



## A GUIDE THROUGH THE NUTS AND BOLTS OF RESEARCH IN THE SCIENCES

<sup>1</sup>\*Ousman Bajinka, <sup>2</sup>Pa Modou Drammeh and <sup>3</sup>Lucette Simbilyabo

<sup>1</sup>School of Medicine, University of the Gambia.

<sup>2</sup>Ege University, Turkey.

<sup>3</sup>Faculty of Medicine, Protestant University of Congo.

\*Corresponding Author: Ousman Bajinka

School of Medicine, University of the Gambia.

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### ABSTRACT

Research, predominantly in the field of sciences, is an essential part of the discipline. Needless to say, students should have tolerable mastery in research methods and skills needed to excel in courses required for the concentration. Accurate academic research requires a good deal in terms of rigor, reflection, and justification. Have you ever mused over this question: what does it take for a piece of writing to count as an academic knowledge; what assumptions can you afford to make? Students are habitually challenged with the task of how to write a good academic paper. Understanding a broad range of methods and methodological traditions is undoubtedly a prerequisite for research. This review aims to expedite the development of a broad understanding of research. Both students and researchers will be introduced to the techniques, processes, research design and choices, research ethics, literature review, methodologies, utility and limits of case study research among others. Scholars will also be introduced to the divergence that exists between various research paradigms and methodological traditions. It is expected that students will broaden their understanding on research methods and practices. Students will surely be guided through the wholeness of research. This work covers both qualitative and quantitative methods in science and offers an assessment of the main methodological debates within the discipline. It further provides the necessary tools for effectively designing and researching rigorous research and policy papers. Concurrently, some imperative commonalities exist in the ways and manners in which scholars rationalize evidence to make a robust and intelligible argument.

**KEYWORDS:** Research methods, qualitative, quantitative, ethics, literature, review, methodology.

### INTRODUCTION

In the academia, it is either you publish or get perished in the sea called 'intellectual deficiency'. Where one's research ends or limited is the beginning of another research. This is the quest for knowledge and keeping the science alive. Lots of papers are written to shed lights on the nitty-gritty of scientific research and our paper promise to keep the language clear and precise for those with little experiences or perhaps not fluent in English language to grasp the conceptual facts and keynotes.

This paper will help students to meritoriously consume and produce research. Science as a field of study covers a wide range of disciplines, and each of the disciplines cuddles multi-research techniques, principles, and methods.

It should be noted that there are different approaches to research that underpins academic disciplines. Students, principally postgraduates, will be preparing presentations

on examples of published research, commenting on the methodology adopted and how it is applied. Moreover, students are required to submit a short written piece describing and justifying the methodological choices for their Ph.D.

A comprehensive synopsis of research approaches, with the fundamental goal of refining students' ability to make a coherent argument based on solid evidence, is provided. It is safe to assume that this paper will help you carry out a fruitful research projects. It will guide you through the nuts and bolts of research in the social sciences.

#### What is a Research?

"Research is defined as the deliberate study of conditions, factors, creatures and other people for the purposes of increasing understanding and/ or adding to knowledge."<sup>[1]</sup> In the words of the American sociologist, Earl Robert Babbie, "Research is a systematic inquiry to describe, explain, predict and control the observed

phenomenon. Research involves inductive and deductive methods.”

“Research is a process of enquiry and investigation; it is systematic, methodical and ethical; research can help solve practical problems and increase knowledge.”<sup>[2]</sup> This involve laboratory experiements, environmental observations, clinical trials and survey.

### Defining Your Project

The questions you need to ask yourself before starting your research: understanding your proposed study will automatically put the exact wordings to define the project. And when defining, below are the key points you need to put into considerstions.

#### What motives the research?

If you have been instructed by either your lecturer or employer to do research, then you need to think about how to stay motivated through the research process. Research sometimes can be very long and hectic. However, it is of utmost importance to stay focus and interested in what you are doing if you don't want to lose the touch. If something has pricked your inquisitiveness and you are eager to acquire knowledge, then motivation won't be a problem.

#### How can I stay focused in my research?

The answer is obvious and straightforward. You need to choose or select a topic that whets your appetite. A good researcher needs to be imaginative and think about a topic that will give him the muse to conduct his research successfully. However, if the researcher has had the topic chosen for him, he should try to choose a research method that interests him.

#### How do I choose a research method?

As you proceed to read this paper you will meet the answer even before reaching. There is a comprehensive explanation on the different types of research methods.

#### Think critically

Did you find pleasure in solving mathematical problems at school? If the answer is yes, possibly you might be curious in delving into statistical software or data analysis?

Have you ever involved in a focus group or been interviewed by a researcher? Would you find it intriguing to conduct your own focus groups or interviews?

Can you withstand the incubations, organic reactions that can last overnights and starting everthing over and over and more times?

Would you like to immerse yourself in the culture of a particular group of people and learn more?

Do you find pleasure filling in questionnaires? Would you like to design your questionnaire and perhaps conduct a postal or internet survey?

What personal traits or personal characteristics do I need which might help me in researarch?

Imagine in a clinical trial, participants might reluctantly fail to turn over for the calls, how much are you prepared to either reach them or convince to keep a go?

#### Ask yourself the following questions:

- Do you have good human relations?
- Do you find more pleasure in written communication or personal interaction?
- Do you love or hate statistics?
- Do people have confidence in you and can they trust you?
- Do you like to research on the internet?
- Do you like being left alone in the laboratory?
- Have you accumulated the necessary skills or perhaps can pay for experts to run some test?

#### Thinking about Research

It is an open fact that many research projects have become unsuccessful over years. This is mostly due to the fact that people do not take the needed time to think critically about the nuts and bolts involved before rushing to start work. It is of fundamental importance to spend valuable time understanding the issues involved in your project before starting it.

**Understand the five Ws:** What?Why? Who? Where? & When?

**What defines your research?** It is important to define your research before rushing to start.

**Why do you want to conduct such a research?** The main aim of your research should be clear and precise.

**Who are you targetting in your research (participants)?** This involves the type of people you will get in touch with in the process of your data or sample collection.

**Where will you conduct your research?** This is one of the yardsticks you will use to narrow down your topic.

**When will you conduct your research?** With regards to the time frame, this question will help you determine whether the research project you have proposed is possible or not.

#### How to Decide Upon a Methodology

It should be noted that the research method and research methodology are different. “Research methodology is the philosophy or the general principle which will guide your research. It is the overall approach to studying your topic and includes issues you need to think about such as

the constraints, dilemmas, and ethical choices within your research.”<sup>[3]</sup> Research method, on the other hand, includes the tools researchers used to gather data. This includes interviews and questionnaires, experimental approaches and sample and data analysis.

“The term methodology refers to the overall approaches & perspectives to the research process as a whole and is concerned with the following main issues: Why you collected certain data or sample, what type of sample or data you have collected, where are these collected, how they are collected, and how you analyzed the data or sample.”<sup>[4]</sup>

With regards to the research methodology, two important concepts come to mind. They are qualitative and quantitative research.

**Qualitative research:** “Qualitative methods refer broadly to sample or data collection and analysis strategies that rely upon the collection of, and analysis of, non-numeric data.”<sup>[5]</sup> Qualitative methods are used to have a better understanding of the world around us by focusing on meanings and processes. Such a method explores behaviour, experiences and attitudes by using some of the most commonly known methods such as interviews and focus groups, positive or negative, good or bad, fit for purpose or otherwise. This method is aimed at getting an in-depth opinion from participants or the integrity of samples in question.<sup>[6]</sup>

Under the parameters of qualitative research, different types of methodologies can be explored: Action research (some scholars consider it a research method). The other types of methodologies include: ethnography, feminist research (the position of feminist inquiry is still not clear as some consider it a methodology, and others consider it an epistemology), it can be both; and lastly, grounded theory.<sup>[7]</sup>

**Quantitative research:** “The emphasis of Quantitative research is on sampling or collecting and analyzing numerical data; it concentrates on measuring the scale, range, frequency etc. of phenomena.”<sup>[8]</sup> Quantitative research includes research methods such as; experimentation, clinical trials, structured interviews or questionnaires.

**Choosing a methodology:** Qualitative and quantitative researches are all research methodologies. They are just different and have their strengths and weaknesses. So, the best and simplest way to decide on choosing a methodology is to draw a ‘red line’ between the two types of research by deciding on which one to choose. In order to arrive at the best form of inquiry, this is the way forward. The words you have used can really help you in deciding. For example, words like how many, test, verify, how often or how satisfied, this suggests a leaning towards quantitative research. If you have used words such as discover, motivation, experiences,

think/thoughts, problems, or behave/behaviour, this suggests a leaning towards qualitative research. However, if you have combined both you will arrive at a method called triangulation. Triangulation overcomes the weaknesses in both qualitative and quantitative research.

**Research Methodologies:** It is important to examine positivistic and phenomenological research approaches because the core research methodologies can be linked to them.

**These methodologies include:**

**Positivistic:** It includes surveys, experimental studies, longitudinal studies, and cross-sectional studies.

**Phenomenological:** It includes case studies, action research, ethnography (participant observation), participative enquiry, feminist perspectives, and grounded theory.

**Note:** Positivistic approaches are commonly used in science while Phenomenological approaches are concerned with understanding behaviour from the participants’ subjective frames of reference- human motivation is shaped by factors that are not always observable.<sup>[9]</sup>

**How to get started when conducting research**

**Steps involved in research:**

- Establish a general field of interest- Selection of topic
- Do background and preparatory reading- Reviewing the literature
- Development of theoretical and conceptual frameworks
- Clarification of research question/hypothesis
- Research design
- Gather information & data- Data collection
- Data analysis
- Drawing conclusions<sup>[10]</sup>

**Choosing Your Research Methods ( How?)**

Research methods are any tools used in data collection. It is vital to study these tools in order to use them fruitfully.

**Interviews:** Interviewing is a common method used in collecting information from people in all walks of life. In the words of Monette et al. (1986:156), “an interview involves interviewer reading questions to respondents and recording their answers”.<sup>[11]</sup> Burns further states that: “an interview is a verbal interchange, often face to face, though the telephone may be used, in which an interviewer tries to elicit information, beliefs or opinions from another person”.<sup>[12]</sup> When an interviewer is interviewing a respondent, he has the freedom to decide the format and content of questions to be asked. Interviews can be flexible, where the interviewer has the freedom to think and formulate questions as they come to the mind, or inflexible, where the interviewer has to follow strictly the questions set beforehand.

In social science research, the most common forms of interviews are unstructured, semi-structured and structured interviews.

**Unstructured interview**, they provide freedom in terms of content and structure. The researcher has the absolute freedom to dictate the wording and questioning. In an unstructured interview, the researcher aims to achieve a comprehensive understanding of the interviewees' point of view. It is unstructured because the researcher is free to ask any questions to the respondent and the respondent is free as well to express what he deems important over an issue, with little or no influence from the person conducting the research. This type of interview is a method of data collection in qualitative research.

**Structured interviews:** "In a structured interview, the researcher asks a predetermined set of questions, using the same wording and order of questions as specified in the interview schedule. An interview schedule is a written list of questions, open-ended or closed, prepared for use by an interviewer in person-to-person interaction".<sup>[13]</sup> Structured interviews produce quantitative data.

**Semi-structured interviews or elite interviews:** Semi-structured interviews maintain some degree of flexibility and basic structure across interview participants. It also allows for cross-referencing across interview participants. This type of interview is very common in qualitative research.

#### General Tips and Guidelines for Conducting Interviews

- Secure the informed consent of interview participants.
- Make a thorough research about the interview participant.
- If you are going to record you must ask for permission.
- Be transparent about the cardinal purpose of the research, the usage of the data and the confidentiality of the interview participant.
- Do not transmit a sense of approval or disapproval through verbal or body language.
- Consider the time that you will require for the interview.
- Be professional in appearances.

**Focus Groups:** It is a form of interviewing that brings together a group of six or ten research participants. It is led by a moderator who introduces the topic, ask specific questions and controls digressions. In a nutshell, the focus group is group interviews or discussion groups.

#### Using Questionnaires: Closed-ended, open-ended, or a combination of both types of questionnaires

**Closed-ended questionnaires:** Most people are familiar with this type of questionnaire. This is the type of questionnaire that is used in generating statistics in

numeric research- quantitative research. It follows a set format.

**Open-ended questionnaires:** "The questionnaire does not contain any form of small boxes to tick, but instead it has blank sections for the respondent to write in an answer. Open-ended questionnaires are used in qualitative research".<sup>[14]</sup>

"Whereas closed-ended questionnaires might be used to find out how many people use a service, open-ended questionnaires might be used to find out what people think about a service".<sup>[15]</sup> Some researchers use a combination of both types of questionnaires.

**Participant Observation:** This involves both direct observation and participant observation. Under direct observation, the researcher observes a 'subject' in a certain situation through the use of visual recording equipment or one-way mirrors.

"Some scholars view participant observation as both a method and a methodology. This type of method is popular amongst anthropologists and sociologists who wish to study and understand another community".<sup>[16]</sup>

#### Choosing your method

If your research work is grounded on quantitative research, you can consider using survey work in the form of a questionnaire or structured interviews. If you want to do action research, you can consider using either semi-structured interviewing or focus groups.

#### Conducting Your Background Research

Conducting a background research is very paramount to your research. Background research helps you to understand your topic better and the existing literatures about your topic. This type of research can be primary or secondary.

Under primary research, the researcher studies a subject through firsthand observation and investigation.

#### Using websites

- Always confirm the veracity of the information.
- Try to use university websites.
- Use websites run by known organisations.
- Do examine and check the About Us section on the website page.
- Use another source to verify the information.

#### Using interlibrary loans

Some schools offer the student the chance to access books from other university libraries when they are not available in their schools.

#### Keeping records

It is vital to keep an accurate record while doing your background research. This is an important ingredient of research. The act of keeping record saves you time.

While keeping records it is important to organize your files and try to separate your files into primary and secondary research.

### How to Prepare a Research Proposal

Research proposal is an integral part of research project. Research proposals are necessary for many types of research, if not all. The research proposal presents your research topic, research question, and research design.

### Let's consider the following questions

- Is your research topic of interest to the field of science?
- Is your project feasible within the time frame determined?
- What kind of data will you need to collect in order to satisfy the demands of your questions?
- Is your research design an appropriate fit for your research question?
- How will you collect data and analyze the data you have collected?

### Understanding the format

Sometimes you are asked to present your proposal document in a specific format. It is important to find out the format you should prepare your proposal. Most of the time, university students are given general guidelines to follow. Make sure you familiarise yourself with these structures, rules, and regulations. With regard to funding organisations, they usually give you forms for you to complete with special guidelines on how to go about it.

### The contents of a proposal

There should be a short title. There should be a background that should contain the fundamental reasons or logic for your research. This rationale should comprehensively answer the following questions: What are the reasons which motivate you to undertake the project? Why is the research project important or needed? This justification should be placed within the context of existing research or within your own experience and observation. You need to satisfactorily prove that you know what you are talking about and that you have knowledge of the literature surrounding this topic. If you are not able to find any existing literature which deals particularly with your proposed project, you need to indicate that, clarifying how your proposed research will fill this academic gap. If there is other literature that has covered your research topic, you need to show how your work will build on and add weight to the existing knowledge. You should be convincing.

### Aims and Objectives of the Proposal

The aim of the proposal should be clearly defined. However, not all research formats will require objectives. The aim of the research is the overall drive and thrust of the research and the objectives are the means by how you intend to accomplish the aims. These must be comprehensible and succinct.

**Methodology/methods:** If you are researching at the postgraduate level you may need to carve up the methodology and methods section into two. However, for most undergraduate projects they can be combined. In the methodology/method section, you need to give a description of your proposed research methodology and methods and justify their use. How do you do this? Consider the following questions: Why have you decided to choose that methodology? Why have you decided to use those particular methods, and why are other methods not appropriate?

In this section, it is of necessity to provide details about samples, methods of data collection and data analysis, ethical considerations and number of people to be contacted. You need to choose a more traditional methodology than a less known methodology. You may need to spend more time justifying your choice than you will need to if you choose a more traditional methodology. This section should be detailed because a lack of methodological detail is one of the most reasons for proposal failure.

### Timeline

There is a need for a thorough timetable scheduling all aspects of the research. This timetable should include time taken to do the preliminary or background research, questionnaire or interview schedule, data collection and analysis, and report writing. Sometimes your research can take longer than you anticipate. If you want to escape this trap you should add a few extra weeks on to each section of your timetable. There is no crime if you finish earlier than you anticipated. You have more time to spend to go through it and write your report. However, finishing late can create problems and cause frustrations if you have to meet deadlines.

### Budget and resources

In the situation, you feel the need to apply to a funding body to fund the research project you need to think about what you will need for the research and the cost. This is necessary because it will help you apply for the right amount of money and you won't go under budget. You equally need to convince the funding body that you have not over-budgeted and expect more money. If you are a student you may not have to include the budget section in your research proposal, although some lecturers will want to know the resources you need for the research and how and where you hope to obtain them. The appropriate research method can help you to save resources.

### Dissemination

Appropriate use of research information, findings and results are important. What exactly do you want to use the results of your research for? How are you going to inform people about what you have found out? For students, most of the time, the results are produced in an undergraduate dissertation which is made available in libraries. Some researcher embarks on research to

produce a report, make a presentation, write articles and journals, or produce a series of recommendations to help in decision making.

### Qualities of a Good Proposal

#### What makes a good proposal?

- The proposal should be relevant to the work of the funding body or the student's course.
- The research should offer new insight into the topic.
- The title, aims and objectives of the research should be clear and brief.
- When an all-inclusive background research and literature review has been undertaken.
- When the research problem and the approach has a good match.
- When detailed timetable and budget have all been worked out thoroughly.

#### Why do research proposals fail?

- When the aims and objectives are unclear and ambiguous.
- When there is a mismatch between the approach being adopted and the research problem.
- When the overall plan is too difficult to achieve within the timeframe.
- When there is no adequate and in-depth background research conducted.
- When the problem to be addressed is of insufficient importance.
- When inadequate information about the data collection method is provided.
- When information about the data analysis method is insufficiently provided.
- When the budget and resources are not clearly defined.
- When the topic has been done too many times before.

#### In summary: contents of a research proposal

A research proposal should contain the following information:

- An introduction, including a brief literature review
- A theoretical framework that underpins your study
- The conceptual framework which constitutes the basis of your study
- Objectives or research questions of your study
- Hypotheses to be tested, if applicable
- A study design that you are proposing to adopt
- The setting for your study
- Research instrument you are planning to use
- Sampling design and sample size
- How you plan to handle the ethical issues involved
- Data processing procedures
- Proposed chapters of the report
- Problems and limitations of the study
- Proposed time-frame for the project.

### Research Ethics

There are very important research ethics principles that should be taken into consideration. (The Belmont Report). These ethics principles are "respect for persons, beneficence and justice." *"The Belmont Report Ethical Principles and Guidelines for the Protection of Human Subjects of Research. Washington, DC: National Institutes of Health, 1979. Available: <http://ohsr.od.nih.gov/guidelines/belmont.html>."*<sup>[17]</sup>

"Respect for persons requires a commitment to ensuring the autonomy of research participants, and, where autonomy may be diminished, to protect people from the exploitation of their vulnerability. The dignity of all research participants must be respected. Adherence to this principle ensures that people will not be used simply as a means to achieve research objectives."<sup>[18]</sup>

"Beneficence requires a commitment to minimizing the risks associated with research, including psychological and social risks and maximizing the benefits that accrue to research participants. Researchers must articulate specific ways this will be achieved."<sup>[19]</sup>

"Justice requires a commitment to ensuring a fair distribution of the risks and benefits resulting from research. Those who take on the burdens of research participation should share in the benefits of the knowledge gained. Or, to put it another way, the people who are expected to benefit from the knowledge should be the ones who are asked to participate."

"Confers on the researcher an obligation to respect the values and interests of the community in research and, wherever possible, to protect the community from harm."<sup>[20]</sup>

#### Other ethics principles include:

- The researcher should always seek the informed consent of subjects. "If we dissect the principle of informed consent, we will see that it consists of four separate elements: the assumptions of competence, voluntarism, full information, and comprehension."<sup>[21]</sup>
- Researchers should respect subjects' privacy: The right to privacy should be respected. Since research is essentially a tool for "finding out," virtually any attempt to collect data from people can raise a red flag for the privacy issue. "A subject's right to privacy requires the researcher to pay attention to three different privacy issues:
  - (1) the sensitivity of the information being solicited,
  - (2) the location or setting of the research, and
  - (3) the disclosure of a study's findings."<sup>[22]</sup>
- Researchers should avoid conflicts of interest: There should be no conflict of interest between research funders and potential research findings.
- Researchers should conduct themselves to ethical reporting. They should report the whole truth and nothing but the truth.

- Researchers should not attempt to distort other author's arguments.
- Researchers should not be involved in any activity that can harm those with whom he interacts.
- Researchers should strictly avoid any form of plagiarism.
- Researchers should avoid inappropriate use of information and any form of bias.

### Reviewing the literature

One of the primary tasks, when you undertake a research study, is reviewing the existing literature to broaden your knowledge base on the topic and to fully acquaint yourself with the existing literature. Reviewing the literature is a challenging task. It can be frustrating and time-consuming but is a matter of most. A literature review makes an important contribution to any research. It can help you establish the theoretical roots of your study and develop your research methodology. The higher the academic level of your research, the more important a thorough integration of your findings with existing literature becomes. "Literature review helps you to understand how the findings of your study fit into the existing body of knowledge."<sup>[2,3]</sup>

### How do you review the literature?

Be it you have a specific research problem or not, you should review the literature broadly with the aim of gradually narrowing it down to the research problem. The literature review should focus on your research problem. Therefore, conceptualize your research problem before undertaking your literature review. How do you review the literature? You should search for the available literature on your research topic then review the selected literature. After reviewing the selected literature you should then develop a "theoretical and a conceptual framework". Developing theoretical and conceptual is challenging. Don't forget to compile a bibliography of the literatures, books, journals, internet sources that you have consulted. Books related to your research problem are important elements of a bibliography. You also need to go through journals relating to your research. You can get up-to-date information from journals. The Internet has become a central tool for finding published literature. However, not all information on the internet is accurate.

### Other types of research

**Basic Research:** It is for knowledge expansion or to generate knowledge.

**Problem Oriented Research:** It is a type of research used to understand the nature of a problem in order to find solutions to the problem.

**Problem Solving Research:** The research aims to understand and resolve a problem. It is normally conducted by companies.

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