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Writing a Quantitative Research Thesis

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ABSTRACT Research is an exciting adventure which if properly carried out adds richly to the student's experience, to the school academic prestige and to the society through the new knowledge it creates which could be applied in solving related problems and in other services. Young researchers always encounter problems designing and carrying out their first study which usually is their project, thesis or dissertation. Some who are not properly guided or supervised get frustrated and drop out of their programmes because of these problems. The ideas in this paper which metamorphosed over 25 years of teaching and supervising research, represents an attempt to contribute to the solution of such problems especially for graduate students. It presents elaborately, in very simple language and in five sections, the practical steps that should guide beginning researchers on how to carry out their study and report it.

1. RESEARCH PROBLEM AND TOPIC

There are basically two types of problems: that whose aim is to increase our knowledge and that whose aim is to make our life better (Selamat 2008). Research topic emanates from a detailed and insightful analysis of a research problem as one of the possible ways through which a solution could be contributed to the problem. Such analysis might involve experiences gained from literature review. Generally, research topic should reflect three components: the independent variable, the dependent variable and the population under study. The dependent variable is the problem variable while the independent variable is that whose influence or relationship to the problem variable is to be established, and which if effectively manipulated is highly likely to bring about desirable changes in the problem variable.

For example the problem of deteriorating quality of performance of mathematics by senior secondary students in Botswana, was analysed, and several possible contributory factors were identified. These included: quality of textbook, teaching methods, teachers' experience, teachers' motivation, parental involvement, study time, etc. These are called the independent variables, while the problem variable is called the dependent variable. A contribution to the solution of the problem could be done by manipulating any of these independent variables in a direction that would enhance desirable changes in the problem variable - quality of students' performance in mathematics. But first of all, we must determine the amount of influence, if any, which such

manipulation would have on the problem. Hence the first step in tackling this problem is to carry out a study to determine the amount of influence any of the independent variables has on the problem variable, and based on the result of such study, we make recommendations or come out with a model through which contribution could be made towards the solution of the problem.

Since we may not, in one study, handle all the variables that could possible influence our problem variable, we have to choose one or sometimes few of them to study, and the chosen ones(s) become(s) the independent variable in our study. Let us say that in our own case, we choose teacher motivation, hence our topic would be "*Teacher motivation and quality of performance in mathematics by senior secondary students in Botswana*" Here we have 'the level of teacher motivation' as our independent variable; 'quality of performance in mathematics' as our dependent variable; and 'senior secondary school students in Botswana' as our population under study. Each of these has to be defined or operationalized during the process of the study. Topics should be stated as concisely as possible. Irrelevant phrases like "A Study of . . ." "A Comparison Between . . ." should be avoided. The maximum length, in number of words, of a typical topic should be 20 (Graduate Studies, College of Education, University of Florida [GS/COE-UFL] 2005).

The Problem

The first chapter in a thesis research report is

often labelled as “The Problem” because everything that goes into it has to do with the presentation, analysis and validation of the research problem. Some authors title it as “Introduction” but each of the other chapters has a section on introduction hence it is sometimes confusing when it is so titled. If the first chapter of the research report is titled “Introduction”, there will be no need for any section or subsection to be titled “Introduction”

Generally, the chapter presents, analyses, and validates the problem for which a solution is sought through the study. It validates the problem through presenting and analysing:

- (1) current observations, experiences, views, opinions that reflect or bear on the existence of the problem;
- (2) background (historical, cultural, economic, social, etc.) information on the problem or on its development;
- (3) rationale or theoretical/conceptual background/foundation information that provides the knowledge so far available to human on the area of the problem. This is the ‘major premise’ of the study. This provides the basis or a foothold for speculating the possible solution to the problem at hand. Solution to problems emanates from putting what is known or theoretical knowledge to work. One who does not have the theoretical knowledge cannot speculate and follow through possible solution to a practical problem. It is what is known so far in the problem area that provides the foundation for practice or for an attempt to solve any related problem.
- (4) The actual problem to which one intends to contribute a solution.
- (5) The purpose of the study and if possible, its objectives based on which research questions could be derived.
- (6) Research hypotheses which, informed by theory, speculate possible solution to the problem.
- (7) The significance of the study.

In a very elaborate form, the chapter as presented has the following sections: introduction, background, rationale or theoretical/conceptual background, statement of the problem, purpose of the study, research objectives, research questions, research hypotheses, significance of the study, assumptions, limitations, delimitations (or scope) and definition of terms and sometimes a summary of the chapter.

1.1 Introduction

This section presents and analyses current observations, experiences, views, opinions, etc. that reflect or bear on the existence of the problem. It argues with evidence for the existence of the problem. It serves to present the existence of the problem to potential readers in such a way as to involve them as stakeholders and capture and keep their attention and whet their appetite to read the work. (For large funded studies, rich materials for this section can be generated during a stakeholders’ consultation or need assessment study.) The aim is to create the existence of the problem to which you are trying to contribute a solution in their minds, their feelings and make it real to them and thus arouse their interest in the problem at hand. Try to make it their problem too, let them see the problem with you, and to feel that the solution to the problem is important to them. What brought this as a problem to your notice? Introduction is a ‘public relation’ section of the study. The questions you should try to answer here are:

1. What observations, experiences, etc., caught your attention and raised interest and/or questions in your mind and hence gave rise to the study?
2. In other words, what did you observe, hear, see, or experience that prompted you to think that this is a problem worth spending your time and funds on trying to contribute a solution? or
3. What prompted your curiosity or interest which you are trying to satisfy?

Present and analyse these in such a way as to whet other person’s appetite to read your work by raising similar interest or curiosity in their minds. Your problem should intrigue and motivate not only you but also your audience. Others should find your problem interesting and worth attention (Selamat, 2008). Explain your and other related observations, experiences, views and related opinions in such a way as to make the problem obvious to everybody. Current views and opinions such as those expressed in newspapers, magazine on issues related to the existence of the problem at hand are good at this point. Get and present, if possible, data and figures that highlight the existence of the problem. Avoid theory or review of empirical literature here but use current information and data that highlight your problem, curiosity or interest.

1.2 Background to the Problem

Sometimes it is necessary to present and analyse the historical, cultural, social, etc. background to the problem of your study within the population under study. Place the problem under study in a historical, sociological, traditional or cultural etc perspective. Does the problem have any history, or does it have any cultural or sociological root in the tradition or culture of the population under study? Present and analyse such historical, cultural or sociological roots here.

1.3 Rationale, Theoretical or Conceptual Background/Foundation

Research, especially quantitative research is basically a theory validation procedure hence the research process is cyclic in nature. It starts from theory and ends in theory. It is a process through which theories are validated, refined or invalidated. Though this may not always be obvious, especially to beginning researchers, effective solution to any human problem is based on an application of one existing theory or the other or an application of “what is known so far” in the search of what could be known in the problem area. Hence, especially with applied research one needs a theory related to the problem to provide a foundation and a sort of guidance for the search of a solution to the problem. To Hair and his colleagues (2001), theory serves three basic purposes in a research study. These are: the provision of a conceptual framework for a research study; serving as a vehicle for incorporating prior knowledge; and linking research to the larger body of knowledge in the area of the problem (p. 2).

Any attempt at the solution of any problem is always founded on what is known so far in the area of the problem. What is known so far is often enveloped in one theory or the other. Our reasoning toward a solution to the problem starts deductively from here and ends inductively at adding to the theory or increasing our confidence or lack of confidence in the theory. It is based on what is known that a possible solution to the problem is speculated. For example, one cannot speculate a valid solution to a faulty carburettor unless he/she knows the theory of the working of a carburettor. So the logic is from theoretical understanding to observations underlined by that

understanding; and from a consensus or convergence or these observations back to theory. Generally therefore, from a body of acceptable knowledge, a hypothesis is deduced and tested inductively based on the result of an empirical observation of a large enough typical cases. Tested hypothesis are used inductively to build, revise or validate a generalization or theory. Hence at this point the researcher should present and analyse an existing knowledge or theories that relate to or underlie his/her problem or interest. What is the theoretical foundation, or what do humans know so far, which provides the basis for speculating possible solution to the problem at hand, or which provides the basis for any attempt to solve this or related problems? Such theoretical or conceptual foundation should provide an explanation for the relationship among variables involved in your problem. What is the theory (major premise) that provides the foundation to your study and to which your findings will provide a contribution? Hitch your wagon to theory (Aleman 1999), or fit your observation or experience into the framework of what is already known in this area, and from it derive definitions, orientations, questions, and directions to your thinking; and speculate, based on relationships among variables as postulated by the theory, the possible solutions to your problem (Kerlinger and Lee 2000; Mouly 1978). Your speculations (hypotheses) must stand theoretical test by being compatible and consistent with existing knowledge. Theoretical background should precede the research questions or hypotheses which are speculated based on it.

1.4 Statement of the Problem

Here the researcher presents and analyses the problem to which he/she is trying to contribute a solution through his/her research. Or exactly what is the curiosity or the interest which you are trying to satisfy? According to Selamat (2008), “the heart of any research project is the problem” and “researchers get off a strong start when they begin with an unmistakably clear statement of the problem” (Slide 25). Unlike the public-relation minded ‘Introduction’ which presents and analyses current observations, experiences, views, opinions, etc. that reflect or bear on the existence of the problem or interest, here a statement of the actual problem or interest is

presented and elaborated on. Ideas from the theoretical foundation are conscripted and used to 'paint the problem red.' The purpose of the study is not its problem, the two are different. Present and analyse, with a high level of clarity, the problem of the study and then specifically focus it by narrowing it down to the aspect your study will contribute solution. Relevant questions to be answered here are:

1. What exactly is the problem to which you are trying to contribute a solution? Present the problem explicitly and elaborately, clarify and delineate it. Specify the nature of the problem and, if necessary limit, the scope of the investigation. You might delineate and define sub-problems. Present and analyse problems in education, for example, to which your study is going to contribute solutions.
2. Specifically, what problem in education, or in any area, or in the society/community, or in your job, etc, are you intending to, or interested in, contributing a solution through your research? 'Paint the problem red.'
3. How and why is this a problem? What are the current adverse consequences of the problem? What are the impacts of the problem? What are likely to be the consequences of this problem if a solution for it is not sort for now? In other words, why is it important to address the problem?

You should not be writing a thesis only for the sake of meeting graduation requirements but you should make a significant contribution to knowledge or to the solution of a significant problem. Avoid trivial problems as such problems may not sufficiently "enlarge our wisdom" and may not reach findings that are useful to a large audience (Selamat 2008). You should enlarge our wisdom in the area of your problem or curiosity through your study. Information from literature should help you delineate, clarify and enrich your problem statement; it should rarely be the source of your problem since you should aim at contributing solution to a real life problem.

1.5 Purpose of the study

The statement of the purpose of the study is often confused with the statement of the problem of the study. While the statement of the problem of the study is a presentation and analysis of the problem to which a solution is being sought through the study, the purpose of the study is

the intention which the study hopes to realize at the end of the attempt to contribute a solution to the problem at hand. Some guiding questions are:

1. What are the general goals/purposes or aims of the study?
2. What are the emanating objectives that the study hopes to achieve?
3. Following from these, when the research is completed, what are the research questions to which reasonable answers can be expected?

1.6 Research Questions

Research concerns are operationalized through research questions to which valid answers are sought for during and are expected by the end of the study. Research questions should be clear, concise, and as simple as possible, focused and empirically answerable. They should not be questions that require a yes or no answer (Selamat 2008). They should be framed to provide the guide for the conduct of the study. For descriptive empirical studies they are answerable through descriptive analysis of data, for inferential study, they are answerable through testing hypotheses that emanate from them. A study can have some research questions that are not convertible into hypotheses, and then both research questions and hypotheses are accommodated in such cases. This might call for a mix-method approach involving both quantitative and qualitative methods. The research question should be framed in such a way that it will not provoke "yes" or "no" answer. For example, based on the sample topic selected earlier, the research question "to what extent does teachers' satisfaction influence students' performance in mathematics?" is more appropriate than "does teachers' satisfaction influence students' performance in mathematics"

1.7 Statement of the Hypotheses

To Kerlinger (1968) "hypothesis is the most powerful tool man has invented to achieve dependable knowledge" (p. 27). It is a powerful tool for the advancement of knowledge because it serves as the working instrument or the tentacles of theory and a means for seeking solution to human problems. They are tentative, intelligent guesses posited for the purpose of directing one's thinking and action towards the

solution of a problem (Selamat 2008). Hypotheses are derivable from theory and they serve as means through which theories are validated, revised or invalidated through research (Glassman 2007). Once stated, they guide the rest of the study especially in terms of the literature to be reviewed, research design and methodology, data analysis procedure, arrangement of research sections, discussions of research findings, etc. The questions here are:

1. What are your intelligent or informed (by analysis of related theory) guesses or speculations as to the solution to your problem?
2. What are the scientific research speculations through which you hope to find solutions to your problems? Be very concrete and clear and state each hypothesis in terms of observable behaviour allowing for empirical testing and evaluation of the implications?

While research hypotheses are never expressed in the question form, research questions are convertible to research hypotheses. Hypothesis generally always indicates a possible influence on the problem variable by another variable – the independent variable. Underlying the establishment of influence is the determination of the relationship among variables. As a means of contributing a solution to the problem, such influence or relationship, if significant, points to the fact that if the independent variable is manipulated, there could be desirable changes on the problem variable, leading to a solution of the problem under consideration.

A speculation is a scientific hypothesis if and only if it is testable. That is, it must be amenable to being confirmed or disconfirmed through the collection and analysing of empirical data. The convergence or consensus among several empirical evidence must be that which determines the tenability of the statement. A research hypothesis statement necessarily involves or implies the fact that the observed difference or relationship is over and above that which could be accountable for by chance or random error; hence the word ‘significant’ is always used. A difference or a relationship can be observed, but if such difference or relationship is not above and beyond that which random error could bring about then it is not significant. If the observed difference or relationship is not bigger than that which random error could account for, then the null hypothesis of no significant difference or

relationship is retained, but if it bigger, then the null hypothesis is rejected and the research hypothesis retained. Retaining the null hypothesis is like acquitting a defendant based on evidence before the judge. There may be other evidence not before the judge which if available would alter the decision of the judge, hence an appeal is always allowed (Churchill and Iacobucci 2004).

Sometimes the level to which one is willing to reject a true null hypothesis, that is, significance or alpha level is specified generally for all hypotheses or indicated in each statement of the null hypothesis. For example for our study on teachers’ motivation and quality of performance in mathematics by senior secondary students in Botswana, one of the statistical null hypothesis with the alpha level indicated in the statement of hypothesis might be: “there is no significant relationship, at the .05 alpha level, between teachers’ level of intrinsic motivation to teach and the performance by his/her students” (GS/COE-UFL 2005).

The logic of quantitative research does not encourage the idea of accepting, but of retaining the null hypothesis, because failure to reject the null hypothesis still has some probability that it might be incorrect. So instead of being accepted, such a speculation is retained because further evidence might come to show it false and hence rejected. This is especially so as we did not study the entire population but studied a sample from it. It is therefore not logical to accept that for which there is some likelihood that it might be incorrect as the truth but to retain it as the truth so far pending further evidence.

Descriptive studies make do with research questions only, but inferential studies might involve both research questions and hypotheses. The problem variable, or some aspect of it, which is the dependent variable for the study is often directly or indirectly implied in each research question/hypothesis.

1.8 Significance of the Study

What contributions do you think your study intend to make to the advancement of knowledge and/or to the solution of some practical or theoretical problem(s)? What are the intrinsic and extrinsic benefits of the study? What is the potential usefulness of the findings of the study to all stakeholders? How will the findings assist or be of benefit to each stakeholder? How would

the solution to the problem influence educational theory and practice? What are the educational, social, theoretical, cultural, etc. significance of the study? Convince the stakeholders of your study of the potential impact of the study for them. Formulate and present the anticipated implications or possible applications of the results of your study. Indicate significance to all related stakeholders of the study including: (1) theory or advancing accumulated knowledge; (2) current literature; (3) policy development and implementation; (4) practices in the field; (5) the study's subjects or participants; (6) teachers and other practitioners; (7) researchers; (8) parents, government and other stakeholders, etc. (GS/COE-UFL 2005)

1.9 Assumptions

What assumptions have you made, or what have you taken for granted about the nature of the behaviour you are investigating, about the conditions under which the behaviour occurs and about your methods and measurements (Isaac and Michael 1990). Unlike hypotheses, assumptions are not testable but are statements about observations and experiences related to the study that are taken for granted or are assumed to be true. They are statements that help to remove/reduce doubts on the validity of the study and are accepted in faith, or taken to be true without proof or verification (Assumption 2007; GS/COE-UFL 2005; Hungler and Polit 1999). For example, if your study involves scores from or subjects' performance in public examination, then your study would assume that the examination was reliable and valid. The question is what are you taking for granted in the conduct of your study?

1.10 Limitations

What are the unavoidable limitations conditions (not within your control) surrounding your study and within which conclusions to the study must be confined? What limitations exist in your method, design or approach, sampling restrictions, uncontrollable variables, faulty measurements, and other compromises to internal validity? (Isaac and Michael 1990). For example constraining characteristics of methodology/design that tend to limit the interpretation and application of the research findings. For example

the constraint in, or lack of simple random sampling places limitation on generalizability of the findings. What are those constraints that would be faced by anybody who tries to conduct or replicate the study? To what extent is the study limited and why? Limitations become clearer or more obvious at the conclusion of the study hence sometimes theses could not be fully specified until after the study, and could be placed elsewhere possibly at the interpretation or discussions stages of the report (GS/COE-UFL 2005). They serve as warning or precaution to the readers or consumers of the research findings on the extent to which they can apply or generalize the findings.

1.11 Delimitations

What are your self-imposed limitations in the study? How have you narrowed the scope of the study? Such scope includes geographical and conceptual scope (often presented under definition of terms). State precisely what you did/ what you did not do, or what you intend to do / what you do not intend to do, or define the boundary for your study with regard to the scope of the study. Have you decided to focus only on selected aspects of the problem, certain areas of interest, a limited range of the subjects, etc.? (Isaac and Michael 1990). You might, through sampling, narrowed the population as in the topic. This will jeopardize external validity of the study. What are those constraints imposed by, and may be unique to, you in carrying out this study?

1.12 Definition of Terms

List and define conceptually unusual terms or acronyms to avoid misinterpretations particularly where they have different meanings to different people. (If such definitions are based on new instruments developed for the study, the operational definitions should come after the development of such instrument in section/ chapter three). Make sure you do not repeat definitions implied in your theoretical foundations here.

2. REVIEW OF LITERATURE

2.1 Introduction

What is the content of the chapter on review of literature, and how are you going to arrange

the materials in it? Unlike the theoretical materials presented under the section for theoretical/conceptual background/foundation in the first chapter, here the researcher should present and critically analyse the empirical experiences of other researchers like him/her who had tried to contribute solution to problems similar or related to his/her problem. In quantitative research, literature reviewed under this chapter is seen as important data or input into the research process as it provides the researcher a source of materials with which to revise one's problem, topic, and hypotheses and an informed source for writing one's methodology. It also provides important inputs into the discussion of the research findings.

2.2 Literature Review

Review other researchers' empirical experience (theoretical review belongs to the section on theoretical background) with your, related or similar problems? Critically and analytically review the experiences, findings, and the design, method, analysis used and such results. What are others' views based on the results/findings of these relevant studies? Organize and present these reviews in a systematic way in related sections, in terms of relationships between variables as implied by your hypotheses. This should not be merely descriptive or narrative, but critical and analytic. When you review others' studies, pinpoint or indicate flaws, and other technicalities that may seriously distract from their validity (Mouly 1978, p. 92). The guiding questions here are: When other researchers like you tried to contribute a solution to this, related or similar problems:

What did they do?

How did they do it?

What population, strategy, method, and measures did they use?

What did they do wrong?

What did they find out?

What have they or others said about what they did and what they found out?

What are the inherent weaknesses/strengths of the strategies, methods? measures?

How (if at all) did the researchers mitigate/address the weaknesses? (Did they acknowledge the weaknesses?). Think of these questions when you are planning your literature review.

To maintain the systematic nature of research,

present your reviewed materials in sections according to your research questions or hypotheses. For example, if your first research question was: "To what extent does level of teachers' extrinsic motivation influence students' performance in mathematics?" The first hypotheses might be "level of teachers' extrinsic motivation has a significant influence on students' mathematics performance." Then the first section in the literature review following the introduction should be headed: "*level of teachers' extrinsic motivation and Mathematics Performance.*" Under this heading, relevant and current empirical experiences of other researchers like you on this area should be critically reviewed, analysed and arranged systematically to show a trend in the development of empirical knowledge in the area. Have a specific reason for reviewing a particular research study. This might be its importance given your problem; its unique methodology, data analysis procedure and findings (GS/COE-UFL 2005). While empirical literature from studies undertaken within the last 10 years are generally accepted as current, literature from classic/important studies in the area should also be reviewed

2.3 Reviewing Literature

The most important skill for efficient review of literature is the ability to read fast, comprehend and summarize material quickly and put it in a form that can easily be retrieved and used in the future. During a review, a researcher's activities are quoting, paraphrasing, summarizing and evaluating. Each of these should be done in a manner as to protect the right of the author and avoid plagiarism.

2.4 Summary of Literature Reviewed and Justification (Rationale) for the Study

Provide a comprehensive summary of the reviewed materials. How are you going to use them in your study? In other words, what is the place of the reviewed materials in your study? Present a brief appraisal of the need or justification for your study in the light of the reviewed materials. Generally, what is known so far in the area of your problem, what still remains to be done? (Selamat 2008). These should be taken into consideration at the end of the report when writing your recommendations. What in the

materials you have reviewed in terms of coverage by the studies reviewed, methodology used, types of analysis done, findings, etc. justifies the need for your research study? Given other related studies reviewed, why is this study necessary? What are the gaps, inconsistencies, inadequacies, or deficiencies in existing literature which you are trying to fill or correct through your study?

3. RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

Introduce the chapter, and define your problem operationally, and on the basis of these, establish an appropriate and suitable design for the study. You may restate your hypotheses in the statistical form and for each or for all indicate the level of significance at which you want to test the hypotheses.

Note that problem for which we are seeking solution through research exists or occurs because the relationship between or among interacting variables or phenomena involved in a situation, an experience, an observation or event results in an undesirable or intriguing consequences. Seeking any solution to such problem calls technically for disentangling such relationship or identifying the variables or phenomena involved and analyzing the relationship devoid of extraneous influences. The more we can do this devoid of extraneous influences, the more valid will be our findings (Best and Kahn 1996). So research design involves procedures through which we can explore and analyze the relationship among the variables involved in our problem with minimum error while controlling for sources of extraneous variability. In all aspect of the research design, we want to know specifically the reason why the particular procedure used was preferred over the others. So all choices or preference of any particular procedure or method over others must be justified preferably by referring to other published studies which had used or recommended the use of the method or procedure. Each decision about any aspect of the design and methodology procedures used must be defended. Is the preferred procedure consistent with the acceptable practice in the problem area or field? Each procedure under the research design and methodology section/chapter must be valid or appropriate given the research

problem, research question and/or hypotheses. Anticipated method- or design-related problems should be highlighted and steps taken to prevent them from occurring should be indicated and explained. Procedures should be vividly explained to allow for valid replication. Fundamentally, quantitative research is an inferential endeavour which seeks to uncover universal truths and principles in the form of relationship among variables or phenomena. Philosophically and methodologically it is designed to enable inference from a sample to a larger population (The Validity and Reliability of Qualitative Research, n.d.).

3.2 Research Design

Besides indicating and justifying the type of research – qualitative, quantitative or mixed model – and the underlying philosophy or paradigm, clearly describe the design of the study and defend your choice of type and design for your study. Accepting research as a search for the truth, how will you ensure that your findings reflect the truth as much as possible? What precautions will you be taking under every aspect of the study to inhibit error from carrying the findings of the study away? How are you going to minimize error and manage the variation in the variables under the study in order to avoid the results being significantly influenced by extraneous sources? How do you control for probable sources of error? Research design is fundamentally a variance management procedure. What is, in an analytic form, the fundamental objective of the study? Is it an attempt to reconstruct and describe the past objectively and accurately, that is to describe *what was?* In that case it is historical, ethnographical, etc. Is it an attempt to discover relationships that exist between non-manipulated variable that is to describe, explain or infer some aspects of the present - what is? In that case it is either a survey-descriptive, or a survey-inferential, evaluation study, etc. Is it an attempt to find out what will be when variables of interest are carefully manipulated under controlled condition, that is, to describe - *what could be?* In that case it is quasi- or pure-experimental study (Van Dalen 1979)

3.3 Population of the Study

Describe your population explicitly in terms of geographical limits, demographic and

sociological descriptors, time period covered, etc., as dictated by the problem. Have you delimited the population as specified in the topic, if yes, how and why? Describe the population so well that you leave no doubt in the readers' mind as to who is qualified or not qualified to be members of the population of the study (Isaac and Michael 1990). If possible, what is the number of members in the population? Note that there is the need to first define or describe vividly the research population in your study; for it is not in all cases that the research population will be human beings. Research population could be certain products in the market or certain textbooks in the school system, etc.

3.4 Sampling Procedure

We can only get from the population to the sample through sampling; therefore describe the sampling procedure that you used to select the sample from the population described above. Be explicit to allow for replicability. Do not just say "simple random sampling was done." What exactly did you do? What are the possible constraints that may be encountered in an attempt to carry out a scientific selection, and how did you overcome these? The main concern here is, given the sampling method you are using, how well does the sample that results from it represent the population? This is one of the two sources of random error which research design must minimize. It is the cornerstone for ensuring generalizability or external validity of the study.

3.5 The Sample

Describe the resulting sample in details in terms of each level of the independent variables implied in the study. Present this in a tabular form if possible. Describe, if possible, the sample-to-population ratio? Evaluate this ratio in terms of the anticipated or desirable precision of your study.

3.6 Instrumentation

What instrument(s) are you going to use to collect data for the study? If the instrument to be used is constructed by you, describe clearly, with accurate details, how the set of items designed to illicit responses for each variable were constructed, or how you came by the set of items

which you are using as an operational definition of each of the variables. How was the instrument validated? Describe the validation process, and indicate and evaluate the results. If the instrument was adopted, why it had to be adopted? If the items were adapted from existing instrument summarize the procedure that was used in its construction and its measurement properties. What method did you use in selecting or on what basis did you select the items? How well is the validation population of the existing instrument which you are using comparable with the population of your study? What changes or adaptations did you make to the original instrument? If the validation population is significantly different from your population for the study, or if the adaptations or changes made on the original instrument are significant, describe your revalidation process, indicate and evaluate the results. Validity is at the heart of both measurement and research.

Here again, we are talking about representativeness that sustains generalization. The question here is to what extent will your instrumentation procedure or methods produce measures or scores that validly represent the behaviour or variable under measurement for every subject or participant? To enhance external validity avoid under-representation of the subjects or participants, of the research setting, of the variables or measures. This is the deficiency where your instrument fails to include all items that are representative of and from all aspects of the construct or variable under measurement. On the other hand avoid measure contamination in which items that are irrelevant to the construct or variable are included in the instrument. Items must succinctly represent the behaviour under measurement. Here the question is, how well do the set of items you have designed, selected or used to measure your research constructs or variables represent all possible indicators or universe of all indicators of the behaviour represented by your research variable or construct?

In all cases, the reliability of the instrument designed to measure each of the variables should be presented at the proposal stage. Besides sampling, instrumentation and data collection procedures are the other sources of random error which research must be designed to minimize. We can limit this by using instruments that have high reliability. While validity represents the accuracy of your measure, reliability indicates the precision

of your measure. Here we are talking about how well the items of the instrument combine to measure precisely whatever it is measuring. It can be measuring precisely whatever it is measuring but not accurate at measuring what it was supposed to measure. Reliability has to do with stability, repeatability and consistency of the results of our measurement or observation.

3.7 Data Collection

Under what condition(s) were the data collected? Be explicit to allow for replication. What did you do to limit the error that might have been as a result of data gathering procedure? What special precautions, instructions, etc., did you take or give during the administration of the instrument or interview or during the observation to minimize the data-collector effect on the result of the data collection procedure? This is another source of measurement error which if systematic comes in to adulterate the results of our research study and reduce the internal validity of such findings. Hence we want to know specifically how the research data were collected.

3.8 Ethical Considerations

What type of and how is each ethical issue likely to manifest during the study? What is likely to be consequences of each of these to the subject? What procedures have you put in place to address each of these issues and their probable consequences? For example, what precautions and safeguards have you incorporated in the study design to protect the rights of human subjects? (see American Educational Research Association [AERA] 2005)

3.9 Data Preparation

Describe how you will score, in respect of each variable, the responses by the subjects to each item of your data collection instrument. Note that in your instrument some of the items may be negatively worded while some are positively worded and to add these up you need to transform all of them to the same polarity. How did you code, roster, or transform the emanating data in preparation for analysis? There may be need for you to transform the data into a numerical form more suitable for appropriate statistical analysis.

3.10 Operational Definition of Research Variables

How did you measure or manipulate each of the variables or constructs in your study? How did you get, for each subject, the data that replaced or took the place of each variable for every subject or participant in your study? How did you turn the participants' behaviour into a score that validly represents the behaviour? Be explicit to allow for replicability. Give meaning to your variables by spelling out what you did (and how you did it?) to measure or manipulate it. This can be through experimentation or through measurement.

Quantitative research is conceptually made up of three sections: (1) a section based completely on verbal discourse; followed by (2) a section based on numerical or quantitative discourse; and finally concludes with another (3) section based again on verbal discourse. In the first section the research problem is presented, analysed and validated; literature is reviewed and reported; and the procedure for carrying out the study is presented and justified, all verbally. Towards the end of this section, research variables, concepts and constructs are replaced with numbers. It is through the operationalization process that this is done in such a way that the resulting quantification with a score or normative qualification represents the variables, concepts or construct validly. A construct is an imaginative or abstract entity, purposely created to provide a guide, a foothold, for further study and understanding of the concept it represents (Kerlinger and Lee 2000).

During the next quarter of the process the discourse is purely numerical and technical logic, involving hypothesis testing and the attainment of results. Owing to lack of understanding of numerical logic by many readers, the report often loses some audience within this section. It is through the interpretation process that this logic is again converted from numerical to verbal. It is at this point that results, which are expressed in technical terms, are translated into findings. The last section which includes summary of the study, discussion of the results, presentation of the implications of the findings, conclusion and presentation of the recommendations is purely verbal and non-technical (Nenty 1999b) and you should avoid bothering the readers with technical jargons and numerical expressions in these sections.

3.11 Procedure for Testing Hypotheses: or Answering Research Questions

Restate each of the hypotheses in the null form and for each identify the variables (independent and dependent variables) involved. And given the nature and type of variables involved, indicate and defend your choice of the type of statistical analysis you will be doing to test the hypothesis. This may be presented in a tabular form.

4. ANALYSIS OF DATA AND INTERPRETATION OF RESULTS

4.1 Introduction

What intends to be the focus of this chapter? How will you arrange the contents of the chapter? Data analysis is a means of determining and testing for the extent of convergence, commonality or divergence among data collected during the study, and hence the relationship among variables which these data represent. The question here is, for example, to what extent do the data collected from several subjects and through different sources converge to support the existent of a significant influence or relationship between or among the research variables? Present and interpret the results without discussion or comments here (Morley 2006).

4.2 General Description of Data

Give a general descriptive analysis including the number of cases, mean and standard deviation for each dependent variable given each level of each of the independent variables in your study. This is a descriptive summary of the data and should be presented in tabular and figural forms.

4.3 Answering Research Questions

For those research questions that were not convertible to hypothesis answers to them must be sought through descriptive analyses of relevant data. These might involve frequencies and/or percentages; graphs; and other descriptive analyses including determining the relationship among relevant variables. The results of descriptive data analysis should be presented in appropriate tables and figures. Tables must be numbered and given titles (Morley 2006)

4.4 Hypothesis-by-Hypothesis Presentation and Analysis of Data, and the Interpretation of Results

Taking each hypothesis in turn, state in the null form and indicate, and if necessary, explain, the variables involved. Analyse the data using appropriate quantitative (statistical) techniques, and indicate and present the tables and figures if necessary. Prepare and present the tables and figures neatly in such a way that they can stand alone in describing the outcomes of the study. Tables and figures must always be referred to in the text at least once before they are inserted. *Interpret* the results, that is, read appropriate meanings into the results and present this in non-technical language. Interpretation transforms the results of data analysis into the findings of the study, in other words, interpreted data analysis results become the findings of the research study. Selamat (2008) calls interpretation an “analytic thinking that squeezes meaning out of the mere accumulation of facts”. The question here is “What do the results of the data analysis mean in a ‘lay person’s’ language? (Slide 9) Specifically the reporting steps in this section should include:

- (a) State the statistical version of the hypothesis in the null form;
- (b) Present and describe exactly what you did, in terms of data analysis procedures, to test the hypothesis. How did you do these? What was the result? End this up by referring to the table on which you present the results.
- (c) present the table that has been referred to in (b) above. Avoid using words like above” or “below” to refer to the table or to a figure or any diagram in your paper
- (d) what does what you found out imply for the research question or hypothesis under test? For each research question or hypothesis, what does the finding mean, in a layman or non-technical language? (Nenty 1999b).

To ensure validity in the interpretations of the results of data analysis, it is pertinent to ask yourself “to what extent ‘does your data say what you say it is saying?’” (MacLean and Mohr 1999, p.117).

4.4 Summary of Findings

Summarize all the findings in a paragraph or two, and with it, prepare the reader’s mind for the ensuring discussion of the findings that follows.

5. DISCUSSIONS, SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

What is going to be the content of this chapter, and what is its thrust? How are you going to present or arrange materials in the chapter?

5.2 Discussions

Discuss each of the findings exhaustively per research question or hypothesis. All discussions should be done in the light of the limitations to the study. Discussion is a means of presenting and analysing the convergence or divergence of ideas from the findings of your study, the findings from the literature reviewed, and from the theories that underlie the problem under consideration. It is an integrative analysis of information from these sources. It is mainly an attempt to answer the question "why?" and "how come?" Why do boys do significantly better than girls in mathematics in the population under study, for example? Advance reasons to support and/or explain your findings. Discussion is never within one person but between or among persons, ideas, etc. In research, especially in quantitative research, discussion is among four 'persons,' these are: the findings from your study; theories related to the problem at hand (these were reviewed and analysed in the first chapter); empirical experiences and findings of other researchers when they were trying to contribute solution to the problem at hand or to related or similar problems (these were reviewed and analysed in the second chapter), and the researcher with all his/her expertise and experiences as an impartial and insightful moderator and recorder of the results of the discussions (Nenty 1999a, 2001).

Discussions should be analytic, logical and comprehensive and should bring together your professional knowledge, the findings of your study, the findings of related studies reviewed earlier and you should argue in the light of related theories presented in the first chapter (See Kerlinger 1968, pp. 135-136). To what extent do your findings support the findings of most related studies? How? If not, what are the possible reasons for the discrepancy in the findings? Does the discrepancy or similarity result from differences or similarities in design, methodology,

data analysis methods, etc.? Is it as a result of a flaw in yours or other's design, methodology, data analysis methods, etc? Do your results tend to support others in arguing for the related theory? If so, how? If not, why? Argue towards the related theory presented in chapter one. Discussion ties everything up? Do not re-report, the findings but discuss based on them. Answers to the following concerns should guide and be integrated into the discussions of the research findings:

- (1) What are the findings of other empirical studies that support or fail to support your findings in arguing for the theories on which your study is based and what are the probable reasons for this?
- (2) How has your findings altered, strengthened or weakened the theory on which your study is based?
- (3) What theoretical assertions has your findings been able to account for, or what theoretical claims has your findings reinforced? (Aleman 1999)

Explain unanticipated and statistical insignificant findings. Bring out and discuss in the light of the shortcomings, limitations, delimitations and assumptions of this study. Integrate and theorize by trying to make your findings part of a comprehensive body of the knowledge/theory either by working within an existing theory or by generating pointers to an original theory (Tuckman 1978). Discuss in the light of the limitations of your research methodology and highlight the possibility of generalizing your findings.

Discussion is the most complex (Morley 2006) and important section of a research report as it is integrative, synthesizing the theory, and all findings reviewed and reached given several methodological procedures, etc. It is the most intellectually demanding section, and the only one that calls on the researcher's creativity, synthesis and evaluation skills. Inputs to all other sections have been borrowed from literature and from available physical resources and facilities, here the thinking is original and contribution to knowledge, if any, is made at this point.

5.3 Implications

It is important to remember that the study set out or was designed to contribute a solution to a given specific problem, or to satisfy a specific interest or curiosity, so, to complete the logical

loop of the research process, such problem should be restated here, and the implications of the findings of the study to the solution of this problem highlighted.

What is the implication of the findings of the study to the various stakeholders? What do the findings of the study suggest or what do evidences from the study suggest to each stakeholder? These include theory, policy and people involved in education, for the classroom, administration, other researchers in the area, etc? What implications have these results or findings to existing related theories? What are theoretical, practical and policy implications of the findings of your study? Given now the findings of the study how well is each of the significance realized? What and how have the findings of the study assisted each stakeholder to given the problem of the study? What are possible practical fallouts from the study? What possible intervention towards solving the research problem do the findings of your study imply?

5.4 Conclusion

Present, in a comprehensive form the conclusion based on the findings of the study. Summarize your thought and present your last words on the problem and the significance of the findings. According to Morley (2006), conclusions serve two purposes: to summarize and bring together the main area covered in the report, and the second is to give a final comment or judgment of the report. Just like the introduction in the first chapter which in trying to make every reader a stakeholder in the study gave them the 'breathe in' type of feeling and whetted their appetite to read the work, conclusions should give the readers the 'breathe out' feeling of having learned something new and worthwhile and giving them the closure thus making them feel it worth while to have read the work.

5.5 Recommendations

Recommendations must be such that would facilitate the solution to the problem for which the study was out to contribute a solution. Present appropriate recommendations that follow directly from the findings of the study. How can the results of your study be used? Having found a contribution to the solution of the problem at hand what role can each stakeholder play in implementing

this solution? Be very clear, specific and practical in your recommendations. Specifically, to whom are you directing each recommendation? Here again the recommendation should target each of the stakeholders of the study.

5.6 Suggestions for Further Studies

What other related studies should be carried out in order to add to the contribution to the solution to this problem?

Writing an Abstract or Summary of the Work

An abstract, a short, concise and comprehensive summary of ones work is that which represents ones study in many on-line and abstract publications. Package your entire study in an envelop that can carry only at most 250 words. It should be written in such a way as to provide a motivation and whet potential readers' appetite to want to read the entire work. It normally consists of four parts: (1) the motivation part which should reflect briefly the problem of the study, the purpose and possibly the theoretical/empirical gap the study is addressing. (2) The design, method and procedures part should indicate briefly and precisely what was actually done to arrive at the findings of the study. (3) The result and findings section should briefly present a summary of the findings arrived at through the implementation of the procedures indicated. (4) The last part should provide summarizing materials on the discussion, conclusion, implications, and recommendations.

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