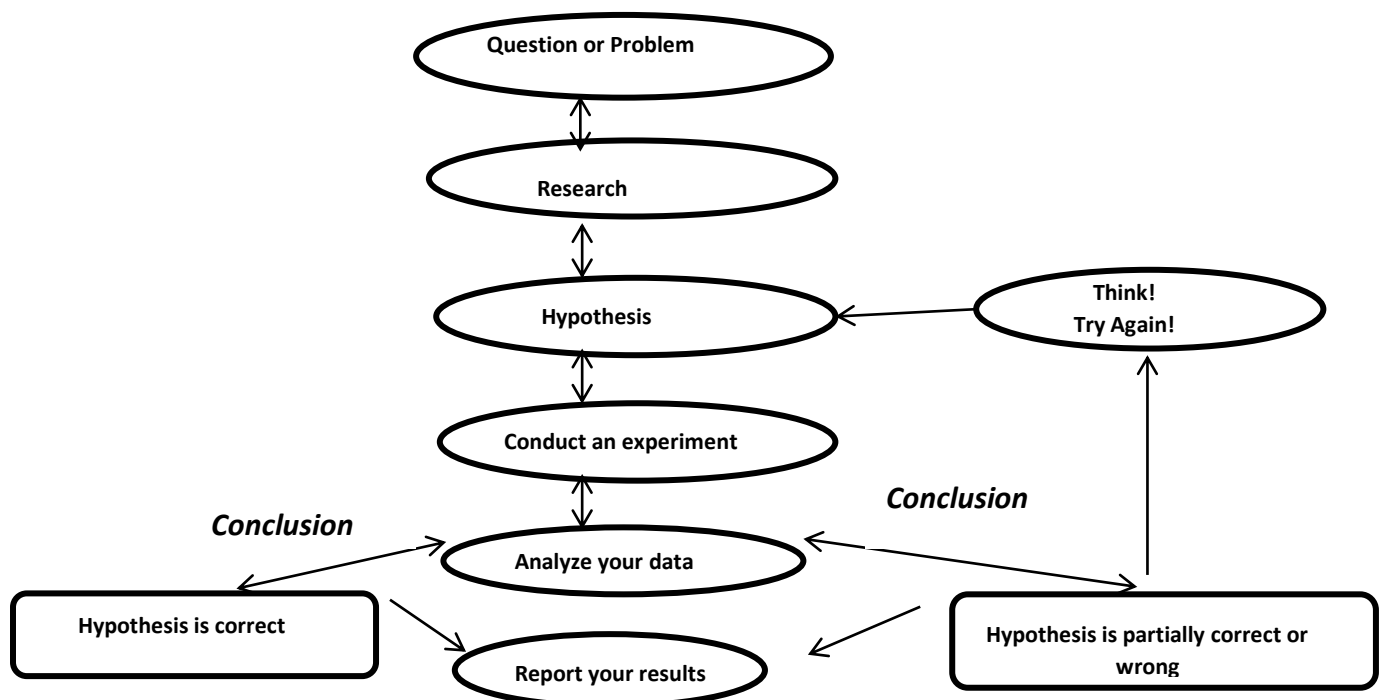


Figure 1. The Scientific Method

The Scientific Method of Doing Research:

1. Do background research and synthesize related studies on topic of interest
2. Ask questions. Identify gaps in the existing body of knowledge.
3. Do more detailed background research and review of related literatures. Identify their limitations.
4. Develop hypothesis
5. Test hypothesis (using Methods)
6. Analyze data (Results of tests and methods)
7. Interpret findings (Discussion and Conclusions)

The **scientific method** “is a body of techniques for investigating phenomena, acquiring new knowledge, or correcting and integrating previous knowledge” (Goldhaber & Nieto 2010). The scientific method starts when you ask a question about something that you observe: How, What, When, Who, Which, Why, or Where? A hypothesis is an educated guess about how things work. It is an attempt to answer your question with an explanation that can be tested. A good hypothesis allows you to then make a prediction. Your experiment tests whether your prediction is accurate. In the experiment, you change only one factor at a time while keeping all other conditions the same. Once your experiment is complete, you collect your data/measurements and analyze them to see if they support your hypothesis or not. Researchers often find that their predictions were not accurate and their hypothesis was not supported, and in such cases they will communicate the results of their experiment and then go back and construct a new hypothesis and prediction based on the information they learned during their experiment. This starts much of the process of the scientific method over again. Even if they find that their hypothesis was supported, they may want to test it again in a new way.

IMPORTANCE OF RESEARCH

Research is the source of new discoveries that are utilized to support the truth; to help researchers in the discovery of new phenomena and deduce meaning from complex situations; to help us make informed decisions; to improve teaching in universities; to help businesses or organizations to improve, re- think or re design certain aspects of the business for success; to create and implement policies, procedures, techniques, and tools that help solve societal or organizational problems in the local, national, regional or international scope.

Researches that are funded by government agencies should be attuned to the national development plan. Hence, these researches should be relevant and responsive to the needs of the society; and organizations should be able to use the results (data generated) of the study for the improvement of organizational processes.

CHARACTERISTICS OF RESEARCH

- Empirical - based on observations and experimentation on theories.
- Systematic - follows orderly and sequential procedure.
- Controlled - all variables except those that are tested/experimented upon are kept constant.
- Employs hypothesis – an assumption that guides the investigation process
- Analytical - There is critical analysis of all data used so that there is no error in their interpretation
- Objective, Unbiased, & Logical - all findings are logically based on empirical data

- Employs quantitative or statistical methods - data are transformed into numerical measures and are treated statistically.

Source: https://en.wikiversity.org/wiki/Characteristics_of_research

THE RESEARCH PROCESS

Research is a systematic process of discovering something. You conduct research because you want to fill some gap in the existing body of knowledge. You want to gather data from which you will draw out your findings and conclusions. Gathering these data and information requires several painstaking activities including formulating specific research questions or objectives, formulating hypotheses or assumptions, conducting surveys and experiments, recording, analyzing and then interpreting the results of these surveys and experiments. For those in science, technology, engineering and mathematics field, it is often necessary to develop models, tools, or prototypes that will be subjected to tests and experiments. A researcher might conduct an experiment to determine the level of accuracy or reliability of a new technology (model/prototype) in terms of a specific aspect. An experiment is also necessary to determine the effect of the introduced innovation or intervention to a certain population. Results of these tests and experiments will then be summarized and analyzed to answer the specific research questions formulated early in the research process. These specific research questions serve as specific objectives that will guide researchers along the research process. The right methodologies and techniques need to be applied to be able to come up with the data that will serve to answer these specific questions. Below are the steps in developing your thesis, which is an academic research.

Begin with a question.

Think about which topics and theories you are interested in and what you would like to know more about. You may want to choose a problem related to your own personal battle in your specific program or field of study. Think about the topics and theories you have studied in your program. Is there some question you feel the body of knowledge in your field does not answer adequately?

A good research (point of inquiry/investigation) actually stems from conflicting theoretical claims of theorists, and/or conflicting results from previous studies. It may also stem from a sound recommendation of past researcher.

In formulating research objectives (specific problem statements or research questions): there is no point to prove something (in the problem statement) that is already obvious or is known. There is also no point to compare characteristics/data resulting from the difference in structure and nature (e.g. comparing performance of different algorithmic structures is like comparing the performance of a dog and a cat). Thesis advisers and/or thesis panel should look into all these things. However, we should be careful not to presume that a certain inquiry or investigation already has a given or fixed answer or if the already known value/answer generally applies to all scenario.

Search.

Once you have a question in mind, begin looking for information relevant to the topic (related literatures and studies), and its theoretical framework. Back-up your claims by schematic or textual framework from emerging theories discussed in which the study was anchored. Theoretical framework serves as blueprint of the study that allows you to understand how things go the way they will. It contains explanation or meaning of variables (and relationship of variables) in your study. *However, theoretical framework is not necessary for experimental studies.* Read everything you can--academic research, trade literature, and

information in the popular press and on the Internet. Start writing early; keep notes while reading. Present a coherent framework – what are the major approaches?; what are the main open problems? When you write, don't just copy, give your own opinion. A good way to scoop from an existing study is to determine what statement of the author struck you most. Then determine in which part of your research paper you will mention that author or his/her work.

Propose.

As you become well-informed about your topic and prior research on the topic, your knowledge should suggest a purpose for your thesis. When you can express this purpose clearly, you are ready to write your thesis proposal (Chapters 1-3). This document specifies the purpose of the study, significance of the study, a tentative review of the literature on the topic and its theoretical framework (a working bibliography should be attached), your research questions and/or hypotheses, and how you will collect and analyze your data (your proposed instrumentation should be attached).

You may come up with a formal working *title* for your research where important words are placed first, and leaving out unnecessary words. All claims (e.g. variables) in the title should be supported by the data that will be generated by the research.

After writing the proposal, spare time to sit down with research team members and contributors to refine your plans if needed and to make explicit expectations for completion of the thesis.

Once your instrumentation is developed and validated, you need to present and clear it and your informed consent protocol with the thesis review panel before you begin collecting data. Leave adequate time for the review.

The thesis proposal should have two (2) versions – one for the thesis manuscript and a publishable format for the proposal defense panel. (See difference between thesis and publishable paper in the appendix).

Gather the Research Data.

The next steps are collecting and analyzing data, writing up the findings, and composing the final chapters (Chapters 4-5). You should make sure Chapters 1 and 2 are now fully developed. Your chair and panel committee members provide guidance as needed at this point but expect you to work as independently as possible. You should be prepared to *hire assistance* with coding and data entry and data analysis if needed.

Write.

Write the thesis; but do not start writing without having full knowledge on the research study. Each thesis is unique but all share several common elements: Chapter 1-Purpose and significance of the study, Chapter 2 - Review of the Literature, Chapter 3- Methodology, Chapter 4- Findings Chapter 5- Discussions and Conclusion. Sometimes, findings and discussions are placed in the same chapter.

For more of the research process you may go to <https://guides.lib.usf.edu/c.php?g=291297&p=2104188#:~:text=The%20research%20process%20involves%20identifying,developing%20and%20expressing%20your%20ideas.&text=The%20research%20process%20can%20be,manageable%20and%20easier%20to%20understand..>

RESEARCH CLASSIFICATIONS

Research are classified according to the type of data being collected (data collection method) or by the research design employed. The terms 'research design' and 'research methods' are often used interchangeably; however they are distinct concepts. *Research design* refers to the logical structure of the inquiry. It articulates *what data is required, from whom, and how it is going to answer the research question*. For instance a researcher might choose to do *quasi experimental design* to estimate the impact of an intervention (innovative tool or process being introduced). How to do the research or what information to collect becomes a choice of methods. *Research methods* specify the *mode of data collection*. This includes whether qualitative or quantitative data is required, or a mix of the two. In theory, there is no research design that requires a particular research method, though in practice more experimental designs tend to use quantitative methods (for quantitative data).

By Data Collection Methods

Qualitative Approach. The qualitative approach to gathering information focuses on describing a phenomenon in a deep comprehensive manner. It is appropriate to explore the *nature* of a problem, issue or phenomenon without quantifying it. The objective is to describe the *variation* in a phenomenon, situation or attitude. E.g. *description of an observed situation, historical enumerations of events, an account of different opinions, description of working condition in a particular industry*. This is generally done in interviews, open-ended questions, or focus group discussions. In most cases, a small number of participants participate in this type of research, because to carry out such a research endeavor requires many resources and much time. Interviews can vary from being highly structured and guided by open-ended questions, or be less structured and take the form of a conversational interview. Because of the investment in this type of research and the relatively few number of participants, findings from qualitative research cannot be generalized to the whole population. However, such research serves as a spring board for larger studies and deeper understanding that can enlighten theory, practice, and specific situations. Qualitative data describes problems, behaviors, opinions, experience, attitudes, and beliefs. They are non-numerical in nature, and can come from open ended questionnaires, field notes, or personal log or journals. It is often regarded as a less scientific method than quantitative but its advocates provide arguments that prove otherwise.

Quantitative Approach. The quantitative approach to gathering information focuses on describing observed phenomenon across a larger number of participants thereby providing the possibility of summarizing characteristics across groups or relationships. It is appropriate in determining the *extent* of a problem, issue or phenomenon by quantifying the variation (e.g. *How many people have a particular problem? How many people hold a particular attitude towards a particular technology?*) This approach surveys a large number of individuals and applies statistical techniques to recognize overall patterns in the relations of processes. Importantly, the use of surveys can be done across groups. For example, the same survey can be used with a group of workers that is using a new technology (often called the intervention or experimental groups) and a group of workers who does not use the new technology (a control group). It is then possible to compare these two groups on outcomes of interest, and determine what influence or effect the technology had. It is also relatively easy to survey people a number of times, thereby allowing the conclusion that a certain features (independent variable) influence specific outcomes (dependent variable). The quantitative approach is the preferred research method for beginners and students because it is more objective and the findings from the sample can be generalized to the whole population of respondents or test subjects.

These two main approaches to research are highly informative, especially if used in combination. Each approach has its benefits and detriments, and being aware of the methods used to gather information can help researchers understand the extent to which research findings can be applied. As a rule of thumb

quantitative methods are used when the researchers want to conduct statistical analysis, cover large samples, or seek precision while qualitative methods are used when in-depth information is the key, and sample size is not an issue. But this sharp distinction between the two methods has begun to erode. For instance qualitative data can now be coded, quantified and even econometrically analyzed using powerful statistical software. There is a widespread agreement on the benefits of combining various quantitative and qualitative methods; this is known as *mixed method* research.

Adapted from <https://chronicle.umbmentoring.org/on-methods-whats-the-difference-between-qualitative-and-quantitative-approaches/>

By Research Design

There is lack of consistency in classification of different types of research designs. Some classify based on the *type of research question being addressed (exploratory, descriptive etc.)*, others focus on the *data collection tools (survey, quantitative, qualitative)*. Broadly speaking, we can classify research designs into experimental, quasi experiments and non-experimental designs.

Experimental Design. In an experimental design individuals selected from the population of interest are randomly assigned to two groups, one of which is subject to the intervention (referred to as the ‘treatment’ group) and the other not (referred to as the ‘control group’). Generally this assignment is done before the intervention is launched. The experimental design assumes that, since the two groups are drawn from the same population and randomly assigned, they are similar in every aspect except that one group received treatment. Thus, if there is any difference between them, it must be due to the intervention. This difference is known as the treatment effect. Experimental design is the best way to ensure that the treatment group and control group are really comparable. Without random assignment, individuals receiving the treatment may be systematically different from those not receiving it. This is called selection bias. For instance assume that a vocational training program compared career outcomes between students who have been trained and those who haven’t been trained. In this case, the students who have been trained are the ‘treatment group’, while those who haven’t been trained are the ‘control group’. They may not be comparable, as student who enrolled themselves to the program might be better to begin with, or more motivated. Alternatively, the institution may choose students who are most likely to succeed. Experimental design ensures that groups are similar in both observable and unobservable parameters, because they have been randomly assigned to the control or treatment group. Experimental designs are often called Randomized Control Trials (RCTs). RCT is the most common research design in the field of science (e.g. medical science, computer science, biology).

Quasi-Experimental (post-hoc). This design is similar to experimental design, but it does not randomly assign individuals to groups. Instead, the researcher develops a comparison group which is similar to the treatment group but not necessarily equivalent. Participants are *preassigned* to groups based on some predetermined characteristic or quality. Group assignments have already taken place *before the experiment begins* and the researcher has no control over who is assigned to which group. Also called *post hoc*, or after the fact, research because the actual research takes place after the assignment of groups (e.g. abusive vs. non-abusive, employed vs. unemployed, malnourished vs non-malnourished, male vs. female). It may be easier to implement than an experimental design; although the technical expertise required to develop a quasi-experimental design may be just as high as that of developing a RCT. There are various types of quasi experimental designs – Difference in Difference (DID), Instrumental Variables (IV), Regression Discontinuity (RD), and Propensity Score Matching (PSM). Since difference in difference (DID) methodology is one of the most widely used quasi experimental designs in applied research, we now illustrate the framework in greater detail. Let us assume there are two groups,

one treatment and one control and we wish to see whether an intervention has increased the yield of the farmer:

Step 1: Estimate the yield of the treatment group and control group before the intervention. This is the baseline.

Step 2: Estimate the yield of the treatment group and control group after the intervention. This is the end line.

Step 3: Estimate the change in yield for both the treatment and control group. This will yield two values. Firstly, you will know the difference between the baseline and end line yield for the control group. Secondly, you will know the same for the treatment group.

Step 4: Compare the change in yield for the control group, with the change in yield for the treatment group. This is the 'difference in difference'. Even if the control and treatment group were initially different, this can still estimate the impact of the intervention.

Non-Experimental Design. A non-experimental design does not compare one group with another but describes the relationship between an intervention (treatment) and its effects on the population of interest. Furthermore, it may provide a rich understanding of the contexts, process, event, or situation and explain why results occurred, which may be essential for building result chains. Example of such design includes *case studies*, *longitudinal studies*, *ethnographic studies* etc. A case study is an intensive analysis of a single unit, whether a farmer, business, or village. *Case studies* are frequently qualitative, but can also use very quantitative measures, collecting numerical data about the subject of interest. Case studies can be used to showcase program extremes or a typical intervention, or randomly selected to give a broader picture. A scenario where case studies can be used is monitoring for early sign of impact in an intervention, such as the behavioral change of intermediary agents (e.g. service provider). Another example where case studies could be useful is for capturing employment changes in farms. Before we launch a large scale survey to ask farmers about labor usage, we may need in-depth case studies to identify accurately the different steps in the production process (pre harvest, irrigation etc.) and associated labor usage. This gives detailed information to base the survey on. In *longitudinal studies* individuals or groups of interest are monitored over a period of time and are interviewed at different stages. Sometimes the major objective is to better understand the dynamics of the treatment effect, which can assist in the development of more experimental or quasi experimental design. For example, if one is interested in estimating the consumption pattern of the target group then longitudinal studies can be used to identify major spending channels, and then the research might be supplanted by larger focused survey on those channels only.

By Objectives

Research can also be classified according to the objective in undertaking the research. These are generally non-experimental researches.

Descriptive Research. It attempts to describe systematically an existing situation, problem, phenomenon, service or program, or provides information or describes attitudes towards an issue.

Correlational Research. It attempts to discover or establish the existence of a relationship/ interdependence between two or more aspects of a situation (research variables).

Explanatory research. It attempts to clarify why and how there is a relationship between two or more aspects of a situation or phenomenon.

Historical Research. It attempts to relate events that have occurred in the past to current events.

Exploratory research. It is undertaken to explore an area where little is known or to investigate the possibilities of undertaking a particular research study (*feasibility study/pilot study*).

Below is a table summarizing the types of research according to its purpose, time frame, and degree of precision:

Table 1. Summary of research methods

	Type of Research					
	Non-Experimental				Experimental	
	Descriptive	Historical	Correlational	Qualitative	True Experimental	Quasi-Experimental
Purpose	Describe the characteristics of an existing phenomenon	Relate events that have occurred in the past to current events	Examine the relationships between variables	To examine human behavior and the social, cultural, and political contexts within which it occurs.	To test for true cause and effect relationships	To test for causal relationships without having full control
Time frame	Current	Past	Current or past (correlation) Future (prediction)	Current or past	Current	Current or past
Degree of control over factors or precision	None or low	None or low	Low to medium	Moderate to high	High	Moderate to high

Code words to look for in research articles	Describe Interview Review Literature	Past Describe	Relationship Related to Associated with Predicts	Case study Evaluation Ethnography Historical Research Survey	Function of Cause of Comparison Between Effects of	Function of Cause of Comparison between Effects of
Example	A survey of dating practices of adolescent girls	An analysis of Freud's use of hypnosis as it relates to current psychotherapy practices	An investigation that focuses on the relationship between the number of hours of television watching and grade point average	A case study analysis of the effectiveness of policies for educating all children	The effect of a preschool language program on the language skills of inner-city children	Gender differences in spatial and verbal abilities

(Source: Adapted from N.J.Salkind, *Exploring Research 6th Edition*. Pearson Education International)

DIFFICULTIES IN RESEARCH

Doing research is not easy. Below are proven challenges encountered by researchers worldwide:

Challenge: Choosing the Right Topic

Your research topic is the foundation on which everything else rests, so it's crucial to choose carefully. "You can't do anything else until you figure out the basic focus of your topic," says Dr. Susann V. Getsch. She shares her recommendations for choosing an effective research topic.

- **Develop a doable topic.** Determine what resources you have available—time, money, people—and choose a topic that you can do justice. Getsch scrapped an initial study idea of replicating another researcher's study because it would be too resource-intensive.
- **Read everything you can on the topic.** Getsch "stumbled across" systems theory, an interdisciplinary framework for understanding systems in science and society. The topic was outside her required class reading, but ultimately provided Getsch's theoretical framework.
- **Find a theoretical basis to support your topic.** The key is having an overarching theoretical context for your results. "I was really thrilled when I found these theories that fit my study like a glove," Getsch says.

- **Make sure the topic will hold your interest.** You'll be spending at least a year on a dissertation or any large research project, so it has to be compelling enough that you'll go the distance.
- **Look for a niche in which you can make a difference** ... My view is that you really should be offering something new to the field," says Getsch.
- **... but remember you can't change the world with one dissertation.** Getsch's dissertation committee chair, Dr. Stephanie Cawthon, helped her focus on the crux of what she wanted to explore. "She gently pointed out that I couldn't change the whole world with my dissertation, but I could add to the body of knowledge," says Getsch.
- **Let yourself shift gears.** Getsch admits that the topic she started out with was "in no way" what she ended up with.
- **Fine-tune your topic based on input from others.** "Take every opportunity you can to pick the brains" of experts, Getsch recommends. "I went across disciplines. I drove people crazy. And each time, I would revise slightly based on what the last person taught me."

Challenge: Choosing the Right Methodology

Once you've chosen a topic, you'll need a methodology—a procedure for conducting your research—in order to move forward. **"The best way to choose it is not to choose."** In other words, "the methodology that's used comes from the research question, not from your personal preferences for one design or another." Refrain from choosing between a qualitative or quantitative methodology until you:

- Complete the sentence: "The problem is ..."
Complete the sentence: "The purpose of this study is ..."
Formulate your research questions.
- **Let your answers guide you.** Determine what kind of design and methodology can best answer your research questions. If your questions include words such as "explore," "understand," and "generate," it's an indication that your study is qualitative. Whereas words such as "compare," "relate," or "correlate" indicate a quantitative study. The design comes out of the study, rather than being imposed on the study.
- **Hone your study design.** Once you become clear whether you're going in a quantitative or qualitative direction, you can begin to look in more detail at the methodology. This will be determined by figuring out "from whom you're going to collect data, how you're going to collect the data, and how you're going to analyze it once you collect it," says Crawford.
- **Be crystal clear.** For a qualitative study, you might use focus groups and interviews, for example, to collect data, whereas a quantitative study may use test scores or survey results. Either way, the methodology should be so clear that any other trained researcher should be able to pick it up and do it exactly the same way.
- **Be honest about your abilities.** Ask yourself, "This is what the study demands—do I have the skills to do it?" says Crawford. If not, determine if you can develop the skills or bring together a research team.
- **Take your time with the planning process.** "It's worth consulting other researchers, doing a pilot study to test it, before you go out spending the time, money, and energy to do the big study," Crawford says. "Because once you begin the study, you can't stop."

Challenge: Assembling a Research Team
Research is never done in a vacuum. Once your topic and methodology are in place, you will need a research team to support you, as well as study participants. Dr. Lynette Savage '09, PhD in Applied Management and Decision Sciences, recommends assembling a network of advisors before starting your research:

- **Solicit useful feedback.** Savage suggests that you "cultivate friendships with people who are going to help you think critically" about your topic. These people are invaluable for helping you consider your idea from a different angle or perspective.

- **Vet your committee.** If you need a formal committee, choose your chairperson carefully, Savage says, “because you’re going to work closely with him or her for a while.” She recommends interviewing your potential chair and committee members to make sure there’s a match and discussing upfront what each party needs in order to go through the process. This includes asking whom your chairperson is comfortable working with—“The chair helps negotiate things if the committee can’t come to agreement, so he or she needs to get along with everyone else,” Savage explains.
- **Be clear about your needs.** Similarly, when it comes to finding mentors, or getting help for tasks such as creating a survey tool or writing your research question, Savage suggests being very clear about what you need from them. “People are very willing to help when you come structured and prepared,” she says.

Challenge: Finding Study Participants

Once you have your team together, it’s time to conduct your study, and that means finding participants. Dr. Rodney Lemery ’08, PhD in Public Health, managed to overcome a big challenge to recruiting participants for his study: “Like a lot of epidemiology researchers, I was trying to target a ‘hidden population’—men who have sex with men,” he explains. Lemery shares how, through trial and error, he recruited 125 participants for his study.

- **Don’t waste your money.** Lemery first tried hiring a third-party email marketing group to send his survey to 50,000 self-identified men who fit his criteria. While email marketing might work in some cases, it’s a costly risk—Lemery spent \$2,500 and got just four subjects.
- **Leverage the power of a network.** Lemery’s next attempt to reach his target group was more successful. He used what are called “snowball” sampling techniques—“targeting a particular group, locating advocates within that social network,” and then asking them to recommend others who might be willing to participate in the study. “You almost get a domino effect, if it works,” Lemery explains.
- **Don’t be afraid to reach out.** Lemery also approached established researchers in his field for guidance and networking. “I was very nervous, but I went ahead anyway and contacted two very well-known researchers, and one of them turned out to be a very key advocate in my research and recruitment,” he explains. “If I had listened to my fear, I never would have gotten 45 of my participants.” His advice to others looking for mentors: “Just go for it—the worst thing that can happen is that people can say no.”

Challenge: Getting Institutions to Participate

Sometimes recruiting study participants requires going through institutions, which may put up barriers, particularly if your research is controversial or sensitive, and this presents an additional challenge. Dr. Eileen Berg ’09, Doctor of Education (EdD), conducted her doctoral study on the relationship between teachers’ unions and educators throughout schools and districts in Ontario, Canada, and came up against strong resistance due to the political nature of her topic. And Dr. Christopher Plum ’09, PhD in Education, needed to observe Individualized Education Program (IEP) meetings—in which a plan is developed to help students with disabilities—in order to conduct his research. These meetings are often very difficult for parents and students, and getting access required permission from school districts, as well as the parents, student, and school psychologists attending each meeting. Berg and Plum offer suggestions for getting institutional buy-in:

- **Don’t stop at the first rejection.** “I went to one of the superintendents, and she said, ‘That’s interesting, but you’re not going to get any support from this school district,’” says Berg. “So I started to apply to different districts and got all these rejections—the influence of the unions in Ontario was so strong that nobody wanted to participate.

- **Pursue alternate avenues.** After extensive research online and networking, Berg eventually found an organization that would promote the study to principals and another organization that agreed to publish a notice about the study in its bulletin for teachers.
- **Persevere.** “If it’s an extremely hot topic, you’re going to have the doors blocked,” Berg says. “You need to persevere, you need to make contacts, you need to network with people and make phone calls and ask, ‘How can you help me?’ ... Just sending emails won’t work.”
- **Build relationships.** Plum agrees that when going through institutions to find study participants, the key “is trying to form relationships with the people who will help you gain access.”
- **Learn to sell yourself.** “You’ve got to do a lot of selling of yourself and what you’re trying to do,” Plum says. But, he warns, there’s a fine line between being persistent and not turning people off. “That’s the art,” he says. “You have to finesse it and understand the importance of building that comfort level. The people who are the gatekeepers have to believe that you’re coming in objectively and that what your research yields will potentially positively impact the institution in some way. How does this add value?”
- **Be prepared.** Plum also stresses the importance of having all of your forms and information—such as a copy of your abstract and a thumb drive with supporting documents—on hand at all times, in case someone wants more information.
- **The importance of image.** Finally, Plum says, “presentation is important—it all paints a picture in terms of how you’re going to come across.”

Challenge: Staying Motivated and Working Your Plan
 Sometimes, in the course of a large research project, the biggest challenge can be internal—maintaining the motivation to keep going despite obstacles in your research and the pressures of work and personal commitments. Dr. Latrice Y. Walker ’08 completed her PhD in Education in just eight quarters (while also working “non-stop” on her business). She shares her strategies for maintaining an upbeat, confident attitude and staying the course with any large-scale research project.

- **Follow your passion and your purpose.** “The first component of motivation is working on something you’re passionate about, that you believe in,” Walker explains. “It’s cyclical—if you’re passionate about what you’re researching, the research will increase your passion to complete your research.” Passion, she says, comes from the belief that your work will have some kind of social impact, that an injustice in the world could be improved “even just 10 percent.”
- **Monitor your attitude.** “When there’s so much to do, attitude does make a difference,” Walker says. “There can be no doubt in your mind that you can do this. You must believe that you can make it through this process.” To stay positive, she suggests thinking of the mind like a garden: “We have to pluck out the negative thoughts like weeds and constantly plant positive thoughts.”
- **Reward yourself.** “Make rewards part of your work plan, and then give yourself those rewards,” Walker says. “It could be going to the movies, going out to lunch, spending time with your family—whatever it is, make it something meaningful to you.”
- **Ask for help.** Walker credits her family—especially her husband—with helping her handle all her commitments. “If you share your goals with those individuals you care about, they will get to buy in and help you achieve those goals,” she says. “But only share your greatest dreams and goals with people who are going to be positive and supportive.”

Challenge: Dealing With Your Data

When you’ve completed your study, the final challenge is knowing how to make sense of the data you’ve collected. Dr. Ronald Paige ’07, PhD in Education, was faced with 900-plus pages of transcribed stories from the interviews he conducted. And Dr. Paula Dawidowicz, a faculty member in The Richard W. Riley College of Education and Leadership, is the author of *Literature Reviews Made Easy: A Quick Guide to Success*. Paige and Dawidowicz offer tips for working with your data.

- **Ground yourself in the research.** Paige realized that, to address his large volume of research, he had to connect his own research to the existing research. Grounded in a “huge survey of the literature,” he had the parameters to organize his research. Dawidowicz adds that your data should be presented in a way that demonstrates how your research adds to the body of knowledge.
- **Get back to your methodology.** Paige credits a course in research methodologies taught by his mentor and committee chair, Dr. Linda Crawford, with preparing him to deal with his data. “The books we had to read were excellent,” he says, “and we compared methodologies in class—that was very helpful.”
- **Listen to the data.** “When you have that kind of qualitative data, and you’re looking at it cold, the biggest challenge is not to look at it with any preconceived ideas—you literally have to step back and wait for the data to come alive and start speaking,” Paige says.
- **Take advantage of technology.** “The key thing in qualitative research is looking for patterns, and that’s where having a software program—I used one called HyperRESEARCH—was invaluable,” Paige says. “I couldn’t have done it without that.”
- **Stay focused.** Dawidowicz cautions against being distracted by irrelevant data as you do your analysis. She suggests “keeping a really close eye” on your research questions and your hypothesis, “because sometimes the data you collect will take you away from that.”
- **Account for biases.** Dawidowicz explains that, in a quantitative study, the researcher needs to address the biases of the individuals completing the survey before the results can be generalized to a larger population. Whereas qualitative work requires researchers to discuss “how their bias or interpretation may have played into their conclusions.”
- **Let the data drive your presentation.** Dawidowicz says, “The data should drive how you present what you’re doing. It’s your job to organize it around the research questions.”
- **Draw on the details.** “A good quote or a good point pulled from a quantitative survey—that information can always give us a greater sense of what actually occurred,” Dawidowicz says.

Adapted from <https://www.waldenu.edu/connect/newsroom/publications/articles/2010/01-research-challenges>

DIFFICULTIES ENCOUNTERED IN RESEARCH (BY STUDENT RESEARCHERS)

Right Topic. Many bright and able students have their proposal rejected due to not choosing an appropriate topic. A good exercise for you is to look at PhD papers in general. One common theme amongst them is the fact that they are on very specific topics.

It is very rare to see a PhD level paper encompass a large umbrella of topics. As such, your focus should be very narrow when deciding which topic to choose for your research. If you need some inspiration then check out some recent papers published related to your subject area. You should be looking for a niche within a field that offers a new perspective.

Methodology. Just like your topic, you should also choose the correct methodology for carrying out your proposed research. Choosing the wrong methodology will mean that your proposal is rejected, even if you have a very good topic in mind.

When choosing a methodology, it is a good idea to keep many things in mind such as:

- Formulate your research questions and then choose a method that best answers these questions.
- Be very clear with the methods you are looking to employ. There should be no ambiguity in this matter.
- Take your time to carefully formulate a good methodology for your research.

There can be significant challenges within different methodologies that many students often face. For example, it can be tough to find the right participants for your study. For this, it is a good idea to make good use of social media to find the participants you are looking for.

Research Material. A large part of research will build upon existing research. This means that you need to acquire good research material to read up on for your proposal. One of the best ways to do this is through looking at academic journals related to your subject area.

The journals will have a large archive of all the publications relating to your research. Making use of your university's library is also a good idea, as they will have many important textbooks for you to read up on.

Adapted from <https://www.studioamytis.com/difficulties-encountered-by-students-for-research-proposals.html>

SOURCES OF RESEARCH TOPICS

- published materials (magazines, articles, videos, etc.)
- grey literature (reports, working papers, government documents, white papers and evaluations)
- current affairs
- research supervisors and mentors
- scholarly events
- national and international development blueprints
- calls for research papers
- past research projects where areas for future research are proposed.

CHARACTERISTICS OF GOOD RESEARCH TOPICS

A good research topic should have the following qualities.

Clear. Clarity is the most important quality of any research topic. The topic should have to be clear so that others can easily understand the nature of your research. The research topic should have a single interpretation so that people cannot get distracted. The topic should have to be clear in your mind so that you can properly undertake it. The research topic should have to be free of any ambiguity. Clarity also means that the research topic should have to be directional and it should set the whole research methodology.

Well-defined. Well-defined and well-phrased research topic is a half guarantee of a successful research. Sometimes researchers phrase the research topic in such a way that it gives a double-barreled impression. The research topic should have to be well-defined and well-phrased and it should have to be easy to understand. It should have a single meaning. When the research topic is not well-defined the researcher is not able to formulate the right objectives and the hypothesis. This confusion becomes worse as the research progresses. If you are not sure about the phrasing of your research problem ask help from your research advisor, supervisor, teacher or any other person who has expertise in research.

The language of the research topic should have to be simple. You should use technical terms only when it is necessary, otherwise use simple words so that everyone can understand it. Do not introduce any sort of bias directly or indirectly, willingly or unwillingly in the research topic.

The titling of the research problem should follow the rules of titling. There are various rules of titling. You can either use a sentence case or a title case but most of the titles follow title case. Read the rules of titling titles before writing it down.

Current importance. Current importance should also be the consideration of the researcher while selecting a research topic. An obsolete topic will not be beneficial for anyone the topic should have current importance. You should also assess how much the topic will provide benefit to the field in which you are conducting the study.

Adapted from <http://researcharticles.com/index.php/what-qualities-good-research-topic/>

WHAT IS A THESIS

Thesis is an academic research required to complete an academic degree. It is a *claim* based on theories and tested through the hypothesis testing process such that results are based on empirical data. As a rule of thumb, if a researcher has no claim to test or prove, there is no thesis. It takes the form of a technical paper that documents the entire research process and the results of the study. It is usually presented to a panel of evaluators for critiquing; and the approved version submitted to the department head as final requirement for course completion. As an academic research, a thesis has specified format and required contents depending on the academic program or field of study. A sample format of thesis is presented below.

GENERAL OUTLINE AND GUIDELINES FOR A THESIS PAPER

Chapter 1: Introduction (Purpose and Significance of the Study)

In the first chapter, clearly state what the *purpose of the study* is and explain the *study's significance*. It should be noted that a thesis requires causality and hypothesis testing. *Hypothesis testing* validates previous claims if they are true in your context. It is an empirical testing of previous theories in your current endeavor, in order to provide definitive conclusion. It is needed to have a basis for action and for the design of evidence-based interventions in the future. But prior to hypothesis formulation, there has to be a semi-complete literature review. The chapter generally suggests some theoretical framework to be explained further in the chapter for literature review. For experimental research, it is necessary to test a null hypothesis. The *significance* is addressed by discussing how the study adds to the theoretical body of knowledge in the field and the study's practical significance for professionals in the field being examined. You may also explain how the research makes an original contribution to the body of knowledge in the discipline. It is especially critical that this chapter be well developed. Without a clearly defined purpose and strong theoretical grounding, the thesis is fundamentally flawed and is often rejected. Introduction is like parking a car – you identify the boundary or parking area, you find your space, and then you park there.

Chapter 2: Review of the Literature

The literature review describes and analyzes previous research on the topic. It is where you dissect related studies and identify their limitations and weaknesses. This chapter should not merely string together what other researchers have found. Rather, you should discuss and analyze the body of knowledge with the ultimate goal of determining what is known and is not known about the topic. This determination leads to your research questions and/or hypotheses. In some cases, you may determine that replicating previous research is needed. So rather than organizing the chapter by related study, you should organize it by themes. A practical approach to search for a related published study is to search

from a research database (or Google scholar) the term (e.g. global warming) plus the continent plus the current year, then do the same with the previous one year, and then do the same with the year before the previous year. The next step is to search the term plus the region (e.g. ASEAN) plus the current year, then do the same with the previous one year, and then do the same with the year before the previous year. The next step is to search for the term plus the locality or country (e.g. Philippines) plus the current year, then do the same with the previous one year, and then do the same with the year before the previous year. There are free journals available for public use called “open access journals” which can be found at www.doaj.org. Choose the right level of detail – keep your audience and goals in mind. Give a synthesis of related studies with proper citation and referencing.

Chapter 3: Methodology

This chapter describes and justifies the *data gathering method* used. This chapter also outlines *how you analyze your data* (e.g. statistical treatments). The methodology determines whether the results can be utilized or not. It serves as the pipeline on how to “bring the water from the water shed to the house and eventually to the users”. If there are holes in the pipeline, water can be contaminated. Similarly, if there are errors in methodology, results will be non-beneficial. Begin by describing the method you chose and why this method was the most appropriate. In doing so, you should cite reference literature about the method. Next, detail every step of the data gathering and analysis process. Although this section varies depending on method and analysis technique chosen, many of the following areas typically are addressed:

- a. description of research design internal validity and external validity
- b. description of population and description of and justification for type of sample used or method for selecting units of observation
- c. development of instrument or method for making observations (e.g. questionnaires), pre-test reliability and validity of instrument or method
- d. administration of instrument or method for making observations (e.g., interviews, observation, content analysis)
- e. coding of data
- f. description of data analysis, statistical analysis, and tests performed

For experimental design (which is common for CS and IT researches), it may be necessary to include the dates or time frame of experimentation. However, it is recommended that the timeframe should not exceed five (5) years.

Take note that data gathering should follow ethical considerations such as protection of a respondent's identity and rights. Indicate in this chapter the instrumentations for research ethics protocol (e.g. informed consent, ethics review panel clearance, required permits from government agencies, animal welfare societies, indigenous people, where necessary). It should be noted that because of ASEAN integration, respondents may also come from other countries.

To come up with sound and appropriate methodologies, be sure to understand the different *research designs, sampling methodologies, research instrument design and testing techniques, methods for administering the data gathering instruments, data coding techniques, statistical analysis methods and techniques, and hypothesis testing techniques* (ex. *Correlation* tests the degree of variables' relationships and can be positive or negative; If computed value is lower than *critical value* then accept null hypothesis).

Chapter 4: Findings/Results and Discussion **Findings**

This chapter addresses the results from your data analysis only. This chapter does not include discussing other research literature or the implications of your findings. The answers to research questions/objectives are presented. Usually you begin by outlining any experimental, descriptive or exploratory/confirmatory analyses (e.g., accuracy test, instrument reliability tests, factor analysis of constructs) that were conducted. You next address the results of the tests of hypotheses. Tables and/or figures should be used to illustrate and summarize all numeric information. Organize the data. Use keywords from objectives/specific questions as side-head of this chapter. Use tables instead of lists. Do not forget to put units on values. Results sections typically have more tables and very little text.

Your research findings should be validated by the users (source of data). Provide a copy of the research to the organizational source with response page indicating the impact of the study to their organization.

Discussion

The purpose of this part is not just to reiterate what you found but rather to discuss what your findings mean in relation to the theoretical body of knowledge on the topic and your profession. It validates the theory used in the study. Typically, students skip on this chapter even though it may be the most important one because it answers the "So what?" question. Begin by discussing your findings in relation to the theoretical framework introduced in the literature review. Highlight salient findings of the study supported by global, regional, and local literature. In some cases, you may need to introduce new literature (particularly with qualitative research). This chapter should address what your findings mean for professionals in the field being examined. In other words, what are the study's practical implications? You may provide a critique on the methods and theories used in the last paragraph.

Chapter 5: Conclusions and Recommendations

This chapter directly addresses the questions proposed in the introductory chapter, using the same terminology and phrasing. Give a recommendation of how your results might be used; explain how they have added to the field's knowledge base, and show how they answer a vexing problem in the field; evaluate how well the results answered your question; show how they lead to other areas of study, or give an idea of what new questions they open up. Conclusion and recommendation should be comprehensive, reflecting the contribution and significant findings, and how the result can help in practical application.

Take note that immediate utilization of the results of the study should not be recommended right away, even when predictor variables (causality) have been established. One set of data does not prove anything. Instead, recommend replication in a similarly situated environment to validate the result. You may also recommend a pilot implementation/testing before institutionalizing the result. However, prior to institutionalization or program implementation, a policy should be set and approved by the Board or organizational governing body.

Although the general format of a research or thesis starts with the research title, then with the background and purpose of study (Chapter 1), followed by the review of related literature (Chapter 2), followed by the research design and methodologies (Chapter 3), and then with the presentation of findings (Chapter 4), and finally, with discussion and conclusions (Chapter 5), it is not practical and systematic to approach the research process following this sequence. (See The Research Process discussion above).

Sample Thesis Format for Science, Technology, Engineering and Mathematics (STEM)

1. Title Page
2. Approval and Acceptance Sheet
3. Acknowledgement

4. Abstract
5. Table of Contents
6. List of Tables
7. List of Figures
8. List of Appendices
9. Chapter 1. Introduction
 - 1.1 Background of the Study
 - 1.2 Statement of the Problem/Objective – research project definition
 - 1.2.1 Statement of the Main Problem/Objective
 - 1.2.2 Specific Research Problems/Objectives
 - 1.3 Theoretical Framework and/or Conceptual Framework
 - 1.4 Significance of the Study – describe how the study will benefit stakeholders (the society) and future researchers
 - 1.5 Scope and Limitation – cite the exclusions of the study
 - 1.6 Definition of Terms - define variables unique to the study citing their conceptual(dictionary) and operational definitions (how they are used in the study)
10. Chapter 2. Review of Related Literature and Studies – Cite related literatures and give a synthesis of related studies with proper citation and referencing
11. Chapter 3. Methodology
 - 3.1 Research Design (sub-sections for software development projects only)
 - 3.1.1 Research Method
 - 3.1.2 Software Development Process Model
 - 3.1.3 System and/or Software Architecture
 - 3.2 The Subjects – who/what are the subjects and their characteristics
 - 3.3 Research Instrument – description of instrument used including source/basis, validation process
 - 3.4 Data Collection Procedure, Method and Techniques – Step by step process of data collection including techniques used (ex. Experiment paper, survey, etc.); include sampling method
 - 3.5 Analysis and Statistical Treatment of Data – methods/tools used for data processing/analysis
12. Chapter 4. Results and Discussion – presentation of data collected (thru tables and graphs/figures); presentation of analysis and interpretation of data
13. Chapter 5. Summary, Conclusions and Recommendations - summary of findings; conclusions based on findings; recommendations for future researchers
14. References
15. Appendices
 - Certificate of Endorsement (by adviser)
 - Certificate of Proofreading
 - Screenshots/GUI (for software) and/or pictures of the models/products
 - Experiment paper / survey instrument / test forms
 - CV of Researchers

For more materials on the research process go to <https://www.umgc.edu/current-students/learning-resources/writing-center/online-guide-to-writing/tutorial/chapter4/ch4-01.html>

ASSESSMENT

- In your own words, explain what research is and why is it important.
- Explain why research is a scientific method.
- Describe at least three (3) characteristics of research
- Differentiate qualitative from quantitative research, experimental from quasi-experimental design
- Give example of non-experimental design researches
- What are the difficulties encountered by student researchers?
- Give some sources of research topics?
- What are the characteristics of a good research topic?
- Differentiate thesis from other types of researches.
- Review the general outline for a thesis paper. Describe the process or steps that you would follow to produce the parts of the thesis paper.

Chapter 2: Review of Related Literatures

Overview

This chapter starts with a brief introductory paragraph concerning the researcher's exploration of related literature and studies on the research problem. It states the main coverage of said chapter which are how to review related literatures and studies. It will allow the readers to know how important a review of literature is in research. It will discuss how review will be done and how to write this portion of the research.

Objectives

At the end of the chapter, the student will be able to:

1. Discuss the importance of RRL
2. Identify the key part of reviewing a literature in research writing
3. Write their own Review of Related Literature

Introduction

In research writing the most commonly problem is how to review different studies and literatures related to your chosen topic. Other researchers just read and write whatever they think is related and summarize everything and that's it, they are done with the portion of documentation in thesis writing, which is called Review of Related Literature and Studies (RRL).

But I have a bad news for you, that is not the way you do it, I would like to emphasize that RRL is very important and it must be written comprehensively for you to state that you have a problem to work on. Different researchers write their RRL in different ways, for this discussion these are the key ideas on how to start reviewing related works (literature and studies) for your research:

1. The review shall be organized thematically to confirm to the specific problems,
2. It should synthesize evidence from all studies reviewed to get an overall understanding of the state of the knowledge in the problem area,
3. As much as possible, the reviewed works should be limited within the last ten years, but of course if it is theories better based your work to the original researcher of the theory, and
4. A clinching statement showing how the related materials had assisted the researchers in the present study should be the last part.

Conducting a review of literature

- Introduction
- Reorganize your file
- Retrieve all related abstracts
- Evaluate the results
 - Author, Title, Date, Source or document type
 - Read the abstract

- Retrieve the full texts of the most useful sources such as Books, Dissertation, and Journals
- Use primary source

Why?

As mentioned earlier RRL is important to write because it gives the letter the ff:

1. Knowledge base upon which your study is built
2. Indebtedness to the past and shows connection between:
 - ✓ What was known in the past
 - ✓ What was discovered in the present

Writing an effective related literature

Once you have conducted the review of related literature you are now ready to write an effective related literature. This can be done as follows:

I. Update the comprehensive critique of the literature

- Check Journals that publish educational research
- Contact other researchers working in your field of study
- Attend scholarly conferences

II. Reread all resources

The purpose of this is to freshen your understanding of what has been learned

Example:

Topic: Writing a review of the research on teachers' professional development

1. Review each topical file

Example: Stages of teachers' career development

2. Identify each source with an appropriate code number to simplify the way you refer to it in your own work

Example: Career Stages 1

3. Cross-reference sources appropriately

- Make a simple note card reminding you of the source you should check
- Example:
- Career Stages 1: Stages of teachers' career development
 - Contains Material: Fostering teachers' development
 - See Career Stages 1 + Fostering folder

4. Reread each source and write a brief summary

- Main points

- Perceived value to your review

Example:

- Stages 7. Huberman identifies 5 stages, each with a different theme
- In stages 3 & 4, the teacher may take one of two paths. Very useful review.
 - Clip the summary to the source

Types of sources:

- Opinions about current educational issues
- Reports of practice
- Prescriptions of what should be done

III. Develop the final outline

1. Determine the major components of the chapter

- Includes explanation of the search process that was used in assembling the review
- Discussion of the theoretical literature
- A review of the empirical research

Patterns used:

a. The search process

The theoretical literature

The empirical research

b. The search process

The empirical research

c. The theoretical literature

The empirical research

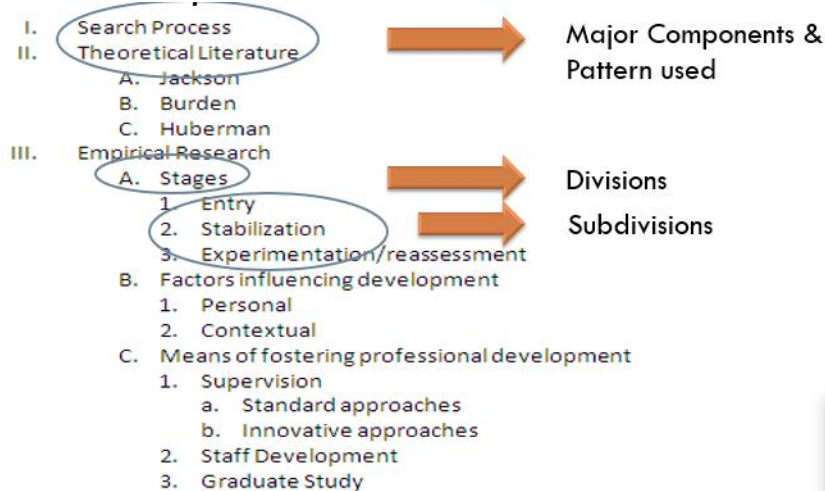
d. The empirical research

2. Analyze the major components into Divisions and Subdivisions

- Question: What are the big pieces of this component?
- Example: How the researcher might identify the divisions of the component “Methods of fostering teachers’ professional development”
 - a. Supervision
 - b. Staff Development
 - c. Graduate Study
- Subdivisions - For divisions that are both complex and critical to the review
 - a. Supervision

- a.1. Standard approaches
- a.2. Innovative approaches

3. Develop and Submit the Final Outline



IV. Use levels of Headings that reflect the outline

This is need to make clear to the reader how the chapter is organized. Consider 4 Heading style: follows the recommendations of the APA Publication Manual (4th ed.)

- Title of the chapter – Level 1
- Main divisions of the chapter – Level 2
- Subdivisions – Level 3
- Sub-subdivisions – Level 4

V. Write an Introductory Paragraph

- Does not have its own heading
- Should be relatively brief
- Providing an overview of the chapter

Write the First Section of the Review

- Provide an Overview
 - ✓ It helps the reader understand how that section is organized and what its main divisions are.
- Generalize
 - ✓ One or two sentences that generalize what the studies show.

- ✓ Obligation to the reader to make coherent sense of the literature
- Specify
 - ✓ Specific evidence, citing and discussing each study relating to that generalization.

Write the Remaining Sections, Including a Summary

- Conclude the chapter with a summary, probably a page or two in length, that reviews the content of the chapter and brings together the key conclusions of all the empirical research

Some Specific Reminders

- ❖ Vary the way you refer to studies.
- ❖ Paraphrase; do not quote.
- ❖ Be sure each section is organized clearly, and give the reader verbal signals to indicate organization.
- ❖ Use headings that reveal the organizational pattern.

Checklist

- Is the review
 1. Comprehensive, including all major works relating to your topic?
 2. In-depth, providing the reader depth of knowledge about the prior research?
 3. Current, including works published recently?
 4. Selective, discriminating between major and less important studies?
 5. Unbiased, without the writer skewing the prior research to suit his or her point of view?
 6. Clearly organized, so that the reader can easily follow the plan and flow of the chapter?
 7. Coherent, making sense of the studies, not simply describing them?
 8. Effectively written, with a scholarly style?

Evaluate and Revise

- * Once done with the writing the chapter, put it aside for a while
 - * Then revise it, using such technological aids as a spell-check, a thesaurus, and a style-checker.
-
- Reference

- Glatthorn, Allan A. (1998). Writing the winning Dissertation: A Step-by-step guide. Corwin Press, Inc. Thousand Oaks, California.
- Katz, Steven B. and Penrose, Ann M. (1998). Writing in the Science, Exploring conventions of scientific discourse. St. Martin's Press: New York, NY.

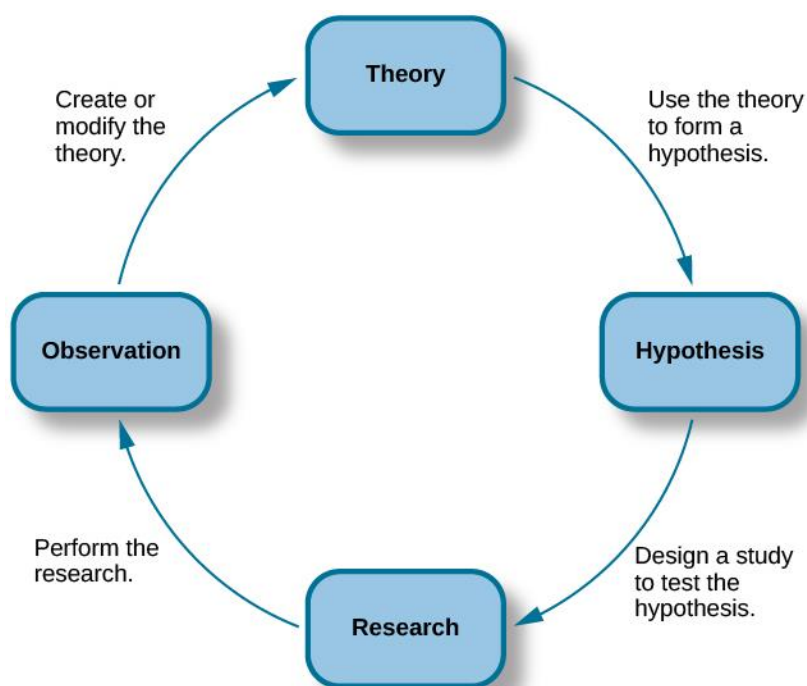
- Online source:

<http://www.jpsimbultan.net/thesis-writing-guide/how-to-write-a-thesis/how-to-write-chapter-2-of-a-thesis-basic-format>

CHAPTER 3: THEORIES, VARIABLES AND HYPOTHESES IN RESEARCH

OVERVIEW:

You begin the research process with a question. You may think about which topics and theories you are interested in and what you would like to know more about. You may want to choose a problem related to your own personal battle in your specific program or field of study. You may think about the topics and theories you have studied in your program. Is there some question you feel the body of knowledge in your field does not answer adequately? A good research actually stems from conflicting theoretical claims of theorists, and/or conflicting results from previous studies. Once you have a question in mind, you may begin looking for information relevant to the topic, and its theoretical framework. You back up your claims by (schematic or textual) framework from emerging theories discussed in which the study was anchored. Theoretical framework serves as blueprint of the study that allows you to understand how things go the way they will. It contains explanation or meaning of variables, and relationship of variables in your study. It is therefore important to understand the nature, characteristics and relationships of variables, research questions and hypotheses, and theories or theoretical frameworks, as you start your research journey.



Image

source:courses.lumenlearning.com

LEARNING OBJECTIVES:

At the end of this chapter you should be able to:

- Describe research question and hypothesis

- Describe the relationship between hypothesis and theory
- Describe the relationship between research questions and research variables
- Classify variables in research questions
- Explain the types and forms of hypothesis
- Formulate sound research questions in a specific computer problem solving area
- *Enumerate the different types of theories in computing research*

READING MATERIALS:

Research Question and Hypothesis

Research questions and hypothesis lead to the development of a research study. For an investigator conducting a study, the research question or hypothesis is a key preliminary step in the research process. The *research question* (sometimes called statement of the problem) presents the idea that is to be examined in the study, and serves as the foundation of the study. Specific research questions serve as specific objectives that will guide researchers along the research process. The *hypothesis* attempts to answer the research question. A hypothesis is an approximate explanation that relates to the set of facts that can be tested by certain further investigations. There are basically two types, namely, *null hypothesis*(H_0) and *alternative hypothesis*(H_1). The null hypothesis states the exact opposite of what an investigator or an experimenter predicts or expects. It basically defines the statement which states that there is no exact or actual relationship between the variables in the research problem/question. The alternative hypothesis makes a statement that suggests or advises a potential result or an outcome that an investigator or the researcher may expect. When the research problem or question has been established, these hypotheses provide the researcher with some specific restatements and clarifications of the research problem/question. The major differences between these hypotheses and the research problems are that the research problems are simple questions that cannot be tested. These two hypotheses can be tested, though.

Hypothesis and Theory

Hypotheses can be considered as intelligent hunches, guesses or predictions that help researchers seek a solution or answer a *research question*. A *theory* is a set of interrelated concepts, definitions, and propositions that explain, predict, and understand phenomena. A theoretical framework consists of concepts, together with their definitions, and existing theory/theories that are used for your particular study. Hypotheses are a vehicle for testing the validity of the theoretical framework assumptions and provide a bridge between theory and the real world. In the scientific world, *researchers derive hypotheses and research questions from theories* and subject them to empirical testing. A theory's validity is not directly examined. Instead, it is through the hypotheses that the merit of the theory can be evaluated.

As discussed in the previous lesson, thesis is a *claim* based on theories and tested through the hypothesis testing process such that results are based on empirical data. As a rule of thumb, if a researcher has no claim to test or prove, there is no thesis. A thesis requires *hypothesis testing*, which validates previous claims if they are true in your context. It is an empirical testing of previous theories in your current endeavor, in order to provide definitive conclusion. It is needed to have a basis for action and for the design of evidence-based interventions in the future.

For experimental research, it is necessary to test a null hypothesis. The experimental study should add to the theoretical body of knowledge in the field, or make an original contribution to the body of knowledge in the discipline. Without a strong theoretical grounding, the thesis is fundamentally flawed.

Research Questions and Variables

Research questions/problems that have been finalized as basis for the study should clearly identify the variables under consideration. The problem statement (research question) should express the relationship between the two or more measurable variables.

Researchers call the properties that they study variables. Such properties take on different values. Thus, a *variable* is, as the name suggests, something that varies. Properties that differ from each other such as age, weight, sex, height, religion, and ethnicity are examples. Researchers attempt to understand how and why differences in one variable relate to differences in another variable. When speaking of variables, the researcher is essentially asking, Is X related to Y? What is the effect of X on Y? How are X1 and X2 related to Y? The researcher is asking a question about the relationship of one or more independent variables and a dependent variable. (Note: in cases in which multiple dependent or independent variables are present, subscripts are used to indicate the number of variables under consideration).

An *independent variable*, usually symbolized by X, is the variable that has the presumed effect on the dependent variable. In experimental research studies (which is common for science, engineering and technology research), the researcher manipulates the independent variable. It is changed or controlled in a scientific experiment to test the effects on the dependent variable. In non-experimental research, the research does not manipulate the independent variable and is assumed to have occurred naturally before or during the study.

The *dependent variable* represented by Y, is often referred to as the consequence or presumed effect that varies with a change in the independent variable. It is the variable being tested and measured in a scientific experiment. The dependent variable is 'dependent' on the independent variable. As the experimenter changes the independent variable, the effect on the dependent variable is observed and recorded. The dependent variable is not manipulated, rather, it is observed and assumed to vary with changes in the independent variable. Predictions are made from the independent variable to the dependent variable. It is the dependent variable that the researcher is interested in understanding, explaining, or predicting. Although variability in the dependent variable is assumed to depend on changes in the independent variable, this does not imply that there is a causal relationship between X and Y, or that changes in variable X cause variable Y to change.

There is no restriction on the number of variables that can be included in a research question. However, questions should not be unnecessarily complex or unwieldy, particularly in beginning research efforts. Research questions that include more than one dependent or independent variable may be broken down into sub questions that are more concise. Take note that variables are not inherently dependent or independent. A variable that is classified as dependent in one study may be considered as independent in another study. Whether a variable is dependent or independent is a function of the role it plays in a particular study.

Source: Adopted from https://medicine.utah.edu/ccts/sdbc/files/Research_Question.pdf

Relationships between dependent and independent variables can be of several forms: linear, or non-linear. Linear relationships can be either direct (positive) or inverse (negative).

In a direct or positive relationship, the values of both variables increase together or decrease together. That is, if one increases in value, so does the other; if one decreases in value, so does the other.

In an inverse or negative relationship, the values of the variables change in opposite directions. That is, if the independent variable increases in value, the dependent variable decreases; if the independent variable decreases in value, the dependent variable increases.

In a non-linear relationship, there is no easy way to describe how the values of the dependent variable are affected by changes in the values of the independent variable.

If there is no discernable relationship between two variables, they are said to be unrelated, or to have a null relationship. Changes in the values of the variables are due to random events, not the influence of one upon the other.

To establish a causal relationship between two variables, you must establish that four conditions exist:

- 1) time order: the cause must exist before the effect;
- 2) co-variation: a change in the cause produces a change in the effect;
- 3) rationale: there must be a reasonable explanation of why they are related;
- 4) non-spuriousness: no other (rival) cause for the effect can be found.

To establish that your causal (independent) variable is the sole cause of the observed effect in the dependent variable, you must introduce rival or control variables. *Control variable* is a variable that is *not the focus or planned as part of a research study* but its existence has certain impact over dependent variable that cannot be ignored in which it is included in the research model testing together with other independent variables. Hence it is called control variable i.e. it is kept under "controlled", "monitored" or "constant" to observe whether it has minimal impact on the relationships between independent and dependent variables. Usually, control variable is not included as part of a hypothesis statement. Control variable is the variable that the researcher "control" so that its effects is not present when the researcher is analyzing the relationship between dependent and independent variables. Control variables are those independent variables which are not part of the research study, but their influence cannot be overlooked. For example, the "price of a product" impacts on "demand of that product", but the influence of the "price of substitute products" cannot be ignored.

If the introduction of the control variable does not change the original relationship between the cause and effect variables, then the claim of non-spuriousness is strengthened.

Commonly used control variables for research on people include sex, age, race, education, and income. Commonly used control variables for research on organizations include agency size (number of employees), stability, mission, budget, and region of the country where located.

For example, consider the placement rates for three training programs. The independent variable is the type of training, and the dependent variable is the placement rate.

Vocational education has a placement rate of 30%; on-the-job training has a rate of 40%; and work-skill training has a rate of 35%. It would appear that on-the-job training is the best program, followed by work-skill training, with vocational education last.

However, when education is introduced as a control variable, it can be seen that the effect of the independent variable (type of training) on the dependent variable (placement rate) is quite different for people with different levels of education.

Source: Adapted from <https://web.csulb.edu/~msaintg/ppa696/696vars.htm>

There are other variables that may be part of the theoretical model or research questions in the study.

Moderating variable is a variable that is consciously understood based on literature review and is required as part of a research study to evaluate how it moderates the relationship between the independent and dependent variables. Moderating variable is starting at the same time as the independent variable which both independent moderating variables are having interaction that influence the dependent variable. Moderating variable is usually explicitly stated as part of the hypothesis. For example, the relationship between HR Practices (independent) and Firm Performance (dependent) can be moderated by leaderships style (moderating variable) such that the relationship is stronger with multiple leadership styles and weaker with only single leadership style. Moderating variable is the variable of interest in the relation between independent and dependent variables. In other words, the researcher is interested to know whether the presence of a moderator variable in the model has moderating effects or not, in the relationship between independent and dependent variables. Moderator variables are those variables which act like a catalyst in a regression relationship. They interact with the independent variables either to shrink or enhance the relationship between the independent and dependent variables. In other words, the relationship between dependent and independent variables is a function of moderator variable (e.g., gender, age, income, education etc.).

Mediators/Intervening variable are more like translators which carry forward the influence of independent variable on the dependent variable. In simple words, mediator variables work like a “middleman” or “broker” between the independent and dependent variables. For example, the influence of “brand knowledge” on “brand loyalty” may be mediated by “attitude towards the brand.” An intervening variable (sometimes called a mediating variable) is a hypothetical variable used to explain causal links between other variables. Intervening variables *cannot be observed in an experiment* (that’s why they are hypothetical). For example, there is an association between being poor and having a shorter life span. Just because someone is poor doesn’t mean that will lead to an early death, so other hypothetical variables are used to explain the phenomenon. These intervening variables could include: lack of access to healthcare or poor nutrition.

A *moderator variable* could be considered as a *control variable* if one can hypothesize its specific effects in a model, where one is not focused on these effects but on the relationship between other variables [i.e., independent and dependent variables] that is not simple in the presence of the moderator. For example, you might hypothesize that an independent and dependent variable are positively related for men, but negatively related for women, but when the sexes are combined, there is no relationship. Here the moderator, gender, might be considered informally as a control variable whose influence you want to remove before investigating the independent and dependent variables. The correct way to approach this issue is to think through your model carefully and include measures of variables that are important to it.

Types of Hypothesis

There are generally two (2) types of hypotheses: the *null hypothesis* and the *alternative hypothesis*. As discussed earlier, the criteria of the research problem in the form of null hypothesis and alternative hypothesis should be expressed as a relationship between two or more variables. The null hypothesis and alternative hypothesis should carry clear implications for testing and stating relations. The null hypothesis and alternative hypothesis are useful only if they state the expected relationship between the variables or if they are consistent with the existing body of knowledge. The importance of the null hypothesis and alternative hypothesis are that they provide an approximate description of the phenomena for the following purposes:

- To provide the researcher/investigator with a relational statement that is directly tested in a research study
- To provide the framework for reporting the inferences of the study.

- To behave as a working instrument of the theory.
- To prove whether or not the test is supported, which is separated from the investigator's own values and decisions.
- To provide direction to the research.

The null hypothesis is generally denoted as H_0 . It provides the statement which is contrary to the hypothesis. It's a negative statement, and defines the statement which states that there is no exact or actual relationship between independent and dependent variables. It states the exact opposite of what an investigator or an experimenter predicts or expects.

The alternative hypothesis is generally denoted as H_1 . It makes a statement that suggests or advises a potential result or an outcome that an investigator or the researcher may expect. It has been categorized into two categories: directional alternative hypothesis and non-directional alternative hypothesis.

The *directional hypothesis* is a kind that explains the direction of the expected findings. Sometimes this type of alternative hypothesis is developed to examine the relationship among the variables rather than a comparison between the groups. It shows how a researcher is intellectual and committed to a particular outcome. The relationship between the variables can also predict its nature. For example- children aged four years eating proper food over a five-year period are having higher IQ levels than children not having a proper meal. This shows the effect and direction of effect.

The *non-directional hypothesis* is a kind that has no definite direction of the expected findings being specified. It is used when there is no theory involved. It is a statement that a relationship exists between two variables, without predicting the exact nature (direction) of the relationship.

Source: Adopted from <https://www.statisticssolutions.com/null-hypothesis-and-alternative-hypothesis/>

A hypothesis can be simple or complex. A *simple hypothesis* shows a relationship between one dependent variable and a single independent variable. For example – If you eat more vegetables, you will lose weight faster. Here, eating more vegetables is an independent variable, while losing weight is the dependent variable. A *complex hypothesis* shows the relationship between two or more dependent variables and two or more independent variables. Eating more vegetables and fruits leads to weight loss, glowing skin, reduces the risk of many diseases such as heart disease, high blood pressure, and some cancers.

Associative hypothesis occurs when there is a change in one variable resulting in a change in the other variable. Whereas, *Causal hypothesis* proposes a cause and effect interaction between two or more variables.

Source: Adopted from <https://byjus.com/physics/hypothesis/>.

For more details on variables and hypothesis, watch <https://www.youtube.com/watch?v=ydI5zPR-hw8> and https://www.youtube.com/watch?v=_BmjujZExQ.

Developing and Answering Good Research Questions

A research study should state questions. Broader questions may be broken down into smaller and more specific ones, identifying testable hypothesis. A specific research question is more than an objective. It focuses on the hypothesis and suggests how to find an answer. Research question/s should be stated clearly at the end of the chapter on introduction. The Introduction should identify the focus of the research

question and state the overall study design. The introduction should explain the research question's background and importance and describe the evidence gap.

Research study/aims (from which research questions are derived) may be categorized into descriptive, comparative, and paired comparative. *Descriptive study* aims to estimate the characteristics of a population (e.g. What is the average student evaluation rate of computer science faculty members handling professional courses?); *comparative study* aims to establish whether there is significant differences between two groups (e.g. Do faculty members who participated in our intervention have a higher student evaluation rate than faculty members who did not?) ; *paired comparative study* aims to compare the same subjects at two points in time (e.g. Do faculty members who participated in our evaluation have a higher student evaluation rate than they did a year ago?).

Research questions/objectives/problem statements should be:

- Feasible – answerable with available resources
- Interesting – primarily to the investigators
- Novel – confirms/refutes/extends knowledge, fills gap that matters;
 - Take note that a novel research question is subjective; may exist abroad but not locally with peculiar environments/factors/contents
- Ethical – likely to be approved by review committee and is applicable to practice
- Relevant – could influence practice, policy, more studies; could advance knowledge

Poor research questions/objectives/problem statements are:

- A question you don't care about; nor does anybody else
- Not necessary nor beneficial as the answer is obvious. (e.g. the answer is known/given; comparing variables of different structure)
- Examining routine data (often incomplete, biased, confounded) and then trying to think of a question
- A fishing expedition/data dredging – gathering lots of information and hoping a question will emerge

Research questions may start with...

- What is the degree of accuracy ofin terms of...
- What was the impact of...on...
- What was the effectiveness of...on...
- What was the association of...with...
- Is there a significant difference between...and...

Formulating Research Questions

In formulating research objectives (specific problem statements or research questions), the following need to be considered:

- There is no point to prove something (in the problem statement or research question) that is already obvious or is known.
- There is no point to compare characteristics/data resulting from the difference in structure and nature (e.g. comparing performance of different algorithmic structures is like comparing the performance of a dog and a cat).
- However, we should be careful not to presume that a certain inquiry or investigation already has a given or fixed answer or if the already known value/answer generally applies to all scenario.

Finally, read everything you can--academic research, trade literature, and information in the popular press and on the Internet. Start writing early; keep notes while reading. Present a coherent framework – what are the major approaches; what are the main open problems? When you write, don't just copy, give your own opinion. A good way to scoop from an existing study is to determine what statement of the author struck you most. Then determine in which part of your research paper you will mention that author or his/her work.

As you become well-informed about your topic and prior research on the topic, your knowledge should suggest a purpose for your thesis. When you can express this purpose clearly, you are ready to write your thesis proposal (Chapters 1-3).

Suggested Research Topics For It/Is/Computing Field

Presented is a table of possible research topics in the field of IT, IS and/or computing and their respective categories; those colored yellow are considered to be computer science researches (introduces innovations in the underlying techniques) and those colored blue are IT researches(integration of innovative technologies) and those colored green can be both. Examples with double quotes are real-life research studies that have been developed by very young faculty members in a university in southern Philippines, except for the last one which I personally authored.

These topics have existing challenges and/or gaps that need to be filled. We should marry these challenges with the university research agenda to come up with suitable research topics. It is a good practice to select the topic which interests you personally.

Table 1.0. Suggested Topic and Category for IT/IS and Computing Research

CATEGORY	RESEARCH TOPICS
Big Data and Data Science	<ul style="list-style-type: none"> •Efficient and effective collection of big data into the data lake and into the DW •metadata management •development of analytics search engine •feedback mechanism on analytics •transparent data science algorithm •solutions for NP complete problem (ex. Cluster computing, new algorithms) •systems that are memory and computationally efficient <ul style="list-style-type: none"> •predictive analytics (utilize supervised and/or unsupervised learning algorithms) Ex. Prediction of unfortunate events (red tide, disease outbreak, etc.) •Visual Analytics (integrating visualization with algorithms that allows user to see and understand large volume of information from the real world, at once) Ex. Visualization-based warning system Visualization-based monitoring system •Web Mining / Application of Unsupervised Machine Learning Algo Ex. Social Media Sentiment Analyzer Ex. Mining and classifying tweets for disaster management (automatic classification, location and problem detection, help mobilization)

	<p>Ex. "Application of Latent Dirichlet Allocation Algorithm on Published Articles on Cyber Bullying"</p> <p>"Application of LDA Algorithm on Online Documents on Child Pornography"</p> <p>"Content Analysis of Online Document on Identity Theft Using LDA Algorithm"</p> <p>"Deciphering Published Articles on Cyber Terrorism using LDA Algorithm"</p> <p>"Global Perception on Cyber Security using LDA Algorithm"</p> <p>"Issues and Challenges on Data Privacy using LDA Algorithm"</p> <p>"Unraveling Online Sentiments on Global Warming using LDA Algorithm"</p> <p>"World View on Climate Change: An Application of LDA Algorithm"</p> <p>•Predictive analytics (applications of supervised learning algorithms to predict trends and behavior patterns or future behavior) to drive better decisions</p> <p>Ex. HR Analytics</p> <p>Ex. customer credit scoring</p> <p>Ex. targeted hiring (forecast) for BPO</p> <p>Ex. targeted client (forecast) for real-estate</p> <p>•exploratory data mining (assess the predictive value of various possible combinations of variables in a data set)</p> <p>•data analytics in behavioral research (use data analytics to track and analyze user actual behavior with system to provide a better indicator of systems (IT) acceptance, adoption and use as compared to survey approach)</p> <p>Ex. Use machine learning to analyze user behavior from data log files, eye-movements, brain imaging (e.g., fMRI, EEG) and other psychophysiological tools</p>
Image Processing (to address manual grading problems that result to inconsistency, monotonous and bias)	<p>•shape analysis</p> <ul style="list-style-type: none"> - change of pose, deformation, varying light condition) - consider area, perimeter, major axis length, minor axis length; - convert RGB to gray scale image to binary image then calculate shape features <p>•size analysis - Ex. Cell counting (size identification, noise identification)</p> <p>•color analysis – convert RGB color to HLS, HSV then for all converted color calculate space mean & SD; each image given diff value of mean & SD to help its classification</p> <p>•texture analysis – measures roughness, coarseness, smoothness;</p> <ul style="list-style-type: none"> -classified by spatial distance of gray levels -helps in surface determination and shape determination - 2 methods: statistical texture analysis or structure of texture analysis
Mobile games social	<p>Types:</p> <ul style="list-style-type: none"> •for advertisement ex. Pixar's "Temple Run" •for social change ex. "Inside the Haiti Earthquake" •games to develop skills, incentivize productivity, enhance training session -ex. Gamification in e-learning <p>Challenges:</p> <ul style="list-style-type: none"> •Cross-platform games (diff. attributes, screen sizes) •Scalable games that do not shut down servers

Capstone (Integration)	<ul style="list-style-type: none"> •Integrated LMS and Social Media •data analytics in academe/e-learning •social media text mining to identify victims of bullying •classroom technology and paradigm in response to climate change •emphatic computing (systems that understand human states and feelings and shares this intimate information, thru the convergence of sensors, embedded processors and wireless ad-hoc networks) •guidance counsellor chatbot for victims of bullying •systems like Trapik.org, Brightspace •CAI for visually impaired students (1.speech- text; 2.NLP; 3. Text-speech)
Descriptive/Social Research	<ul style="list-style-type: none"> •Survey-based Research Ex. "An Assessment of ICT Competencies of Public School Teachers: Basis for Community Extension" Ex. "Understanding Participation In Local Online Learning Groups in A Social Networking Site" •Path Analysis and Discriminant Analysis

Computer Science

INT/IS

Both depending on approach/design

ASSESSMENT

1. In your own words, describe research question and hypothesis, and their relationship
2. In your own words, describe the relationship between hypothesis and theory
3. In your own words, describe the relationship between research questions and research variables
4. Provide scenarios demonstrating the dependent variable, independent variable, control variable, moderating variable, and intervening variable.
5. Give an example of a directional and non-directional alternative hypotheses and their respective null hypotheses.
6. Think about the topics and theories you have studied in your own program, and which topic you are interested in and what you would like to know more about. Is there some question you feel the body of knowledge in your field does not answer adequately? Discuss.
7. *Describe the different types of theories in computing research*

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LESSON: WRITING CHAPTER 4 OF A RESEARCH

Review of the Research Proposal (Chapters 1-3)

- Results and Discussions
- Parts of Chapter 4

CHAPTER 4: Overview

This lesson will guide you in preparing Chapter 4 of your research paper. It will begin by providing a review of the specific parts of a Research Proposal (Chapters 1- 3) . This lesson will also ask you to review the quality of your research proposal by answering a checklist. After reviewing your research proposal, you will then be guided in preparing your Chapter 4.

Learning Outcomes

After completion of this lesson, you will be able to competently do these:

- Review the component parts of a research proposal.
- Assess the quality of your research proposal.
- Facilitate data gathering using google forms.
- Write Chapter 4-Results and Discussion using the data gathered.

Course Materials

Review of the Research Proposal (Chapters 1-3)

The research proposal is composed of Chapters 1 to 3 of the research. Chapter 1 is titled “The Problem and Its Setting.” Chapter 2 is “Review of Related Literature and Studies. Meanwhile, Chapter 3 is “Methodology.” (PUP Website)

Chapter 1 has the following sub-topics:

Introduction

1. Theoretical Framework
2. Conceptual Framework
3. Statement of the Problem
4. Hypothesis of the Study
5. Scope and Limitations of the Study
6. Significance of the Study

7. Definition of Terms

Chapter 2 has the following features:

1. Thematic arrangement of literature and studies
2. Synthesis of Reviewed Literature and Studies
- 3.

Chapter 3 has the following parts:

For Bachelor of Science in Information Technology (BSIT)/Master of Science in Information Technology (MSIT)

1. Research Design
2. Sources of Data
3. Research Instrument
4. Data Generation Procedure
5. Ethical Considerations
6. Data Case Analysis
7. Proposed System Architecture

For BS Computer Science

1. Research Design
2. Sources of Data Instrument
3. Data Generation/
4. Gathering Procedure
5. Statistical Data Analysis

At this point in time, you are expected to have written your Research Proposal. Please review your proposal by answering the following questionnaire.

1.0	Background and Significance of the Research	5	4	3	2	1
1.	<i>The results of my proposed IT/CS research will fill a gap in our knowledge.</i>					
2.	<i>My proposed research will advance our understanding of the topic.</i>					
2.0	Literature Review	5	4	3	2	1
3.	<i>My research proposal demonstrates thorough and current understanding and knowledge of the peer reviewed literature related to the topic.</i>					
4.	<i>The literature that I cited were critically reviewed.</i>					

5.	<i>My literature review identify gaps, shortcomings, and/or limitations in existing research, therefore providing a context for the study.</i>					
6.	<i>My literature review justify the question/problem being studied.</i>					
3.0	Theoretical Framework	5	4	3	2	1
7.	<i>My theoretical framework was clearly identified and described.</i>					

8.	<i>My theoretical framework is linked to the research problem/question/hypothesis.</i>					
9.	<i>My theoretical framework demonstrates understanding of current and relevant peer-reviewed literature.</i>					
4.0	Research Problem/Question/Hypothesis					
10.	<i>My research proposal clearly frame the research question/problem/hypothesis.</i>					
11.	<i>My research problem/question/hypothesis are logical and researchable.</i>					
12.	<i>My research problem/question/hypothesis are manageable and achievable.</i>					
13.	<i>My research problem/question/hypothesis are ethical.</i>					
14.	<i>My research question/problem/hypothesis are focused and grounded in relevant peer-reviewed literature.</i>					
15.	<i>My proposed research is grounded in my experience and context.</i>					
5.0	Methodology					
16.	<i>My methodology (e.g., quantitative, qualitative, mixed methods)is appropriate for the research question/problem.</i>					
17.	<i>My proposal identify and describe the specific type of methodology (e.g., qualitative (ethnography, grounded theory, case study, etc.), quantitative (descriptive, quasi-experimental, etc.), or mixed methods (from both traditions).</i>					

18.	<i>My methodology are clearly articulated and supported by current and relevant peer-reviewed literature.</i>					
6.0	Research and Data-Gathering Procedures					
19.	<i>My procedures are well organized and are clearly described in a carefully focused step-by-step, straightforward manner.</i>					
20.	<i>My procedures are consistent with the selected methodology.</i>					

21.	<i>My methods are reasonable and appropriate for the research question/problem.</i>					
22.	<i>I provided a timeline for the research, and it shows that it is manageable and achievable.</i>					
23.	<i>My proposal demonstrates thorough and current understanding and knowledge relevant peer reviewed literature related to selected research and data-gathering procedures.</i>					
7.0	Data Description and Preparation					
24.	<i>My proposal identifies the who, what, where, when, why, and how of data collection.</i>					
25.	<i>My proposal identifies possible problems with data sources, collection of data, and/or preparation of data.</i>					
8.0	Resources Required					
26.	<i>Required resources (i.e., any special equipment or materials that I will need during the research) are appropriately described.</i>					
27.	<i>Required resources for my research are available and accessible.</i>					
9.0	Data Analysis					
28.	<i>My proposal identifies possible methods for data analysis.</i>					
29.	<i>My proposal demonstrates thorough and current understanding and knowledge of the research/peer reviewed literature related to data analysis.</i>					

10.0	Ethical Considerations					
30.	<i>My proposal anticipates and/or discusses potential difficulties and obstacles in the approach I have chosen.</i>					
31.	<i>I have fully considered potential benefits and risks to my research participants.</i>					
32.	<i>My proposal discusses how confidentiality of subjects and their responses will be maintained.</i>					
33.	<i>My proposal discusses how data will be stored to ensure confidentiality of subjects.</i>					
11.0	References					
34.	<i>My research proposal provides a list of cited references.</i>					
35.	<i>The references I cited are current and relevant.</i>					
36.	<i>I used APA (American Psychological Association) 6th edition appropriately in the reference list.</i>					
37.	<i>My references are cited appropriately in the literature review, theoretical framework, and description of methodology.</i>					
12.0	Overall					
38.	<i>My proposal is coherent and easily understood by the reviewers.</i>					
39.	<i>I used the peer-reviewed literature effectively to support the proposal's theoretical underpinnings.</i>					
40.	<i>I used headings to organize sections and demonstrate understanding of essential components.</i>					
41.	<i>My headings reflect an organizational structure for the final product.</i>					
42.	<i>My proposed research would likely to get ethics approval.</i>					
43.	<i>In my proposal, there are no spelling, grammar, punctuation, or presentation features that interfere with coherence and clarity.</i>					
44.	<i>My APA formatting is consistent and appropriately applied.</i>					

After accomplishing the assessment form above, you have to compute for your composite mean. Just add all your scores from number 1 to 44 and then divide the sum by 44. Now, you can rate yourself. Use the following scales in rating your research proposal.

Range of Composite Mean Scores	Interpretation
1.00 to 1.80	Poor
1.81 to 2.60	Fair
2.61 to 3.40	Good
3.41 to 4.20	Very Good
4.21 to 5.00	Excellent

What is your mean score? How will you interpret it based on the rubrics above? What are your reflections about it?

Chapter 4

It discusses the findings of the study derived from the data that have been gathered, processed and analyzed. It answers all specific questions in Chapter 1 under Statement of the Problem (SOP) supported with statistical tables or figures. It emphasizes only those aspects of the results that are important and noteworthy. You should avoid making the mistake of preparing a table and then discussing every entry in the table whether significant or not. In this part you will identify and interpret the major data. Discuss possible reasons why these results occurred, fit the results into the findings of previous researches, suggest field applications and make theoretical interpretations. Then, you will deal with each hypothesis in the study in the presentation of results.

Results and Discussions

The Results and Discussion (Chapter 4) is where you delve into the meaning, importance and relevance of your results. It should focus on explaining and evaluating what you found, showing how it relates to your literature review and research questions, and making an argument in support of your overall conclusion. There are many different ways to write this section, but you can focus your discussion around four key elements:

- ✚ Interpretations: what do the results mean?
- ✚ Implications: why do the results matter?
- ✚ Limitations: what can't the results tell us?
- ✚ Recommendations: what practical actions or scientific studies should follow?

There is often overlap between the discussion and conclusion, and in some dissertations these two sections are included in a single chapter. Occasionally, the results and discussion will be combined into one chapter. If you are unsure of the best structure for your research, look at sample thesis in your field or consult your adviser.

Parts of Chapter 4

Parts of Chapter 4 will depend on the number of objectives or sub-problems that you have in your research. It will be better if you will follow the relationship of the Statement of the Problem (SOP) with your presentation of data.

Statement of the Problem/Objectives		Sequence of Data Presentation
1	SOP Number 1/Objective Number 1	Part 1 of the Presentation
2	SOP Number 2/Objective Number 2	Part 2 of the Presentation
3	SOP Number 3/Objective Number 3	Part 3 of the Presentation

In writing your Chapter 4, you should be guided by your statement of the problem or objectives of the study and your data gathering tool as well. See to it that when you present your data, sequence will be in accordance to your SOP/Objectives. Bear also in your mind the statistical tools that you have used in analyzing the data. In the presentation, you will use tables and sometimes figures. After presenting the data, you have to provide an analysis and interpretation.

Data analysis is the process of systematically applying statistical and/or logical techniques to describe and illustrate, condense and recap, and evaluate data. According to Shamoo and Resnik (2003) various analytic procedures “provide a way of drawing inductive inferences from data and distinguishing the signal (the phenomenon of interest) from the noise (statistical fluctuations) present in the data.” On the other hand, **Interpretation of data** refers to the task of drawing inferences from the collected facts after an analytical and/or experimental study. In fact, it is a search for broader meaning of research findings. The task of interpretation has two major aspects: first, the effort to establish continuity in research through linking the results of a given study with those of another, and second, the establishment of some explanatory concepts. “In one sense, interpretation is concerned with relationships within the collected data, partially overlapping analysis. Interpretation also extends beyond the data of the study to include the results of other research, theory and hypotheses.”¹ Thus, interpretation is the device through which the factors that seem to explain what has been observed by researcher in the course of the study can be better understood and it also provides a theoretical conception which can serve as a guide for further researches.

Results and findings are backed up with related studies and literature. This is called “cross-referencing.” Cross references are used to support or negate findings of the present study.

While writing your Chapter 4, you may also consider the following:

1. ***In your Discussion.*** In discussing your data, you will need to demonstrate a capacity to identify trends, patterns and themes within the data. Consider various theoretical interpretations and balance the pros and cons of these different perspectives. Discuss anomalies as well as consistencies, assessing the significance and impact of each. If you are using interviews, make sure to include representative quotes to in your discussion.
2. ***In your Findings.*** What are the essential points that emerge after the analysis of your data? These findings should be clearly stated, their assertions supported with tightly argued reasoning and empirical backing.
3. ***Relation with literature.*** Towards the end of your data analysis, it is advisable to begin comparing your data with that published by other academics, considering points of agreement and difference. Are your findings consistent with expectations, or do they make up a controversial or marginal position? Discuss reasons as well as implications. At this stage it is important to remember what, exactly, you said in your literature review. What were the key themes you identified? What were the gaps? How does this relate to your own findings? If you are not able to link your findings to your literature review, something is wrong – your data should always fit with your research question(s), and your question(s) should stem from the literature. It is very important that you show this link clearly and explicitly.

Watch and Reflect:

1. Video clip on the types of data and the corresponding statistical tools that can be used
<https://www.youtube.com/watch?v=hZxznfnt5v8>
2. What are your significant learning from the video?
3. What are your reflections about the video?

Review:

1. Review the coding of data in a qualitative research especially if your are using triangulation. Watch this video on coding using this link <https://www.youtube.com/watch?v=IYzhgMZii3o>

Activities / Assessment Tasks

After administering your questionnaires using google forms, you may now start applying the appropriate statistical tools and preparing tables for the data that you have gathered.

1. You may now present these data in accordance to the SOP or Objectives of your study. If you have three SOPs, then there must be three parts in your presentation. Use PUP Manual in the preparation of your tables.
(https://drive.google.com/file/d/0B1BuDAuN0r8SMFpBYWNGckhUWkE/view?usp=drive_open)
then provide an analysis, interpretation and cross references in each part of your presentation.

Sample ANALYSIS OF DATA

Title: DRUMSYNTH: DRUM STROKE GESTURE SYNTHESIZER USING CONVOLUTIONAL NEURAL NETWORK

(Rhegie R. Candelaria, Angelito M. Encinas and Iverson C. Gruezo, 2020) The purpose of this study is to solve drum sound generation based on realistic gesture by developing a system that will synthesize drum stroke gesture into drum sound. The researchers underwent experimentation to thoroughly investigate and analyze data to come up with the following results. Table 5 summarizes the collective data of the experimentation. The researchers conducted tests to evaluate the degree of accuracy of the system in synthesizing drum sound based on 'Correctly Synthesized' (The system correctly synthesized a drum sound by a drum stroke gesture) and 'Incorrectly Synthesized' (The system incorrectly synthesized a drum sound by a given drum stroke gesture).

The researchers conducted several trials to evaluate the accuracy of the developed system in terms of synthesizing drum sounds using Neural Network. Also, the researchers identify the significant difference between the drum sounds produced by professional drummers and the drum sounds produced by the system.

Table 5

Evaluation of Overall Accuracy of the System

Overall System Accuracy Rate for Synthesizing Drum Sound				
No. of Test	Correctly Synthesized	Incorrectly Synthesized	Accuracy	Verbal Interpretation
726	679	47	93.53%	Very High Accuracy

The researchers conducted a live video testing to evaluate the system. Most of the song that the researchers choose have a 120 BPM mark as the maximum count for every

Most of the song that the researchers choose have a 120 BPM mark as the maximum count for every sequence.

CHAPTER 5: Conclusions and recommendations

OVERVIEW:

Summary, conclusion and recommendation are necessary to end the research paper. This chapter identifies the salient points that must be improved in the next research. The recommendations are very important for the future researchers to continue what was missed in the link, or problems created after carefully analyzing data gathered in the research output.

LEARNING OBJECTIVE:

1. Formulate properly acceptable standardized conclusions and recommendations based on proposed research major and minor topic/s;

The Conclusions and Recommendations may be combined or, in long reports, presented in separate sections. If there are no recommendations to be made as a result of the project, just call this section Conclusions.

The Conclusions section sums up the key points of your discussion, the essential features of your design, or the significant outcomes of your investigation. As its function is to round off the story of your project, it should:

- be written to relate directly to the aims of the project as stated in the Introduction
- indicate the extent to which the aims have been achieved
- summarize the key findings, outcomes or information in your report
- acknowledge limitations and make recommendations for future work (where applicable)
- highlight the significance or usefulness of your work.

The conclusions should relate to the aims of the work:

Example 1:

Aim

The aim of this project is to design a mobile phone tower for a suburban location..

Conclusions

The mobile phone tower presented here can be erected safely in a suburban street. It requires a total area of no more than 2m² l, and has the following safety features:...

Example 2:

Aim

This investigation will review the volume of passengers using the Monash University Clayton-Caulfield inter-campus bus in order to recommend adjustments to the service if needed.

Conclusions

Analysis of the survey data obtained in this project shows that use of the Clayton-Caulfield inter-campus bus has increased by 24% in the past five years. It is recommended that frequency be increased during peak usage...

The Conclusions section below is from a level 2 Civil Engineering Alternative Designs report presenting two designs for a an overpass bridge. Click on the coloured buttons to see the comments.

Conclusions

Each of the two bridge designs presented in this report fulfil the criteria specified in the project brief. Both designs incorporate round piers on piled foundations, which are used because the soil conditions are unknown and possibly unstable. Design 1, a simple composite I-girder bridge, has the advantage of being made of steel and thus has longer spans and fewer piers.

Design 2, a super-T beam bridge, requires minimal formwork in the construction of its concrete deck, is relatively easy to erect and will maintain stability during transportation and construction. In addition, it is more economical to build and maintain. Design 2 is therefore recommended. It offers an affordable overpass with superior durability, and fully meets the requirements of the design brief.

Recommendations

Always address limitations and suggest how they might be overcome in future work. The excerpt below is from the Conclusions of a report on a project investigating the effect of pulsation on heat transfer in horizontal pipe flow.

Experimental results showed that pulsed flow without flow reversal had no significant effect compared with steady flow. Preliminary experiments with reversed flow, however, clearly indicated increased heat transfer. This is likely due to the large disturbances in the hydrodynamic boundary layer when the flow changes direction. Further research is recommended to determine the maximum achievable enhancement.

It should be noted that the experimental results do not agree with the theoretical equations. This may be due to the deposits which developed inside the pipe, or to inconsistent thermocouple temperature. Therefore, regular inspection of the test rig is recommended.

For a very long report, it is acceptable to present the conclusions and recommendations in point form:

The prototype robot courier presented here has been shown to be capable of delivering documents autonomously in an office environment. It has demonstrated the following components of mobile robotics:

1. Localization: The Kalman filter-based localization algorithm achieved sub-centimeter accuracy under normal operating conditions.
2. Environment modelling: The occupancy map was updated dynamically to include obstacles not included in the original map.
3. Path planning: A distance transform-based path planner using obstacle transforms produced a globally optimal local entrapment-free path to the goal.

[10] date retrieved: July 27, 2020: <https://www.monash.edu/rlo/assignment-samples/engineering/eng-writing-technical-reports/conclusions-and-recommendations>

DEFINITION OF CONCLUSION

The conclusion is intended to help the reader understand why the research should matter to them after they have finished reading the thesis. A conclusion is not a summary of the points or a re-statement of the research problem but a synthesis of key points. For most essays, one well-developed paragraph is sufficient for a conclusion, although in some cases, a two-or-three paragraph conclusion may be required (USC Libraries, 2014).

IMPORTANCE OF A GOOD CONCLUSION

A well-written conclusion provides one with several important opportunities to demonstrate the overall understanding of the research problem to the reader; and these include the following:

1. Presenting the last word on the issues one raised in the thesis. Just as the introduction gives a first impression to the reader, the conclusion offers a chance to leave a lasting impression. Do this, for example, by highlighting key points in the analysis or findings.
2. Summarizing one's thoughts and conveying the larger implications of the thesis. The conclusion is an opportunity to succinctly answer the "so what?" question by placing the study within the context of past research about the topic one has investigated.
3. Demonstrating the importance of one's ideas. One should not be shy. The conclusion offers one a chance to elaborate on the significance of the findings.
4. Introducing possible new or expanded ways of thinking about the research problem. This does not refer to introducing new information which should be avoided, but to offer new insight and creative approaches for framing or contextualizing the research problem based on the results of the study (USC Libraries, 2014).

GENERAL RULES OF STRUCTURE AND WRITING STYLE OF CONCLUSION

When writing the conclusion to the thesis, one needs to follow these general rules:

1. State the conclusion in clear, simple language.
2. Do not simply reiterate the results or the discussion.
3. Indicate opportunities for future research, as long as one hasn't already done so in the discussion section of the thesis.
4. The function of the thesis conclusion is to restate the main argument. It reminds the reader of the strengths of the main argument(s) and reiterates the most important evidence supporting those argument(s). Make sure, however that the conclusion is not simply a repetitive summary of the findings because this reduces the impact of the argument(s) one has developed in the thesis (USC Libraries, 2014).

One needs to consider the following points to help ensure the conclusion is appropriate:

1. If the argument or point of the study is complex, one may need to summarize the argument for the reader.
2. If, prior to the conclusion, one has not yet explained the significance of the findings or if one is proceeding inductively, use the end of the thesis to describe the main points and explain their significance.
3. Move from a detailed to a general level of considerations that returns the topic to the context provided by the introduction or within a new context that emerges from the data (USC Libraries, 2014).

The conclusion also provides a place for one to persuasively and succinctly restate the research problem, given that the reader has now been presented with all the information about the topic. Depending on the discipline one is writing in, the concluding paragraph may contain the reflections on the evidence presented, or on the essay's central research problem. However, the nature of being introspective about the research one has done will depend on the topic and whether one's supervisor wants one to express the observations in this way

Don't delve into idle speculation. Being introspective means looking within ourselves as an author to try and understand an issue more deeply not to guess at possible outcomes (USC Libraries, 2014).

DEVELOPING A COMPELLING CONCLUSION

Strategies to help one move beyond merely summarizing the key points of the thesis may include any of the following:

1. If the study deals with a contemporary problem, one needs to warn readers of the possible consequences of not attending to the problem.
2. Recommend a specific course or courses of action.
3. Cite a relevant quotation or expert opinion to lend authority to the conclusion one has reached; a good place to look is research from the literature review.
4. Restate a key statistic, fact, or visual image to drive home the ultimate point of the thesis.
5. If the discipline encourages personal reflection, one needs to illustrate one's concluding point with a relevant narrative drawn from one's own life experiences.
6. Return to an anecdote, an example, or a quotation that was introduced in the introduction, but add further insight that is derived from the findings of the study; use the interpretation of results to reframe it in new ways.
7. Provide a 'take-home' message in the form of a strong, succinct statement that one wants the reader to remember about the study (USC Libraries, 2014).

PROBLEMS TO AVOID IN CONCLUSION

The following problems should be avoided in writing the conclusion:

1. Failure to be concise: the conclusion section should be concise and to the point. Conclusions that are too long have unnecessary detail. The conclusion section is not the place for details about the methodology or results. Although one should give a summary of what was learned from the research, this summary should be relatively brief, since the emphasis in the conclusion is on the implications, evaluations, insights, etc. that one makes.
2. Failure to comment on larger, more significant issues: in the introduction, one's task was to move from general (the field of study) to specific (the research problem). However, in the conclusion, one's task is to move from specific (the research problem) back to general or field – i.e. how the research contributes new understanding or fills an important gap in the literature. In other words, the conclusion is where one places the study research within a larger context.
3. Failure to reveal problems and negative results: negative aspects of the research process should never be ignored. Problems, drawbacks, and challenges encountered during the study should be included as a way of qualifying the overall conclusions. If one encountered negative results of findings that are validated outside the research context in which they were generated; one must report them in the results section of the paper. In the conclusion, use the negative results as an opportunity to explain how they provide information on which future research can be based.

4. Failure to provide a clear summary of what was learned: in order to be able to discuss how the research fits back into the field of study and possibly the world at large; one needs to summarize it briefly and directly. Often this element of the conclusion is only a few sentences long.
5. Failure to match the objectives of the research: often research objectives change while the research is being carried out. This is not a problem unless one forgets to go back and refine the original objectives in the introduction, as these changes emerge they must be documented so that they accurately reflect what one was trying to accomplish in the research and not what one thought one might accomplish when one began.
6. Resist the urge to apologize: if one has immersed one's self in studying the research problem, one now knows a good deal about it, perhaps even more than one's supervisor! Nevertheless, by the time one has finished writing, one may be having some doubts about what one has produced. Repress those doubts! Don't undermine one's authority by saying something like: this is just one approach to examining the problem; there may be other, much better approaches ... (USC Libraries, 2014).

SUMMARY, CONCLUSION AND RECOMMENDATION

This chapter may consist of five sections namely: summary, conclusion, implication, recommendations, and suggestions. The last two are optional depending on the nature of the report (Mutai, 2001, p.35).

SUMMARY

To start with, summarize what one has attempted to do and the results one has achieved; one may restate the original research questions, or hypotheses, and indicate whether one has supported, or rejected them. Briefly summarize everything covered in the first three chapters and in the findings portion of chapter four (results) (Mutai, 2001, p.35). The summary reminds and informs the reader about the purpose of the study, the process used to collect, analyze data and the major findings of the study. A summary must reflect as accurately as possible the body of one's report (Mugenda & Mugenda, 2003, p.151) In summarizing the results, keep in mind, the importance of inter-chapter consistency. For most dissertations, the statement of the problem in chapter one; the literature review in chapter two; the explanation of methodology in chapter three; the presentation of results in chapter four; and the synthesis and interpretation of findings in chapter five should be arranged in a consistent manner. One should summarize these without the introduction, or addition of new irrelevant information (Mutai, 2001, p.62).

Summary serves the following three purposes:

1. It refocuses the reader's attention in the main issues and findings: by encapsulating the varied details which have been presented.
2. It qualifies some of the findings (when appropriate): by stressing methodological limitations and alternative limitations of research.
3. It may suggest promising directions for future research: based upon the experience of the researcher. It also highlights serendipitous findings and generalizes research results into theoretical findings (Mutai, 2001, pp.62 – 63).

In summarizing results, one should find that the general-to-specific pattern works well. Begin with the general, and support it with appropriate details. Finally, increase the clarity of the summary section by using appropriate transitional cues. One can use sequencing words such as the following: first; also; next; finally (Mutai, 2001, p.63).

The final chapter should not introduce any new data or analysis into the report. Everything that was to be tested or evaluated should have been included in prior chapters. Only summation of one's findings appears in the final chapter, making it relatively brief (Mutai, 2001, p.63).

CONCLUSIONS

One needs to draw together the threads of research to arrive at some general conclusions. In other words, one recapitulates the ideas of the dissertation in terms of research problem, or objectives and tie up both ends neatly. By and large, the conclusions are drawn by logical inference, from findings. The conclusion verifies or disproves the premises or hypotheses upon which the investigation has been conducted. Care should be taken to state a conclusion for each objective or problem delimited in the proposal or statement of the research objectives. Conclusions should flow logically from the findings. But since drawing conclusions involves the human process, should help one to avoid this inherent problem (Mutai, 2001, p.35).

The conclusion culminates the research report and is of utmost importance to one's readers because it answers the questions that sparked the collection and analysis of the data in the first place. In concluding one's report, it is important to discuss the practical application and implications of one's findings in the real world. Although one is supposed to have interpreted evidence at every step of one's analysis, one's conclusions pull the strands together in a broader perspective and indicate possible action, where appropriate (Mugenda & Mugenda, 2003, p.151).

In the main text of the conclusion section, one needs to draw together the threads of the research to arrive at some general conclusions and perhaps, suggest some ways forward. Rather than let the report fizzle out as it reaches the end, this part of the report should be constructive and positive. Conclusions should not contain any ideas not previously raised in the report. It should state in unqualified terms what the findings are. The findings should then be related to other evidences or hypotheses as described in the main body, including a comparison with other similar studies. Where appropriate, a variety of options arising from the study should be explained. The content of the conclusion logically preceded it. In tying these material together, the conclusion can perform on of the three functions:

1. Recapitulate the ideas: of the paper in terms of the thesis statement returns to the first paragraph or so, and ties up both ends neatly.
2. Extend a challenge: usually reserved for the problem-solving paper. Such a conclusion may call on the reader himself to help affect the solution by telling him what to do.
3. Draw inferences: if opposing ideas have been presented, the conclusions may challenge the reader to accept one or the other of the ideas or at least to consider their relative value (Mutai, 2001, pp.63 – 64).

PARAMETERS OF CONCLUSIONS

The following points should be considered when writing conclusion section:

1. Write the conclusions at a scope and level of generality justified by the data presentation.
2. Make necessary qualifications with care and caution.
3. Coordinate the conclusion with the tentative acceptance or rejection of the research hypotheses presented, or with the objectives or questions posed.
4. Present the conclusions in a form that other investigators can understand and subsequently verify.
5. Ensure that conclusions which are within the limits of the results obtained and must be sound and based upon the body of the thesis.
6. The conclusions are drawn by inference, either inductive or deductive, from the findings; the conclusions verify or deny the premises, or hypotheses upon which the investigation has been conducted; hence care should be taken to state a conclusion for each objective or problem delimited in the proposal or statement of the research objectives.
7. Ensure that conclusions should flow logically from the findings; but since drawing conclusions involves the human process, should help one avoid this inherent problem.

8. Discuss the conclusions in the light of the present and future practices, for theory, and for additional needed investigations.
9. Give an indication of the usefulness of the research: who could benefit from what one has done? How? What theories, discipline; organizations, groups etc. would like to know what one has uncovered, or concluded? What is the value of one's effort? (Mutai, 2001, pp.64 – 65).

PRECAUTIONS IN WRITING CONCLUSIONS

One should always bear in mind that feeble conclusions can easily mar the total effectiveness of the report. Several factors contribute to weak conclusions as follows:

1. The sense that the writer is in haste to finish up the dissertation may be due to shortage of time or a lack of ideas.
2. Obviousness is another factor: terms like "in conclusion", or any of its relatives, are unnecessary in concluding paragraphs. Exceptional to this rule do exist, but logically, once one has given the subheading i.e. conclusion, there is no need to keep on repeating it again.
3. Moralizing, apologizing or congratulating weakens the conclusions too. Phrases like, "this study having tried to prove ...", "having shown ...", "hopefully has given you a better understanding ...", or "hopefully inspiring you ..." are inappropriate and usually insulting to the reader's intelligence (Mutai, 2001, pp.65 – 66).

RECOMMENDATIONS AND SUGGESTIONS

In most theses there is always confusion between recommendations and suggestions. Some writers do not include the suggestions sections in the last chapter and write recommendations. But when one looks at it critically one would note that the contents included therein are not actually recommendations, but suggestions and vice-versa. To avoid this kind of confusion, herein briefly outlined what recommendations are all about. Otherwise, the two sections are optional. One can always omit them if one doesn't have anything to recommend or suggest; nobody would punish one for that. But it is important, because it portrays how much one has mastered the subject, and, in one way or another, it shows one's contribution to the solution of the problem under study (Mutai, 2001, p.66).

RECOMMENDATIONS

One's summary and conclusions should lead logically to one's recommendations. Recommendations must be consistent with the purpose of the study, its objectives, the evidence presented by the data and the interpretations given. Recommendations should be practical and achievable (Mugenda & Mugenda, 2003, pp.151 – 152).

The recommendations concerning the action to be taken follow the conclusions. Where recommendations involve policy decisions, state them completely as possible including who should do what, when and why (Mutai, 2001, p.35).

Common recommendations that researchers often make include:

1. Areas of further research: emphasizing the questions in the study that remain unanswered and therefore ought to be explored further.
2. Methodological issues: that could be addressed and refined to improve future research in the areas of study.
3. Actions that should be taken to address the problem based on the research findings: solving specific problems could involve designing and implementing an intervention of project (Mugenda & Mugenda, 2003, p.152).

The recommendations section should be made as short as possible. Half or one page is sufficient. Use bullets or numbers for each point and make it short and clear. This may include the following:

1. Recommendations concerning implementation of the research findings, when appropriate, relative to the objectives stated in the purpose of the investigation, most frequently encountered in survey studies and action research.
2. Recommendations for improving the situation guidelines or codes of practice. Many educational studies will have clear implication for practice. Although one should feel free to make such recommendations, one should again avoid diagnostic assertions, or sweeping recommendations that go beyond the study.
3. The recommendations concerning action to be taken follow conclusions. Where recommendations involve policy decisions some researchers prefer to report any conclusions and leave out recommendations.
4. The researcher is often in the best position to determine recommendations, and if asked to do so, should state them as completely as possible, including who should do what, when, and why. But making recommendations depends not only on the nature of decision to be made, but also on the researcher's knowledge of the total situation of the problem. In many instances, the researcher does not have this "total picture" of the situation (Mutai, 2001, pp.66 – 67).

SUGGESTIONS

In this section, one may give suggestions about new lines of thinking, research, methodological modification, theoretical limitations and implications drawing inferences from the study and may include the following:

1. Suggestion for additional research a section indicating what questions one was unable to answer, or what research questions one formulated as a result of the research.
2. New questions set forth for possible investigation; recommendation for additional research in the problem area study.

In giving suggestions in this final chapter, note only the research that the study suggests is needed. Do not make a mistake of listing an array of "interesting" topics, many of which have no relationship with the study. One's suggestions should not be broad statements like "more research would be needed" (which invariably would be the case); but

IMPLICATIONS

Such implications are usually targeted to stakeholders (Mugenda & Mugenda, 2002, p.151).

It may be that the study has some major theoretical implications. It confirms existing theory, or presents disconfirming evidence. If so, one should call attention to these implications, as in this example, "Bridges (1967) theory of the "zone acceptance" would have predicted that teachers would have been receptive to Estevan decision in areas where they had no personal stake. However, the teachers in this study frequently manifested resistance even when the decision had no immediate impact ..." One should discuss any possible implication of the study for a model, group theory and discipline in a more focused and pointed manner. Whenever one is referring to a theory ensure that one restates the theory before discussing its implication (Mutai, 2001, pp.67 – 68).

CONCLUSION CHAPTER LAYOUT

Example from the Ebrahim (2017) study on the conclusion and recommendations was as follows: these guidelines deduced from the literature review that the built form embodied and had key indicators on the causes and possible remedies of the temperature change. This fundamental idea was the main focus of these guidelines, which focused on how structured neighborhoods such as Komarock Infill B Estate are designed, planned and embodies a unique fingerprint on the identity, determination of significant built form variables. The study was keen to determine the development and control mechanisms necessary in the designing and planning of sustained built forms that can mitigate and remain relevant in a temperature changing environment. It is with this in mind that the study research methodology was designed and the study commenced the data collection, processing and analysis, and eventually testing

of the hypothesis. The results of the guidelines were synthesized and the findings were interpreted. This chapter proceeds with reaffirming the purpose of the guidelines, summarizing the findings as per the objective and research question, reporting the findings of hypothesis testing, stating the philosophy behind the work, limitation of findings, conclusion, implications of the study in practice and theory, recommendations based on findings and stated as per objectives, and suggested areas for further research (Ebrahim, 2017, p.245).

PURPOSE OF STUDY

Example from the Ebrahim (2017) study on the conclusion and recommendations under the heading of purpose of study was as follows: the aim and problem statement posed by the study was to what extent did micro-temperature change at the Komarock Infill B Estate study site compare to the Jomo Kenyatta International Airport (JKIA) Nairobi office of the meteorological department, for the period 8th June 2013 to 19th September 2015 in respect to the significant identified urban built form variables, further, what factors were responsible for the temperature differentials between Komarock Infill B Estate study site and the information inferred from the Jomo Kenyatta (JKIA) Nairobi office of the meteorological department, on the urban built form variables.

The objectives of the study included establishing the influence of the urban built form on the micro-temperature change and the identification of urban built form variables causing temperature change in Komarock Infill B Estate study site, again the study wanted to determine the influence of the of the significant urban built form variables causing temperature change and to develop design and planning strategies in view of sustainable urban built form in a temperature changing environment. It was envisaged that the findings of the study would act as a valuable tool in future related studies; solving the potential challenges posed specially by temperature change at the local level, and broadly by environment change at the global level, by seeking and devising appropriate tools and measures for achieving sustainable built forms (Ebrahim, 2017, pp.245 – 246).

SUMMARY OF FINDINGS

Example from the Ebrahim (2017) study on the conclusion and recommendations under the heading of summary of findings was as follows: the findings identified urban built form variability and trends which determine and have impact on the dependent variable micro-temperature change. The building variables were: building type, plot size, building orientation, building classification, building road proximity, ground coverage and plot ratio. Open space variables were: open space size, open space orientation and road proximity, hard landscape coefficient, light angle, shading ratio and open space length (Ebrahim, 2017, pp.246 - 248).

FINDINGS OF HYPOTHESIS TESTING

Example from the Ebrahim (2017) study on the conclusion and recommendations under the heading of findings of hypothesis testing was as follows: the findings of hypothesis testing of the individual building and open space variables related to the scatter gram plus slope of the regression line, suggests a rejection of the null hypothesis as none of the building or open space variables had a slope of zero relative to the micro-temperature change. Seven out of the 14 urban built form variables had a positive and ascending line of regression and the other seven had negative and descending line of regression (Ebrahim, 2017, pp.248 -250).

PHILOSOPHY STATEMENT

Example from the Ebrahim (2017) study on the conclusion and recommendations under the heading of philosophy statement was as follows: in regard to the hypothesis testing, the findings suggested that micro-temperature change had a positive relation to building and open space orientation, building type, ground coverage, open space light angle, open space area and open space hard landscape, and had a

negative relation with building classification, building and road proximity, plot size, plot ratio, open space shading coefficient and open space length of the urban built form. The philosophical statement for the study was that the temperature change near the ground for any area is directly affected by the planning, design and development decisions implemented by architects and planners.

Given the urban built form variables (building and open space) chosen for analysis, a decision based on one of these urban built form variables would by choice have an impact on the micro-temperature change. The findings of the study suggest that by using two or more urban built form variables, the impact on the micro-temperature change would be more pronounced. It is important to understand that the decisions made by the architects today, can have a long-term implication for the future in terms of micro-temperature change and the sustainable urban built form (Ebrahim, 2017, p.250).

LIMITATION OF FINDINGS

Example from the Ebrahim (2017) study on the conclusion and recommendations under the heading of limitation of findings was as follows: the building and open space orientation of the urban built form variable suggested that the positive and ascending line of regression relation between the building and open space orientation and temperature change was cyclic rather than linear in nature (Ebrahim, 2017, pp.250 – 252).

CONCLUSION

Example from the Ebrahim (2017) study on the conclusion and recommendations under the heading of conclusion was as follows: the perceived observations on the phenomenon associated with micro-temperature change have either been misrepresented in terms of the relationship between urban built form and micro-temperature change, or not enough research has been done to justify a valued judgment on the degree of change or its causes. As such planning and design guidelines need to be developed based on minimum distances of buildings and open spaces to the primary and secondary roads based on isotherm distribution maps (Ebrahim, 2017, pp.252 -254).

IMPLICATIONS OF THE STUDY IN PRACTICE AND THEORY

Example from the Ebrahim (2017) study on the conclusion and recommendations under the heading of implications of the study in practice and theory was as follows: the study has revealed that the temperature change near the ground for any area is directly affected by the planning, design and development decisions implemented by architects and planners. Inferences drawn from the study of the relationship between micro-temperature change and urban built form especially of structured neighborhoods in a tropical upland climate may be expected to apply in similar circumstances. Gaps in the knowledge of the relationship between micro-temperature change and urban built form, needs to be filled integrating the findings into theory courses in the architectural schools, studio programs and eventually into practice through the continuous professional development (CPD) conducted on an annual basis by the architectural associations of the country and the board of registration of architects (Ebrahim, 2017, pp.254 – 257).

RECOMMENDATIONS

Example from the Ebrahim (2017) study on the conclusion and recommendations under the heading of recommendations was as follows: arising from the problem statement and the research objectives, the study made several recommendations with a view to enhancing the appropriate and sustainable built form in a temperature changing environment, building variables which correlated to average micro-temperature change results, related to exposing future problems for further research and introduction of more questions based on the time limit of the current study. Planning of structured neighborhoods and

the design of urban built forms should involve the use and application of the building and open space prediction and remedial action design temperatures, polar curves, prediction and remedial nomogram, and summary tables. Recommendations based on issues related to coefficient and slope of the regression line, the summary of findings on micro-temperature change variability and trend by use of the isotherm distribution maps, related to exposing future unsolved problems associated to the area of study. Arising from the summary of findings of the study, it is suggested that the application of a bivariate approach to design where say two built form variables are used would be appropriate at the preliminary design stage, and multivariate approach where more than two built form variables would be more appropriate for a detailed design of sustainable built form in structured neighborhoods in a temperature changing environment (Ebrahim, 2017, pp.257 – 258).

SUGGESTED AREAS FOR FURTHER RESEARCH

Example from the Ebrahim (2017) study on the conclusion and recommendations under the heading of suggested areas for further research was as follows: there is a need for further research and adequate theoretical development concerning the relationship between climatic design and architecture, especially in regards to the limits set by adhering to the three research objectives of the study. Further research, related to the urban built form variables yet to be identified, and which cause temperature change in structured neighborhoods may include the following: research in other manifestations and recordings of temperature as this study was limited to the study of air temperature, while other manifestations are radiate, surface and ground temperatures (Ebrahim, 2017, pp.259 – 260).

ASSESSMENT:

On a yellow paper, write the expected conclusion and recommendation of the proposed research topic/s chosen by your group. Add reference list similar to the sample provided here.

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