RESEARCH METHODOLOGY STEP BY STEP GUIDE FOR GRADUATE STUDENTS

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Introduction

A scientific research becomes an important component to qualify for the Clinical MD in Paediatrics and child health, awarded by the Sudan Medical Specializations Board. It is a partial fulfillment research submitted before sitting to the second part. The Paediatric Training Committee is responsible for helping the graduate students with every possible weapon to accomplish their research. This article is a mean to step forward.

A research proposal is a very difficult writing, which is made when one went through the highest academic steps of education. It the first thing that should be done by the researcher in the case he/or she wants to make the research successful. It provides the rationale for the proposed research. It also shows the researcher's awareness of the subject.[1]

Research is defined as a careful, systematic investigation in some filed of knowledge, undertaken to establish facts or principles or to find answers to a problem[2]. According to Kerlinger (1986) "scientific research is a systematic, controlled empirical and critical investigation of propositions about the presumed relationships about various phenomenon"[3] Bulmer in 1977 stated: 'Nevertheless sociological research, as research, is primarily committed to establishing systematic, reliable and valid knowledge about the social world'[5].

These guidelines are meant to help the graduate student to present his/her proposal ideas in a strong, concise and systematic manner, to be read with a few simple and direct purposes. Before proceeding the researcher has to insure that the research is feasible, i.e. the research is ethical and potentially viable. A formal written consent is usually needed.

It is both unnecessary and unwise to start by preparing a comprehensive, detailed project proposal. The student has to produce a preliminary project paper of no more than five pages. It is important, although quite commonly overlooked is that, the proposal is generally written in present and future tense, whereas, the dissertation or thesis is always written in the past tense, as it is a report of a completed study.

Format of a Research Question

This is the most important step in any research. It is the foundation for further development of the research proposal (i.e. objectives, methodology, work plans and budget). There should be a question or a problem which requires an answer or a solution. A well defined research question makes it easier to review the literature. It drives the entire study. A well known and tested method is needed to answer or solve the research question.[5] Therefore, a researcher cannot be guided by a tentative answer i.e., a hypothesis.

Research proposals serve a number of purposes. Members of a thesis or dissertation committee read the proposal with a few simple and direct purposes[6]:

1- To determine what the researcher wants to do,
2- To establish why the research is important, convincing and worth undertaking.
3- To understand how he/she wishes to do it. Proposal writing enables researchers to demonstrate expertise and competency in a particular area, and
4- To learn what benefit will result from the effort or attempt. This may be fundamental to convince the research funders.

Any part of the proposal that fails to be directed toward fulfilling these purposes is at best unessential and at worst, damaging. Following this the researcher has to review the relevant literature to determine the research suitability, this will provide rich resources of ideas and research questions. A second opinion of an expert is necessary at this stage.

Although a research is a process of collecting, analyzing and interpreting information to answer questions, however, to qualify as a research, the process must have certain characteristics: It must, as far as possible, be controlled, precise (i.e. relevant, appropriate and justified) systematic, valid and variable, critical and empirical *(this mean any conclusions drawn are based upon hard evidence gathered from information collected from real life experiences or observations).*

The research question should contain the following[1]:

- ***Relevance.*** The topic chosen should be a priority problem. The problem is viewed as follow (how large or widespread and has an impact e.g. severity? Who is being affected and or who recognizes the problem as important?)
- ***Avoidance of duplication.*** The researcher has to avoid investigated and answered questions. Therefore literature should be reviewed to explore major unanswered questions.

- ***Feasibility.*** The research problem must be easy to implement. This depends on the resources and the researcher should not be over ambitious. Thought should be given to personnel, time, equipment and money locally available.
- ***Authority acceptability.*** This increases the chances of implementation of the results. Strong and conforming research questions will attract the interest of the grants providers and their support.
- ***Applicability.*** Applicability of the research recommendations depends on the resources to implement these recommendations and authority or policy makers' interest. The latter has to be involved from the beginning.
- ***Urgency of data needed.*** This is usually decided by the policy makers, so it's important to address their priorities.
- ***Ethical acceptability.*** The research should not inflict any harm on others, during the research or following its outcome. The research has to be reviewed with the view of ethics. An ethical clearance from (a research ethical committee) is almost always asked for.

There are no specific guidelines to formulate a research problem; however, a researcher can follow the following steps[1]:

1-Identification of a broad area of interest in his/her academic/professionals field.

2-Dissection of broad areas into subareas, this needs a brain storming session with oneself, peers, professionals).

3-Selection of subarea by elimination.

4-Raising research questions need to be answered.

5-Formulation of objectives.

6-Assessment of these objectives (s) to ascertain their feasibility of attaining them in view of time, logistics and technical expertise.

Types of Researches

A research can be classified from three perspectives: Application, objectives and the type of information thought[1]. A research project may be classified as pure or applied research (*from the perspective of application*) as in most social researches, or as a descriptive, correlational, explanatory or exploratory research (*from the perspective of objectives*) and as quantitative or qualitative (*from the perspective of the type of information thought*). As an example of researches based on information thought are:

i- ***Qualitative research:*** The research is conducted under clear methodological principals and involves collection and analyses of qualitative data, such as social behaviour, attitudes, knowledge

and practice of a group of respondents about certain issues. Its main objective is to describe the variation in a phenomenon, situation or attitude.

ii- Quantitative Research: this type helps to quantify data which is collected in quantities (numerical manner).

In controlled research, the researcher in exploring causality in relation to two variables, the study must be set up in a way that minimizes the effects of multiplicity of relationships and interacting factors affecting the outcome. This is difficult to apply in social sciences, as it is not possible to control external factors which their impact needed to be qualified.

A Research Design

A research design is a plan, structure and strategy of investigation considered to obtain answers to research questions or problems. The various designs have been classified by examining them from three different perspectives:

The number of contacts: (This based on the number of contacts with the study population)[1]:

- **The cross-sectional study design** (one-short or status studies). Most commonly used design in social sciences. It suited to studies aimed at finding out the prevalence of a phenomenon, situation, problem, attitudes or issue.
- **The before and after study design (pre-test/post-test design).** This can measure changes in situation, phenomenon, problem or attitude. It is the most commonly used design in evaluation studies and the most appropriate design for measuring the impact or effectiveness of a program. An example: *The impact of increased funding on the quality of teaching in universities.*
- **The longitudinal study design.** This is used to determine the pattern of change in relation to time. It is also useful when a researcher need to collect factual information on a continuing basis.

The Reference Period: This refers to the time-frame in which a study is exploring a phenomenon, situation, event or problem.

- The retrospective study design. This investigates problems that have happened in the past, based on available old data, or respondents' recall of the problem).
- The prospective study design. This investigates the prevalence of phenomenon in the future.
- The retrospective- prospective study design. This focuses on past trends in a phenomenon and studies it in the future.

The nature of the Investigation:

- The experimental study design.

- Non-experimental; and
- Quasi or semi-experimental.

The Elements of a Proposal

The research proposal is an overall plan, scheme, structure and strategy designed to obtain answers to the research questions. It consists of a series of tasks which form a logical path that leads the observer to his/her conclusions. It is a plan that should be undertaken to fulfill the research objectives and test hypotheses. It answers what a researcher proposing to do, how is he/she plan to proceed and how the proposed strategy is selected.

Views are different about the best arrangement of a research' ingredients and vary markedly from discipline to discipline. The order usually reflects what seems to be the order in which proposal writers think through and develop their ideas. Therefore, it must be a convincing and descriptive document, that makes the ideas and approach crystal clear.

The Proposal Contains Information About the Study, *these are*[6]**:**

- Study's objectives.
- A list of study hypotheses need to be tested.
- Study's design proposed to be used.
- The setting of the study.
- Instruments planned to be used.
- A sample design and a sample size.
- Outline the proposed chapters for the report.
- Study's problems and limitations.
- A proposed time frame.

An eight model suggested by (R. Kumar 1999) are suitable particularly for a graduate beginner. The model covers the total spectrum of a research effort, starting from problem formulation through to writing a research report. These steps are:-

- Step I: Formulating a research problem.
- Step II: Conceptualizing a research design.
- Step III: Constructing an instrument for data collection.
- Step IV: Selecting a sample.
- Step V: Writing a research proposal.
- Step VI: Collecting data.
- Step VII: Writing a research report.

A research problem formulation is what the researcher intend to do. It should be more specific and clear, as it influences everything that follows in the research design. The research problem has to be evaluated in the light of the financial resources

available, the time allotted to the task, and the researcher or his/her supervisor expertise and knowledge in the field of the study.

* Sample problem statement in social impact research:

(Children from low socio-economic strata in the Sudan are often denied proper education because teachers perceive them to be 'less intelligent').

* Sample problem statement in theoretical research:

(*To what extent is poor school performance of children from southern Gezira locality influenced by intelligence or by socioeconomic status*).

The Title

The title should name clearly the main purpose of the project. It should fit the target population, the area where it is supposed to be conducted and the date of the research.

Introduction and Background

The introduction serves to orient the reader to the researcher approach. What first awakened his interest in the study? It presents shortly the broad guidelines of the study, its scope and limits.

In this section the researcher elaborates on the research problem and answers the question about the topic area and the questions most appropriate to the study. In answering these questions, the researcher should give concrete instances which illustrate the problem, the theoretical issue and the historical events.

It is better to be short but it has to persuade the reader that the project is feasible, appropriate and worthwhile. In the background the researcher includes a rather complete description of the project justification, he/or she has to include statements of opinion by knowledgeable observers (political figures, important theorists, or professionals in a position to comment authoritatively on some aspect of the problem) who attest to the fact that the problem is worth addressing.

The researcher has to start with a very broad perspective of the main subject area, before gradually narrowing the focus to the central problem under investigation. This covers the following aspects of the study area:

- An overview of the main area under study;
- A historical perspective (development, growth, etc) pertinent to the study area.
- Philosophical or ideological issues relating to the topic;
- Trends in terms of prevalence, if any;

- Major theories, if any;
- The main issues, problems and advances in the subject area under the study;
- Important theoretical and practical issues relating to the central problem under study; and
- The main findings relating to the core issue(s).

This section also reviews the public statistics which provide evidence of the pressing nature of the problem and highlight the need of the study.

- **Geographic and General Information:** The background should include a description of the study area, its location with maps showing villages, roads and important marks. It should also include other important economic political or historic information.
- **Population:** The researcher has to describe the demographic characteristics of including the population size, gender, ethnic groups and the target group(s) of project or such as children below five years or females in the reproductive age group.
- **The Problem:** The researcher should also identify his research problem e.g. (medical or societal problem).

Statement of Hypothesis

A hypothesis is an uncertain or a tentative statement that is subjected to verification through a research study. It is a statement about the expected relationship between variables. Hypothesis though important, is not essential for the study but they bring clarity, specificity and focus to a research study. The researcher at this stage should spell out clearly, the particular research hypotheses. He should state the hypotheses in term of observable behaviours, allowing evaluation of the results. Hypothesis should be simple, specific conceptually clear, able to be verified, rooted in a body of knowledge and able to be operationalized[7].

There are two broad types of hypothesis: a research hypothesis which can be further classified as (*a null hypothesis, a hypothesis of difference, a hypothesis of point prevalence and a hypothesis of association)* and an alternate hypothesis.

The testing of the hypothesis becomes meaningless if any one of the aspects of the study (design, sampling procedure, method of data collection, analysis of data, statistical procedures applied or conclusion drawn) is faulty or inappropriate, as this can result in erroneous verification of a hypothesis.

Reviewing the Literature

Reasons for Reviewing the Literature:

Reviewing the literature is usually time consuming but rewarding. The purpose is to place the study in the context of

similar studies that have addressed the same problem[5,7,8]. A literature review has three functions: It help the researcher to:

1- Bring clarity and focus to the research problem.
2- Improve the methodology; and
3- Broaden the knowledge base in the research area.
4- Paradoxically, formulate the research problem.

Procedure for Reviewing the Literature:

The literature review should be focused around the research problem. This means a research problem has to be stated earlier, otherwise literature review can condition the researcher thinking about the study and methodology, resulting in a less innovative choice of research problem and methodology. Literature review is a continuous process, needed to integrate the researcher's findings with those from others either supportive or contradicting to these reports. Literature pertinent to the proposed study may deal with two types with information; universal and more specific i.e., local trends, or specific programme. The main sources are books, journals and websites. There are four steps involved in conducting a literature review

1- Searching for relevant existing literature.
2- Reviewing the selected literature.
3- Development of a theoretical framework, so as to discover a number of theories that has been proposed to explain relations in the study: and
4- Development of a conceptual framework stems from a theoretical framework and describes the selected aspects from the theoretical framework to become the basis of the study.

The Significance of the Study (rationale of the study)

The rationale of the study shows the importance of the study, as distinct from other studies addressing the same topic. The researcher has to put clearly his potentially valid reasons, such as: scarcity of similar studies needs of various publics, in whom the problem is of a critical importance and the study is beneficial. Rationality and logic are not enough to get the project adopted. The study may need to coincide with the interest and values of an important decision maker. The researcher has to consider all forces that affect his project and he has to see how he can acquire allies at all levels.

The Research' Objective(s)

The research goal describes the researcher intentions, specifically and clearly. General and ambiguous definition of objective(s) makes interpretation invalid. From the programme

goals, specific measurable objective(s) are derived. Objectives should be specific, measurable, feasible, relevant, observable and logical (i.e., internally consistent).

The objective (s) should be relevant and stated in the most technically appropriate language. This part of the research should be closely read and most frequently referred to. The researcher should state briefly but precisely what he/she I intentions to do about the specified problem. Therefore each sub-objective should delineate only one issue.

Methodology (Strategies, Interventions and activities):

The methodology describes the research design. It must fit the purposes(s), its feasibility depends on your time and resources i.e., it should state clearly:

a- Dates, duration of the research.

b- Describe the patient(s) with their inclusion and exclusion criteria.

c- Sampling technique.

d- *Information needed to fulfill the objective.*

The construction of research instrument is most important aspect of any research effort as it determines the nature and quality of the information. The research instrument must be developed in the light of the research objectives.

There are two approaches of data collection; i) the secondary data which provide second-hand data such as data to obtain information on the age-sex structure of a population using the census data; and ii) the primary data, these are first-hand information provided by primary sources such as ascertaining the quality of services provided by a worker.

There may be problems with using data from secondary sources. The researcher must be careful as there may be certain problems with the availability, format and quality of data. The validity and reliability of data, personal bias, availability of data and format in which data is available.

Interviewing, observation and the use of questionnaires are the three main methods classified under primary sources. All other resources, where the information required is already available, such as government publications, reports and previous research, are called secondary resources. The choice of a particular method of data collection depends upon the purpose of collecting information, the type of information, the available resources, the skills of the researcher and the socioeconomic-demographic characteristics of the study population.

The quality of the information is dependent upon several methodological, situational and respondent-related factors. The researcher skill is to minimize the effect of these factors in the process of data collection.

Variables identification:

An image, perception or concept that is capable of measurement is called a variable[1,5,9]. There are four measurement scales used in the social sciences: nominal, ordinal, interval and ratio. Any concept that can be measured on these scales can be called a variable. Variables are important in bringing clarity and specificity to the conceptualization of a research problem, formulation of hypotheses, and to the development of a research instrument. They affect the whole research *(data analysis, selection and application of statistical tests, data interpretation and presentation and the conclusion).* A variable can be classified from three perspectives that are not jointly exclusive: *casual relationship, design of the study, and unit of measurement.* There are 4 types of variables; nominal, ordinal, interval and ratio variables.

Sampling:

Sampling is the process of selecting a few (a sample) from a bigger group (the sampling population) to become the basis for estimating or predicting a fact, situation or outcome regarding the bigger group[1,9].

The theory of sampling is guided by three principles:

- **Principle one:** In a majority of cases where sampling is done there will be a difference between the sample statics and the true population mean, which is attributable to the selection of the units in the sample.
- **Principle two:** The greater the sample size, the more accurate will be the estimate of the true population mean.
- **Principle three:** The greater the difference in the variable under study in a population, for a given sample size, the greater will be the difference between the sample statistics and the true population mean.

In selecting a sample the researcher should always try to achieve maximum precision in his/her estimates within a given sample size, and should avoid bias in the selection of his/her sample.

Sampling design can be classified as random/probability sampling designs, non-random/probability sampling designs, and 'mixed' sampling design. In a random sample, each element in the study population must have an equal and independent chance of

selection. Three sample designs are; simple random, stratified random and cluster random sampling.

There are four non-probability sampling designs: quota, accidental, judgmental and snowball. Each is used for a different purpose and in different situation. Systematic sampling is classified under the 'mixed' category as it has the properties of both probability and non-probability sampling designs. Lecture notes on research design by Sirag Eddin Mustafa who clearly describes this issue of research[9].

Data collection:

Numerical data whether primary or secondary has different resources such as population census, hospital registrations or government documentary data. The data is collected by surveys, observations, interviews, documentary records and questionnaires. The latter is commonly used method and its wording should be clear and simple relevant and well designed to provide the needed information Personal or private questions should be avoided and hypothetical questions are of limited value. The questions should be put in a logical order to be easy for the respondent to remember the answers. Leading questions should be avoided[9].

Processing and Displaying of Data

The processing of data includes all operations undertaken from when a set of data is collected until it is ready to be analyzed either manually or by a computer[9]. Computers primarily help by saving labour, save time and increase speed. The extent of their application depends upon the purpose of the study.

Statistics primarily help to make sense of data, explore relationships and interdependence between variables, ascertain magnitude of an existing relationship or interdependence and place confidence in the findings.

Data displaying is to format the findings in the form of a tables or graph instead of a form a text, this makes the communication easy and clear. Depending upon the number of variables there are three types of tables: univariate (frequency), bivariate (cross-tabulation) and polyvariate. On the other hand there are many forms of graphs; the histogram, the bar diagram, the stacked bar chart, the 100 per cent bar chart, the frequency polygon....etc.

Problems and Limitations

The researcher should list problems that may be encountered, concerning, for example, the availability of data, securing permission from the agency and organization to carry out the stud, obtaining the sample, or any other aspect of the study.

Work Schedule

This is a time-frame and plan of actions in which the researcher sets his dates as he needs to complete his/her research. It includes the different activities and the time allotted to begin and finish each activity. It acts as a control measure as each research has a proposed time to finish. The reviewers and the grants funders are greatly concerned by this table. The researcher has to keep some time towards the end in case the research process does not go as smoothly as planned.

A Gantt chart is a common tool for project planning and keeping track of the status of individual tasks within a project. There are now a great many software tools that use Gantt charts in project planning. Excel is a popular tool for creating Gantt charts, or more better Microsoft Project or a project management add-in for Excel. However, an easier to use and cost effective Gantt Chart Template is also available on line.

Ethical Issues

All professions are guided by a code of ethics that has evolved over years to accommodate the changing values, needs and expectations of the authorized bodies. Being ethical means adhering to these codes of conduct. Some professions have very strict guidelines, monitor conduct effectively and take appropriate steps against those who do not abide by the guidelines. Ethical issues in research can be looked at as they relate to participants, researchers and sponsoring organization.

Ethical issues concerning research participants include:

- Collecting information.
- Seeking consent.
- Providing incentives.
- Seeking sensitive information.
- The possibility of causing harm to participants.
- Maintaining confidentiality.-
- Ethical issues relating to the researcher include:
- Avoiding bias.
- Provision or deprivation of a treatment.
- Using appropriate research methodology.
- Correct reporting.
- Using information.

Ethical issues regarding the sponsoring organization lie in the use of the collected information.

Budget

The researcher usually confronted by the inescapable fact that research is an increasingly expensive and competitive business,

and knowing how to secure his/her funding he/she needs can make all the difference[6]. The proposal should convince the potential financiers and partners that the problem is a priority, feasible, cost effective fits national plans and does not duplicate anything already being done. It may be useful for the researcher to start by listing the resources which are provided by his/her organization or institution for the project. The researcher must develop a monitoring and evaluation system and remember that donors usually insist to know how to measure success or failure of the project.

For the requested budget list the items needed in each budget category, the amount needed and the yearly and total cost. He/she has to use as accurate figures as possible and does not forget to include uncertain events and factors for inflation.

Letters of Inquiry

Private foundations and funding agencies are increasingly requesting that they be approached first with a short letter of inquiry or concept paper before inviting a full proposal. This is a one page long element, the purpose of which is to summarize what a researcher is proposing, briefly describing the main idea of the research proposal.

The researcher should really try to keep it short and convincing, since some reviewers will not read the next parts, but assess this element only. The last thing the researcher wants to do is to give the reviewers a reason not to fund his/her proposal. Too much jargon is a great way to turn off the reviewer[1].

Pilot Study

The pilot study permits a preliminary testing of the hypothesis that may lead to changing, dropping or developing a new one. It permits check up of the planned statistical and analytical procedures and reduces treatment errors that save time and money on a research project. It is also possible to get a feedback[1,5,9].

A Research Report Writing

Writing the research report is the most crucial step in the research process as it communicates the findings with the supervisor or the readers. Styles of research writing vary but all research reports must be written clearly and concisely a badly written report can spoil all hard work had been put into research study. Furthermore, scientific writing requires intellectual strictness and there are certain obligations in terms of accuracy and objectivity.

The chapter should be written around the main theme and sub-objectives of the study. There are different ways of referencing

and writing bibliography. When providing specific information about a variable, the write-up should integrate the rationale for studying the variables; the literature review; the hypothesis, if any; conclusion drawn; and possible explanation of the finding. The researcher needs to select the system that is acceptable to his/her discipline and university.

References

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9- *Siraj Eldin Mustafa. Lecture Notes on Research Methodolgy. 2009. Gezira* University Press.

SUGGESTED WRITING GUIDES (Online resources)

1- ***The Elements of a Proposal****: Frank Pajares, Emory University*

2- ***Beginners Guide to the Research Proposal****: University of Calgary, Manitoba, Canada, the Centre for Advancement of Health*

3- ***Some Thoughts on Dissertation Proposal Writing****: Professor Chris M. Gold, University of Wisconsin-Madison*

4- ***Writing and Presenting Your Thesis or Dissertation****: S. Joseph Levine, Ph.D., Michigan State University*

5- ***Conceptualizing, Writing, and Revising a Social Science Research Proposal****: Institute of International Studies, University of California-Berkeley*

6- ***The Proposal in Qualitative Research****: Anthony W. Heath, PhD, Division of Behavioral Sciences, McNeal Family Practice Residency*

7- ***How to Write A Dissertation: or Bedtime Reading For People Who Do Not Have Time to Sleep****; Douglas E. Comer, Purdue University*

8- ***Resources for Graduate Student Writers****: Sweet land Writing Center, University of Michigan*

9- ***Writing Theses and Dissertations****: Claremont Graduate University Writing Center*

10-***Teaching the Research Proposal: A Brief Process-Oriented Overview****: Writing Center, California State Polytechnic University, Pomona*

11- ***Dissertation Proposal Writing Tutorial:*** *Elys Ben Salem, University of Kansasersity*

12 ***The Art of Writing Proposals****: Adam Przeworski and Frank Salomon, Social Science Research Council*

13-***How to Write a Research Proposal****: Eastchance.com*