

# Research Methodology by Numbers – a teaching tool

Graham Trevor Myers

Durban University of Technology, South Africa

[graham@dut.ac.za](mailto:graham@dut.ac.za)

**Abstract:** Research Methodology is a daunting subject for those who have to negotiate its vastness for the first time. Often the knowledge they gain is not coherent and lacks foundation. In this paper a structured system of incremental assignments given to students allows them to experience research by “doing” rather than learning vast amounts of theory. This model allows all students to grasp the process of research by doing a quantitative proposal and pilot study in seven steps. The result is the completion of a first research project which eventually culminates in a publishable paper at internal university level. From this universal foundation every discipline may expand and hone the skills learnt by students by examining the epistemology and ontology of the specific discipline. It also allows students from different disciplines to comprehend and discuss the research of other disciplines and foster inter-disciplinary research. The model has been developed for Universities of Technology in South Africa over a period of 13 years. It started off as a very theoretical set of lectures which covered as many quantitative and qualitative methodologies as could be taught, but this left students rather bewildered. The simplification of the system to cover just one quantitative method, using the relationship between two variable, or constructs, taught through assignments, self chosen mentors and an e-mail communication system has had remarkable success with high completion rates and high marks from students in large classes. Rubrics have been the main form of assessments and the final products of a proposal and pilot study, and a publishable paper have been of exceptionally high and uniform in standard.

**Keywords:** research methodology, teaching quantitative research, research in large classes, marking rubrics, research mentors

## 1. General introduction or background

Research Methodology became a feature of Universities of Technology (UoT's) in South Africa in the mid 1990's with the introduction of the Bachelors degree in Technology. Every student had pass this course. In the faculty of Commerce the first six students were subjected to this course through a process of lectures only. A local text was prescribed and the introduction of the course started with the difference between quantitative and qualitative studies and the ideas of modernism and post modernism and all the theory that the lecturer thought a good course should have. The only text that existed in South Africa at the time was not the most comprehensible. Since then many more have been authored which are easier to follow.

The results were poor as there was too much to remember and no context within which to place their knowledge.

Thus, a process was started to turn this subject around. The existing texts were of little help, and so it was that like Ball and Pelco (2006) from the College of William and Mary, a process of discovery was initiated to create students interest in the subject and allow them to benefit more from the experience. At the end students had to be able “to do”, and what better way, than to learn by doing. Enjoyment was also a factor that needed to be considered so as to assist in the development of the higher degrees in the university because the university depended on these students returning for study further.

The intermittent years have seen an annual revision of the notes and assignments in the course handout, which has now swollen to some 120 pages, with requirements for each assignment specified and the marking rubric presented so that the students, or their peers or mentors, can assess progress before the work is submitted. In this manner the number of facilitators becomes endless, to the advantage of the student.

## 2. The developmental years

The number of students who chose this Research Methodology course increased rapidly to the point where the Faculty of Commerce had some 1000 students at this level after the normalization of the political situation in South Africa. This “massification” of education led to its own problems. There was not enough time to spend with every individual for correcting and marking their work. Some of the classes were also offered through “block release” in which the lecturer met with the students for a week as they flew in from their home countries and then returned with a set of assignments laid out to

facilitate completion of the work. The full-time classes increased as access to higher education permeated to all, but the number of facilitators did not increase proportionately.

A process of emailing of assignments began, and the load of correcting and advising was spread to persons in the student's community who could assist. Each student had to find in the community three people who could mentor him or her. The first of these was someone who had studied Research Methodology or had a Masters degree, to assist with the methodology sections. The second was a Mathematics teacher in the local high school to help with the numbers, graphs and elementary statistics and the third an English teacher who would give guidance on the layout and expression.

Initially, both quantitative and qualitative methods were made compulsory for students who had to choose from this plethora of "incomprehensible" methods, one method that suited their particular problem statement. This was unsuccessful as there was no underlying understanding of the process of research which had been masked in the search for "being correct" and "inclusive". Different teachers of the Research Methodology course also had vastly different ideas of what constituted a Research Method. There were those who taught an almost pure course in statistics and those who taught only phenomenological methods. There were also those who had a higher degree but knew little of the research process as it did not form part of their coursework or they mimicked the methodology of their supervisor. From this developed a method of teaching students (and staff) a series of steps to tackle an initial project which would take them to the point that they understood the process of solving a problem in commerce (or any other field) and be able to check it on the way, so that a poorly constructed problem statement did not scuttle everything every step of the way. Most of the students had come through a high school system that had emphasized the sciences and mathematics so a quantitative methodology was emphasized with choices within this framework.

### **3. The basic model**

The model has settled down after 13 years of practice, to contain seven steps towards producing two major pieces of work which allow the student to develop skills in Research. After this every faculty or department must put in place a second Research Methodology course that will take the student through the specific methods that are required in that discipline at post-graduate level. This has not materialized as yet but should follow.

The steps are outlined in the diagram below and follow the chapters that will be written in the proposal and pilot study. Every one of these steps has sub-sections, which guide the student to the point that he can successfully solve any management problem. (Cooper and Schindler 2006:56)

Every step results in a piece of work being submitted via e-mail so that there is a record of it on both computers, as well as a date reference, and it is marked according to the prescribed rubric for the year. This is done because students lose the electronic copies and do not keep hard copies. The work would have been checked firstly by one of the three mentors chosen by the student in his or her community or one of his peers, depending on the situation. This also allowed for the development of an academic network of persons who could work together and enhance their own research skills. Some of the students worked in situations where the skills were freely available and they had only to submit after step 3 so that the lecturer had control over the work before data was collected. The final pilot study also had to be submitted and the report returned before the publishable paper was written.

The general framework consists of seven steps (Figure 1), each of which is highly structured with notes and explanations so that a student does not lose focus by being bombarded with too much unstructured information. The sections in the notes also refer the student to relevant chapters in the Research Methodology texts. He also has access to past students' work. These are physical copies but when internet bandwidth and expertise allow, these will be available electronically.

Every step has an attached rubric and a set of instructions on how the assignment for that chapter should be executed. This rubric is in the form of a spreadsheet and complies with the points that are required in that department or field of study. Once the work has been submitted the lecturer will mark it and keep a copy, while emailing the report to the student. This serves as feed-back and as this course is one of continuous assessment, the student has the option to resubmit if the mark is a fail.

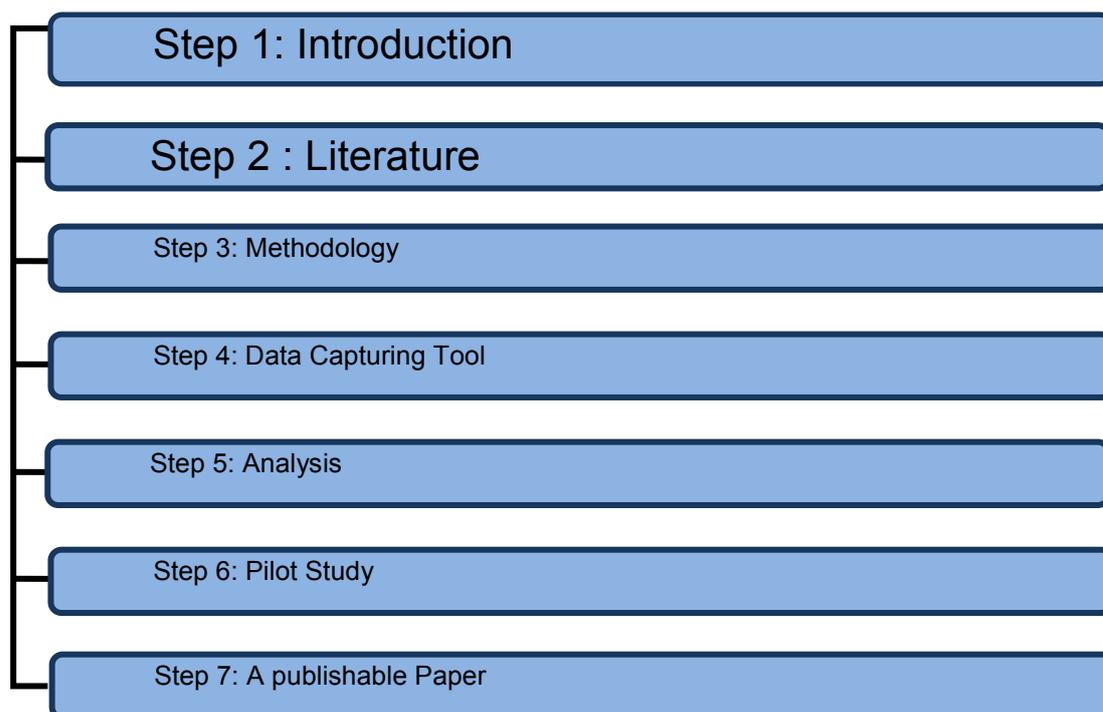


Figure 1: Research by numbers general framework

#### 4. Step 1: Introduction

The introduction is the first chapter of the student's report. Traditionally the stumbling block has been to find a topic. Much discussion has to take place in class on this and it has been found that topical issues around campus or in the community are more likely to be accepted and understood than topics within the discipline. Attempts have been made to provide lists of researchable topics in the discipline but these are very seldom used. Most full-time students prefer to do something that is unrelated to their field of study so that they are not embarrassed by missing major sections of the theory. They also prefer to conduct surveys rather than observational studies or experimentation. Most of their investigations revolve around social issues and often indigenous knowledge.

Students who are in full-time employment prefer to relate their research to their work and are thus more adventurous in tackling other methods of research. Those in engineering and the brewing institutions have tended to conduct experiments which are work-related.

The verbalization of a management problem often is the stumbling point for students. This is a topic in its own right. There is an entire process of discussion that must take place between what is put forward as a management problem, and what materialises as the research problem. One management problem can lead to a number of possible research problems.

Many of the students do not link two constructs (Welman, Kruger and Mitchell 2007:21) together but rather come up with huge topics like global warming, or HIV infection. One has then to create for them a sentence something like this:-

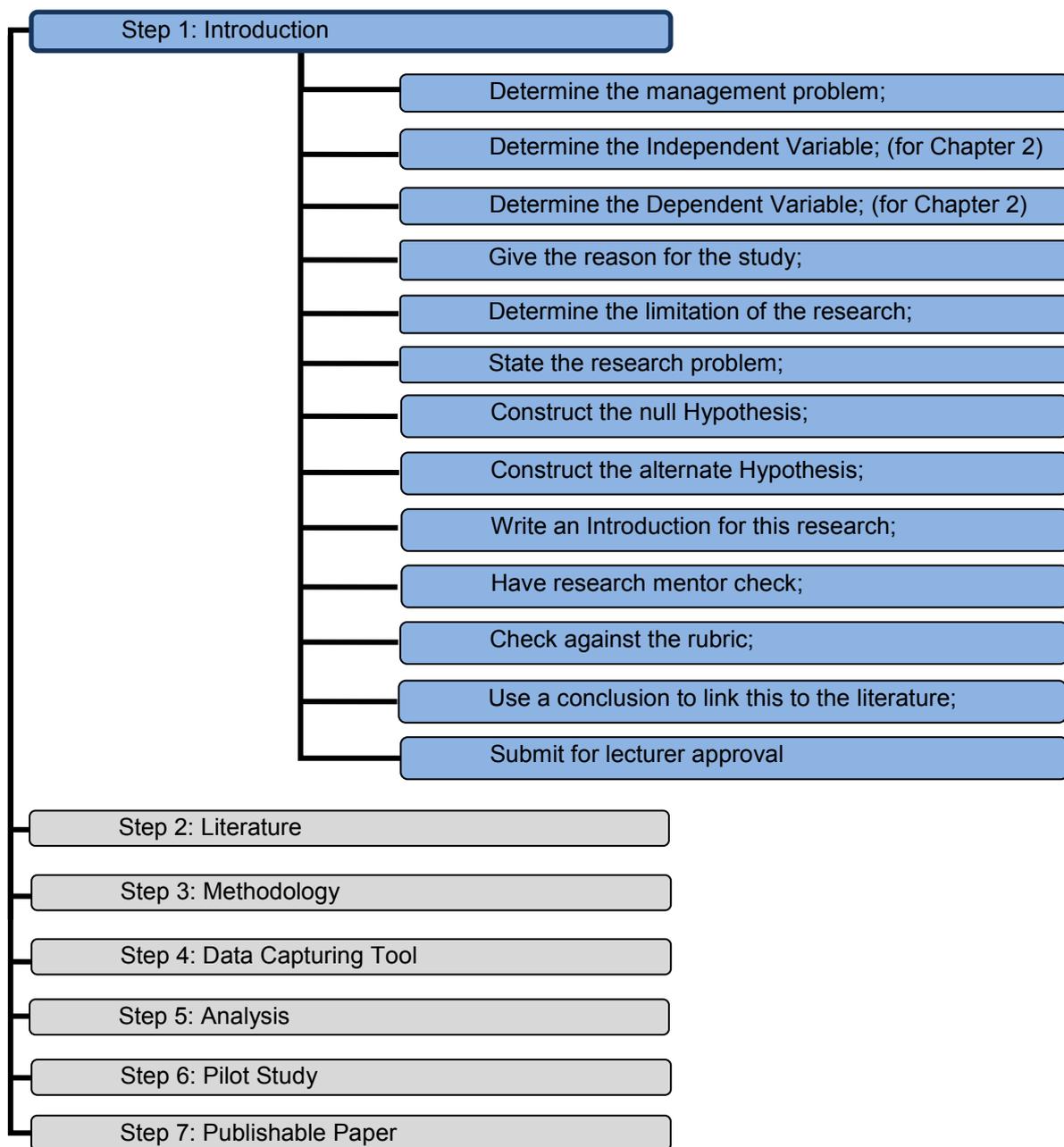
"I want to know if (IV) affects (DV) in/on (Limitation)."

(Where IV refers to an Independent Variable, DV refers to a dependent Variable)

This usually allows them eventually to come up with some relationship to investigate. With some students, however, one has to provide them with a topic as they are insecure about their choice of topic, even though the lecturer covers all types of diverse topics to make them understand that the development of knowledge does not usually come from thinking within the norms they have been exposed to previously.

The questions in Figure 2 below set out the steps that students are expected to follow. As with all chapters there is an Assignment Instruction which sets out the exact requirements. There is a corresponding chapter in the Study Guide (Lecture notes) which directs them to various texts for further reading. It also gives the skeleton outline of the chapter to be written and what should be covered in each section. Numbering is used in this section and cumulative indenting of subsections is practised. All work is double spaced and in the third person passive tense. In later assignments various other styles of reporting must be covered. When work has been done, the past tense is used.

The most effective tool to fast track this process is a red pen. A line through this chapter for just one student, with the word “Re-do” suddenly changes the attitude of the entire class to the seriousness of the topic. They read what they should be doing and start to measure their work against the rubric to ensure that the instructions are being followed. A pass of at least 80% should be the standard. Work that does not meet the standard results in problems in the future chapters and research.



**Figure 2:** Questions and steps required for construction of chapter 1

Much of the work in Figure 2 is self explanatory, to those who are engaged in this pursuit of teaching Research Methodology. The limit for this paper does not permit the inclusion of the course notes but every department in a university should be able to construct these from the available texts. It would

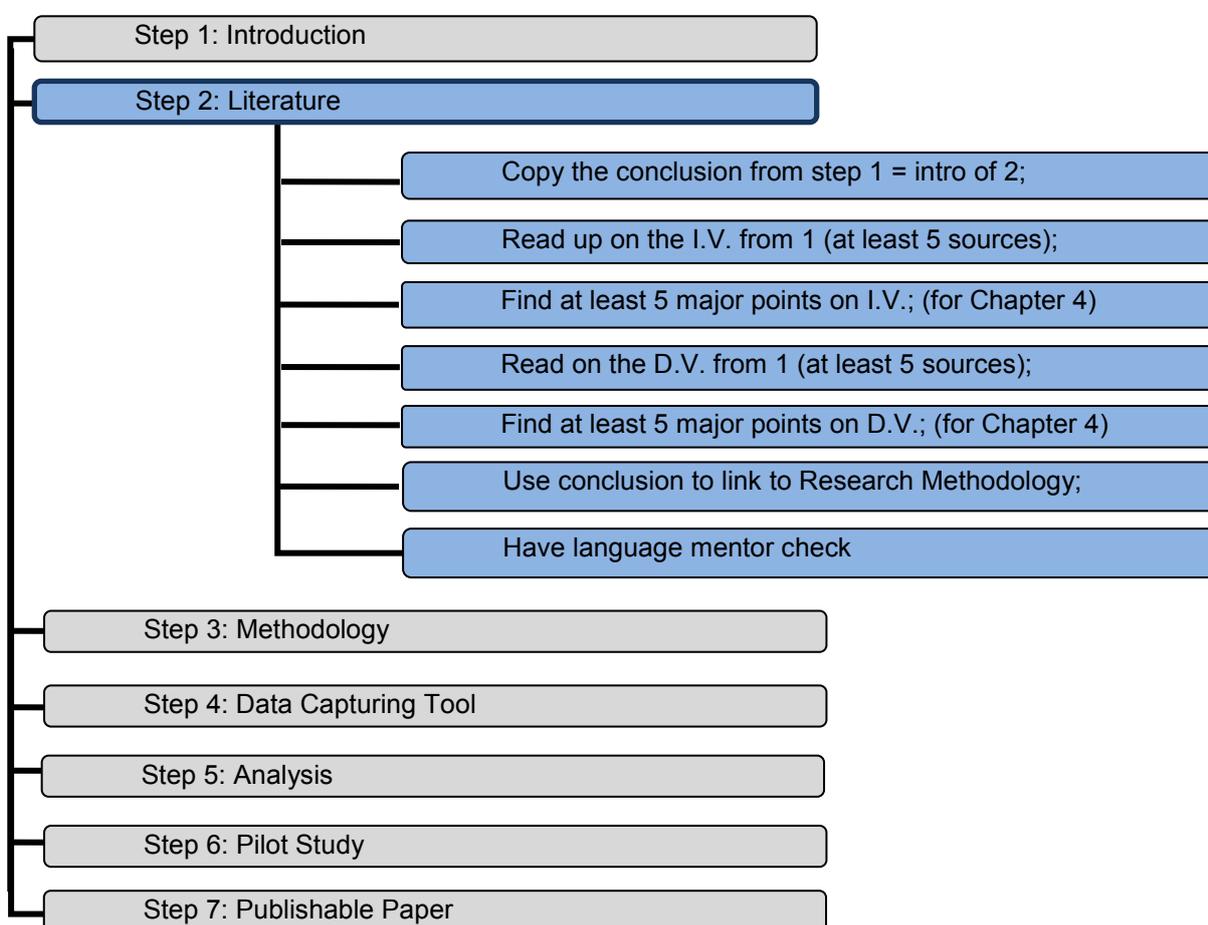
also be wise for staff engaged in this pursuit to devise their own generic course to incorporate what their university would require.

The Durban University of Technology, originally the Durban Institute of Technology at its inception when Technikon Natal was merged with M.L. Sultan Technikon, constructed such a syllabus over a period of 3 months with the consultative input of every interested person in the relevant faculties. This core syllabus still stands as part of the study guide. It included all the sections that are presented in this paper.

### Step 2: Literature review

The second chapter to be written takes the student into the literature of the constructs he or she has designed or identified in the first step. The chapter is linked to the previous chapter through a brief introduction summarising the previous chapter and then the student searches the variables that they have identified. It is impressed upon students that each chapter should be able to stand alone, linking it to the previous and following chapter. This is emphasized in Figure 3.

Some of these steps in the model depict the decisions which will impact on future chapters. The decisions made in step 1 will influence step 2 and so on.



**Figure 3:** Questions and steps required for construction of the literature review in chapter 2

The number of sources is kept to a minimum of 5 per variable so that the student is not delayed or swamped by vast numbers of references as the course is completed in a 15 week semester. They are also marked on having at least one source from a text, one from the internet and one from a journal. The use of knowledge bases is often problematic for some students as they either use only the internet, or the library, but very seldom both. Journals are often disregarded completely.

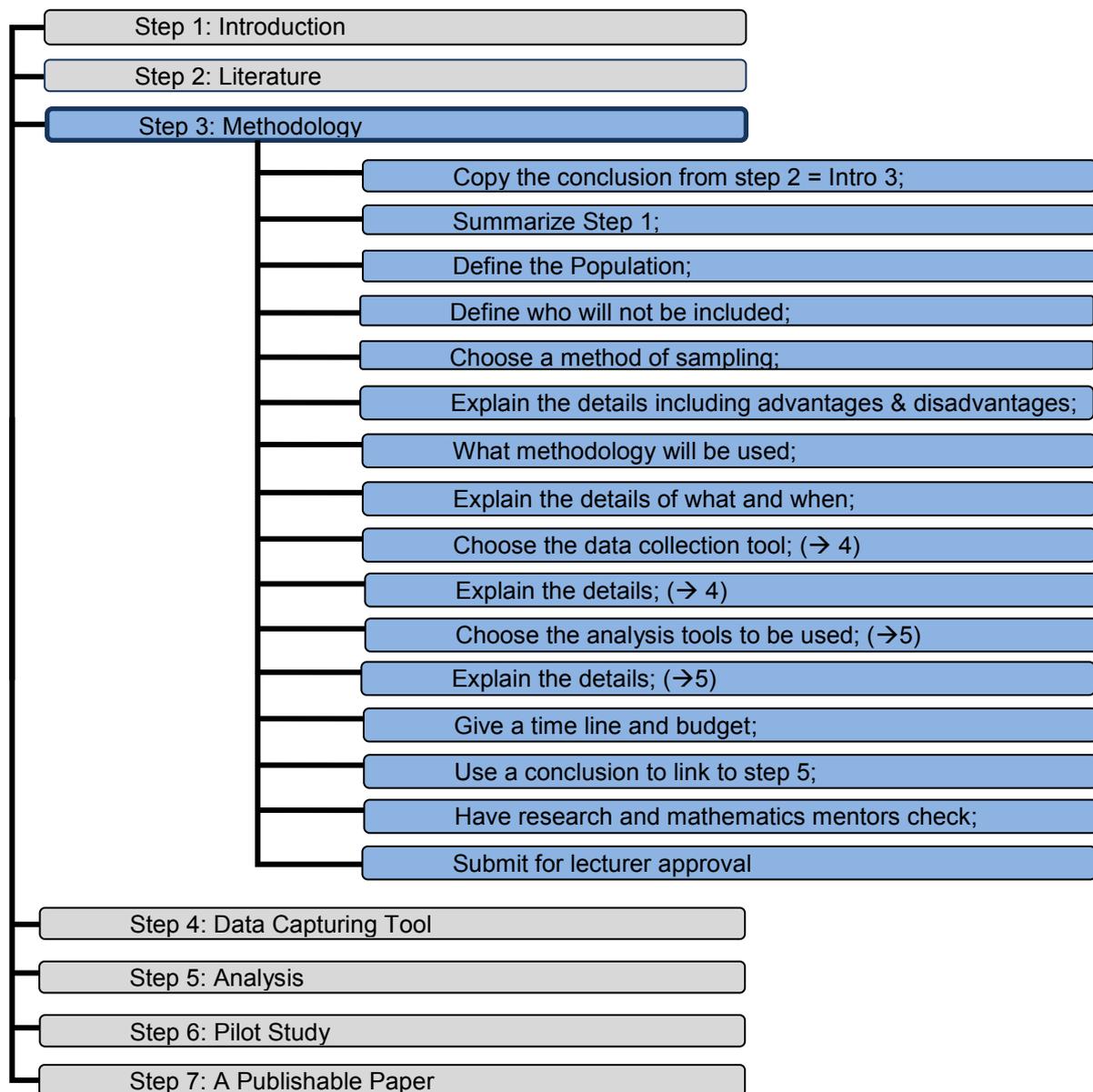
This encourages them to search widely and pick only those sources which cover the concept broadly without getting bogged down in too many references.

From these references they are encouraged to determine the five major characteristics of this construct as these will be used to devise the questions in the data capturing tool in step 4.

It is at this point that library staff is brought into the process to assist students and the writing styles which they have been taught in their first year courses are used. Computer skills which they were also taught in their first year have to be revised because the programs used are now obsolete and the students at the time did not consider what they learnt to be of long term importance.

### 5. Step 3: Methodology

Once the student has examined the literature which underpins his work he has to revisit the questions he asked in the first step and in chapter 1. These must be summarized at the outset in chapter 3 and refined if necessary.



**Figure 4:** Questions and steps required for construction of the research methodology in chapter 3

There is quite a comprehensive set of methodologies that can be chosen, but more emphasis is placed on a survey method for on-campus students. This tends to develop observational skills as well. Each discipline will find their students emphasize certain methods. Students of horticulture tend to choose some form of experimentation while other commerce students may choose a survey method.

Education students are inclined to choose observation and in-depth interviews. Engineering students I have found tend to do some form of data analysis.

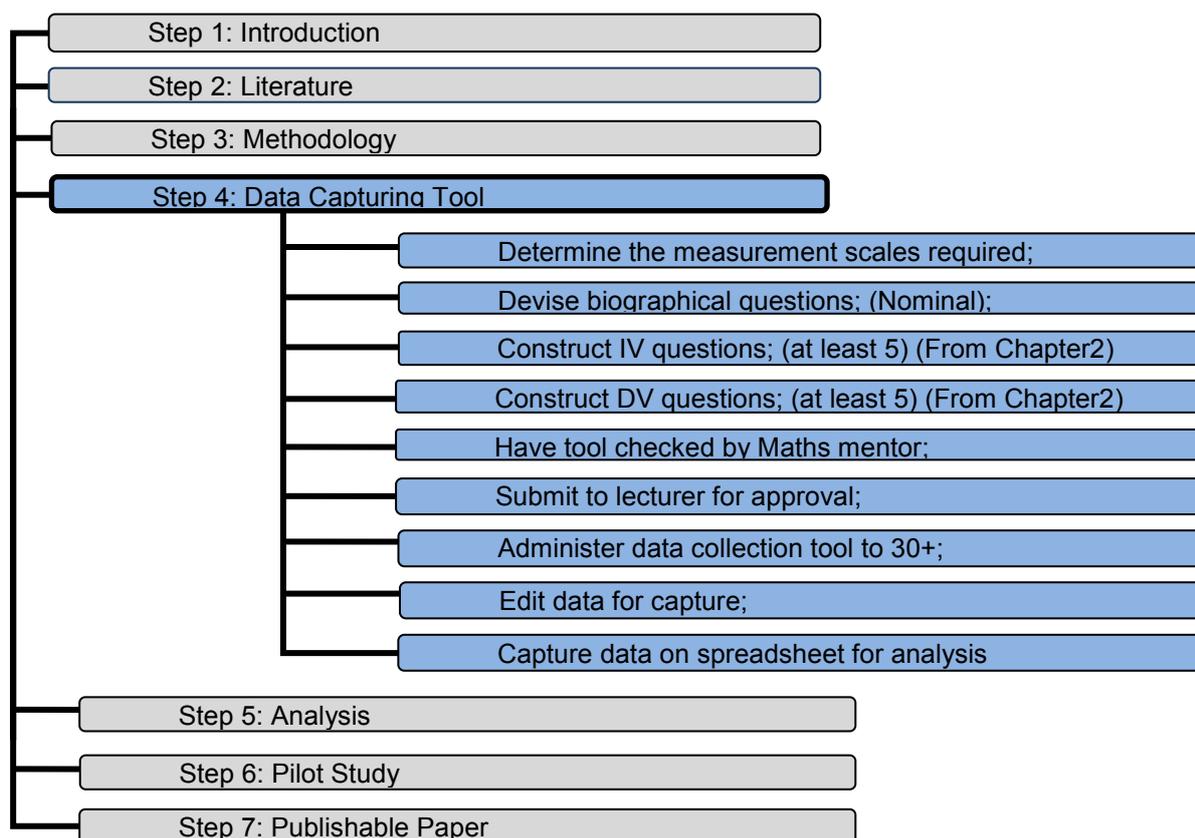
Sampling techniques and data analysis are covered in the lectures at this stage because students have to select how they will gather their data and then analyze it. Validity and reliability are discussed and if time and facilities permit then a course in SPSS (a statistical analysis package) is provided. In the back of the text book that is prescribed is a disk with a free statistical package which a number of students use because the text explains it in some 10 pages. Those who work for large conglomerates have access to very powerful tools in such programs as SAP, as well as operators to analyse and draw their data for them.

Figure 4 sets out the points that should be covered. The rubric should have the same points in it as the model and usually totals 20 marks.

Some of the points in this rubric are not in the “step 3” instruction as they appear in a different place in the notes prepared for 2009. This rubric is presented in Figure 6.

## 6. Step 4: Data capturing instrument

From step 2 the questions that need to be asked materialize. The variables that have been written about had to emphasize the five major points, and it is these that comprise the questions. The Symbol 2 and arrow in figure 5 indicates this.



**Figure 5:** Questions and steps required for construction of the data collection tool

The data capturing tool has to integrate with the methodology and the type of question has to comply with the measurement scale which is dependent on the statistics that are to be used in the analysis. Upon completion it has to be submitted for marking and sanction by the lecturer. The ethical considerations that each university has in place should be carefully considered here as well as the culture within which the research is being done. No data is to be collected without sanction.

## 7. Step 5: Analysis

The analysis section has caused the greatest amount of soul searching in the development of this course and requires a separate paper. Statisticians are inclined to teach many unrelated methods to students without even telling them what they are trying to find. It became necessary to find something that allowed the non-mathematical student to interpret the data and have some idea of what is going on in their research. The solution was found in some wisdom whose origin is no longer in memory, but it came in the form of "Presenting the data". Saunders, Lewis and Thornhill (2000:337) mention Turkey's (1977) exploratory data analysis approach and using this and ideas from many years of teaching mathematics, a system was devised which was called Primary analysis and the Secondary analysis.

Assignment 3					
Name :				Final Mark:	0%
Student No:					
			Mark	Max	Actual
Assignment 3 / Chapter 3		<b>Research Method</b>		20	0
3.1		<b>INTRODUCTION</b>		3	
	3.1.1	Have the salient points of the study been given?		0.5	
	3.1.2	Topic		0.5	
	3.1.3	Problem Statement		0.5	
	3.1.4	Hypothesis		0.5	
	3.1.5	Independent Variable		0.5	
	3.1.6	Dependent Variable		0.5	
3.2		<b>POPULATION</b>		4	
	3.2.1	Has the population been defined?		1	
	3.2.2	Is it clear to you who forms the population and who does not?		1	
	3.2.3	Are the people/items excluded being identified?		1	
	3.2.4	Will the student be able to get access to this population?		1	
3.3		<b>SAMPLING METHOD</b>		6	
	3.3.1	Is it clear how the sample will be chosen?		1	
	3.3.2	Has the student tried to overcome bias in sampling?		1	
	3.3.3	Are the actual details of the procedure given?		1	
	3.3.4	Are the instructions clear enough for another person to repeat?		1	
	3.3.5	Are adv. and disadvantages of this sampling method given?		2	
3.4		<b>TYPE OF RESEARCH STUDY</b>		3	
	3.4.1	Is the methodology appropriate to the study?		2	
	3.4.2	Has it been explained in enough detail for another to execute?		1	
3.5		<b>DATA GATHERING AND ANALYSIS</b>		4	
	3.5.1	Has the method of gathering data been discussed?		2	
	3.5.2	Has the method of analyzing the data been discussed?		2	
<b>Comments</b>					

**Figure 6:** Rubric for assignment 3

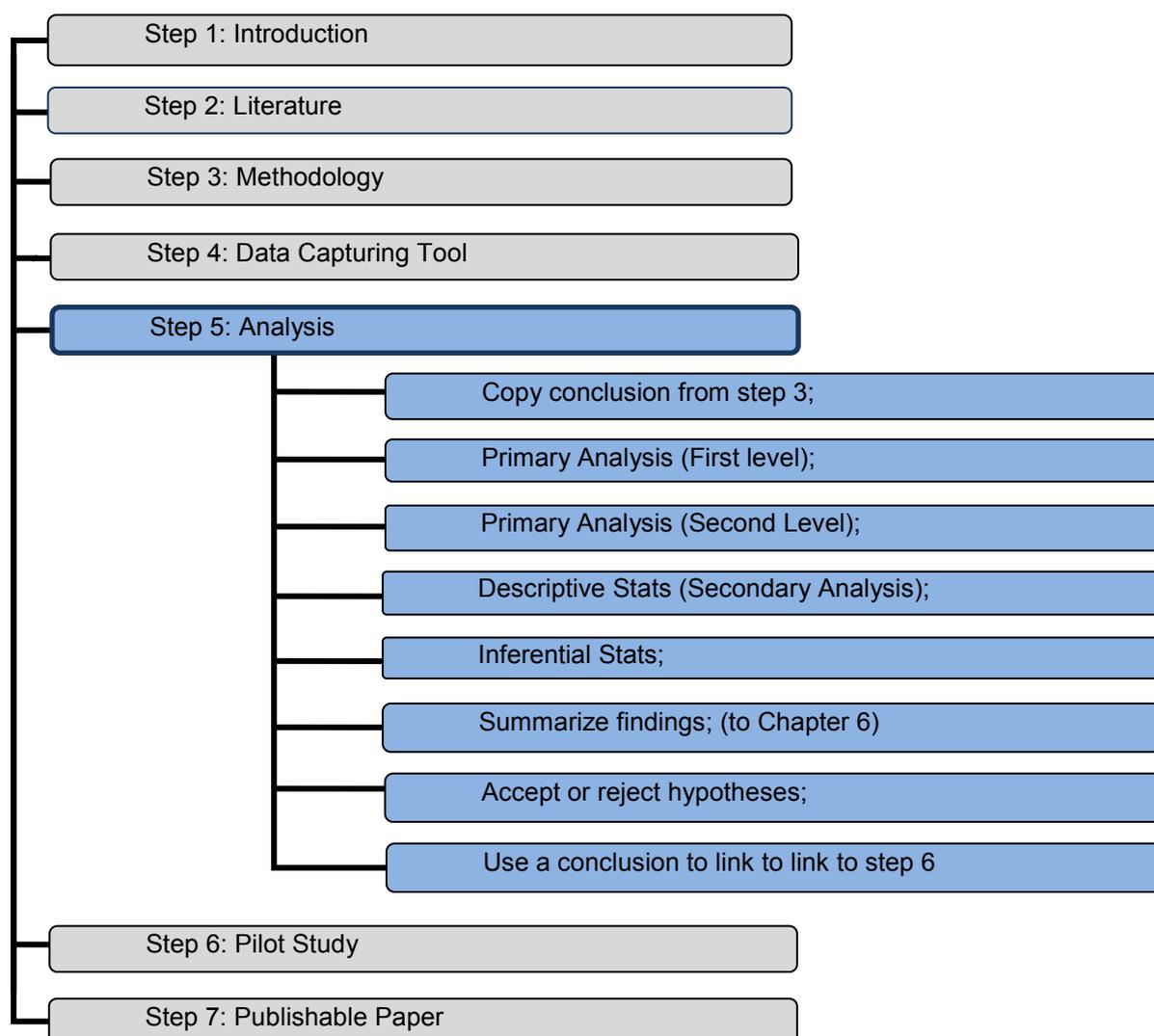
In Primary analysis the student is required to present every question/measure in the form of a table and then a graph and then in language to express what is determined or discovered. This allows an overall perception of what happened and can be compared to what is expected to happen. After this the student does the same thing but compares variables. The table now becomes a cross tabulation and the graph has comparative columns or lines. The program used by the student in presenting his

work has a package which produces graphs and he/she is required to experiment with all of these and to use as many types of graphs and tables as possible to represent the data. Of course the rubric will examine the effectiveness of the choice. All rubrics are on a spreadsheet and automatically total and score the assignment.

Once this “presentation of the data” has been done then descriptive statistics are given and examined by the student, using the package he/she is willing to work with or that is available in the organization or text book. The results are examined within the findings of the previous section and this is a paper in its own right. Box plots and stem and leaf diagrams are encouraged, which many text books do not explain but in every discipline there are diagrams which assist central tendency and dispersion calculations.

Inferential statistics are limited in this course to chi square, correlations and perhaps the student –t test. As some of them will be going into fields of study that need other interpretation these should be covered in that specific Research Methodology Course in the Masters programme.

Deductive and inductive reasoning is also emphasized in this section, as is triangulation, hoping that the same results will be reflected in all three methods of data analysis.



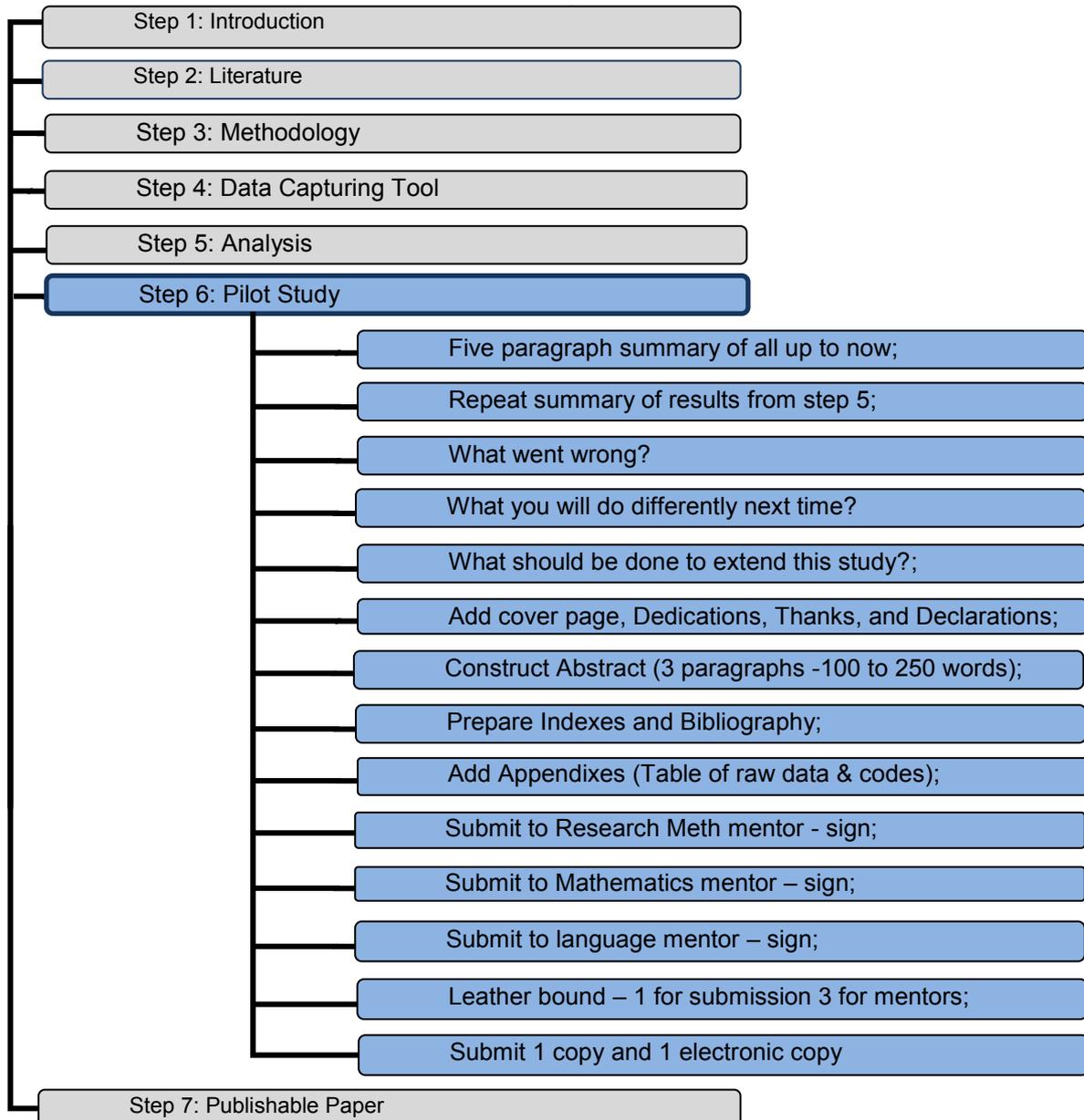
**Figure 7:** Questions and steps required for data analysis in chapter 4

Each one of these assignments leads to the production of another chapter in the proposal and pilot study. The student at this level should now have the idea of research being a process of solving a problem in a scientific manner.

## 8. Step 6: Pilot study

The final proposal and pilot study now comes together. A final chapter is put in place which emphasizes the circular flow of research. The student needs to show some form of self-criticism and growth towards maturity where they can not only take advice from others but also become self-critical. This is probably one of the most important points to inform your acceptance of the student for further study.

The notes on this section are rather detailed and examples of what the university requires such as declarations, indexes, cover pages must be emphasised. Once this has been checked then it is finalized in a leather bound cover. If the mentors charged for their services they do not receive a copy. If they did not charge, in the spirit of true academic development of knowledge, they are given a copy in which their contribution is acknowledged.



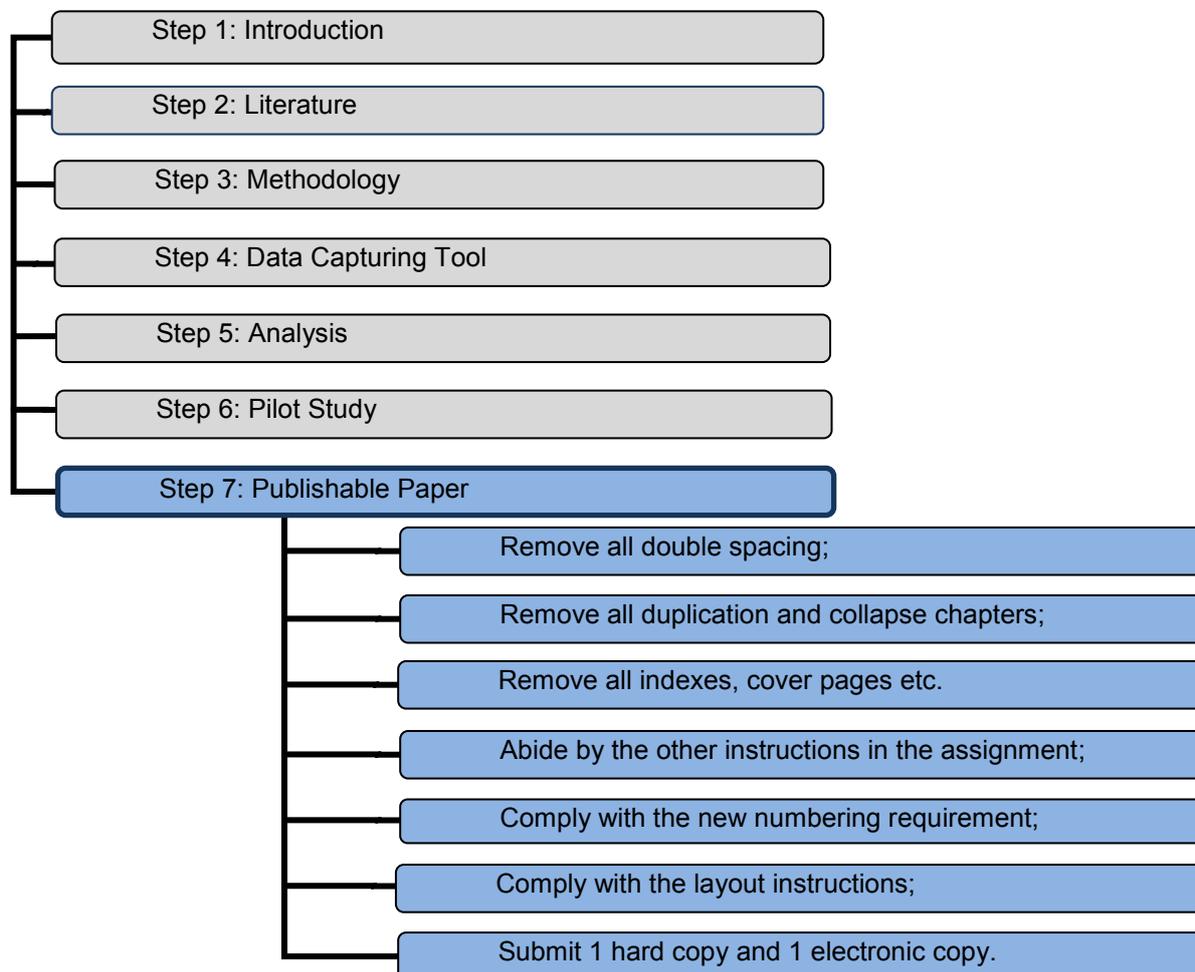
**Figure 8:** Questions and steps required for final submission and chapter 5

## 9. Step 7: Publishable paper

The mark of a good research student is to be able to use different research methodologies and express themselves in different formats to comply with the requirements of different journals. For this reason, and also to complete the research cycle where knowledge gained is fed back into the

academic arena, the students are asked to take the information presented in their proposal and pilot study and turn it into a publishable paper. The terms of reference for this assignment are presented in the notes and are taken from the requirements of a journal submission. The students can be asked to change the voice from third person passive, or completely change the format and layout.

The major parts of this assignment are emphasized in figure 9 below.



**Figure 9:** Questions and steps required for construction of the publishable paper

## 10. Conclusion

This model will never cease to change. Every year there is something students do not master and so the following year more emphasis or a different emphasis is placed on this problematic aspect. The development of the discipline called “Research Methodology” also expands. The past 13 years have seen a tremendous increase in the number of texts and articles available and new methodologies in South Africa.

The emphasis is also shifting in some disciplines towards a far more qualitative group of studies yet returning regularly to the concepts underlying Research.

Marks have improved radically since the adoption of this model but follow through into Masters levels has not yet occurred.

From now on, there needs to be a concerted effort to integrate more of this vastly expanding subject into the mainframe of this work so that those universal truths that underlie the discipline will expand its validity as a science and a meta-science (Barbie and Mouton 2001).

## **References**

- Ball, C.T and Pelco, L.E. (2006) Teaching Research Methods to Undergraduate Psychology Students Using an Active cooperative Learning Approach *International Journal of Teaching and Learning in Higher Education* Vol 17, No. 2 pp147-154.
- Barbie, E. and Mouton, J. (2001) *The Practice of Social Research* Oxford University Press Cape Town.
- Cooper, D.R. and Schindler, P.S. (2006) *Business Research Methods 9<sup>th</sup> Ed.*, McGraw-Hill, Boston.
- Saunders, M., Lewis, P. and Thornhill, A.(2000) *Research Methods for Business Students 2<sup>nd</sup> Ed.*, Prentice Hall, Harlow.
- Welman, Kruger and Mitchell (2007) *Research Methodology 3<sup>rd</sup> Ed.*, Oxford University Press, Cape Town.