Doing Research

Revised Edition

Laetus O.K. Lategan
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THEME 1

DOING RESEARCH: NAVIGATING THE PROCESS

Laetus O. K. Lategan, Zelda Uwah and Hanita Swanepoel

The focus of this section is to:

- take a new look at the research process;
- define research;
- identify the challenges in research; and
- outline best practices in doing research.

1. BACKGROUND

Research has become a challenging and complex activity due to the changing research environment. The changes in this environment can be grouped into scientific (academic) requirements and value-adding activities. The scientific requirements involve moving from a purely subject-specific understanding of a research problem to a culture of developing knowledge through application and being engaged with business and industry in knowledge development. The value-adding activities focus on the training and development of supervisors and students to be abreast of the latest developments in the research environment.

In the South African research context at least seven developments justify a new look at the research process. These developments are:

- Postgraduate qualifications are treated as research outputs that are translated into subsidy. This simply means that income can be generated through completed postgraduate qualifications.
- Contrary to popular belief postgraduate qualifications represent much more than the writing-up of the research dissertation only. The Higher Education Qualification Framework (HEQF) requires specific skills to be demonstrated through the completed research project. These skills include among others a comprehensive grasp on a discipline, a critical understanding of advanced research methodologies, independent research, ability to conceptualise, advanced information retrieval, communication of research results, intellectual independence and the capacity to critically evaluate own and others' work.
- The quality of postgraduate qualifications is directed by the guidelines laid down by the Higher Education Quality Committee (HEQC). These guidelines include issues beyond the scope of subject specific knowledge only.
- The low completion rate and high dropout rate of postgraduate students are both areas of concern. Students simply take too long to complete their studies and too many students leave the system without completing their postgraduate qualifications. This situation creates the impression of a non-competitive intellectual environment.
- New demands are placed on the research environment. Notable is the urge to strengthen the research links with business and industry, to enhance a culture of intellectual property (IP) protection and to commercialise more research ideas.

- Training and development are required for both supervisors and students to be abreast of the latest developments in the research environment. These events follow on the general belief that a PhD alone does not qualify a supervisor to supervise a student. In the same way the gap between undergraduate and postgraduate education needs to be addressed so as to prepare and equip students better for the transfer to a next level of intellectual scholarship.
- The government, students and end-users (business and industry) ask questions regarding the quality, relevance and impact of postgraduate qualifications.

The above considerations bring one to the fundamental question: "*What is research?*" This question is explored in the next section.

2. WHAT IS RESEARCH?

In general, research has to do with the *creation of new knowledge*. The creation of new knowledge is the result of a systematic analysis of a problem, and following from the analysis, the solving of the problem. Research may therefore be defined as *a process of critical analysis to solve a problem.*

RESEARCH IS A PROCESS OF CRITICAL ANALYSIS TO SOLVE A PROBLEM

Research has three important components:

- Critical knowledge enquiry
- Discovery of new knowledge
- Implementation and application of new knowledge

Basic research investigates a problem against the background of a specific subject. The knowledge gained from this analysis is used to solve the problem. This is known as applied research.

The researcher looks into the ways in which concepts, theories and trends are related. This is done through scientific investigation based on critical enquiry, discovery, systematisation of facts and evidence, and the formulation of new theories. The research is done according to a stated paradigm and method and has as objective the solving of an existing problem and/or the identification of a new problem.

In research, the question "*why?*" is frequently asked. The "*why*"*-question* normally looks into the reasons for a particular activity. The "*why*"*-question* implies that an investigation is being made into the fundamentals ("mechanics") of an issue and not into the process and/or outcome of the issue.

Research works on the basis of identification (similarities) and distinction (differences). To identify and to distinguish are to analyse; and analysis is the exact function of science. If one relates analysis to research, then it is clear that in the research process one analyses or focuses in order to identify a particular issue. This is only possible if distinction (differences) is drawn into the equation. Analysis helps to find the answer to "*why*" things are as they are and thus contributes to the creation of new knowledge.

Consider this: *Why is it necessary to integrate academic learning with authentic community engagement?* A research approach will unpack the question by

investigating the reasons "*why*" there are links between academic learning and community engagement. Not all research questions are formulated as "*why*"-questions, however. Other questions may be: *"How does the programme in sustainable agriculture address local social problems?" or: "How do the programmes benefit the students' knowledge of the field in which they are studying?"* for example. The answers to all three research questions will contribute towards an in-depth understanding of the problem. These answers will also contribute to the creation of new knowledge – which is a typical research activity.

Research is all about the unpacking and solving of a problem, and is the systematic analysis of a given problem to identify ways to solve that particular problem.

Research involves four activities, namely:

- engaging in a process of critical enquiry;
- addressing of a stated problem;
- solving of the problem;
- basing the research on a scientific method.

It is obvious that routine work cannot be regarded as research. In research one should avoid simply confirming what is already known.

3. WHAT ARE THE RESEARCH CHALLENGES?

In doing the research project, there are a number of challenges that should be considered. Some of these challenges are:

- Regardless of the discipline, certain generic skills will be needed to complete the research project. Examples of these skills are unpacked in the section below.
- Students are not always clear on what the literature review is all about (namely what is said and not said). Critical reading skills and engagement with literature may be lacking.
- There may be a lack of methodology, understanding and insight into the structure of the thesis. Very often scientific writing skills and know-how in relation to referencing techniques are under-developed.
- The methodology doesn't always match the objectives and problem statement of the study; the study is very often too broad and not focused enough.
- The role definition is not always ironed out. Who is responsible for what in executing the research and preparing the thesis/dissertation?

A range of skills for the researcher and postgraduate student is therefore required to carry out the research project. These skills are of a *personal*, *scientific* and *partnership* nature. Each of these classifications has a specific direction. The personal skills mean what the supervisor has to do to act as a supervisor (one can refer to this as licensing); the scientific skills refer to what the supervisor should know about the science of supervision (which is not the same as the science of one's professional field of study); and the partnership skills direct the relation and relationship between the supervisor and the postgraduate student. This relationship entails professional behaviour, leadership and mentorship.

The identification of partnership skills already indicates that research cannot happen by accident, yet postgraduate research supervision is one of the academic skills to which very little attention is paid. The fact that the supervisor holds a PhD doesn't mean that s/he qualifies automatically to be a supervisor. Supervisors need to be trained. Although a number of reasons can be listed, only two are mentioned here. Firstly, because supervision is a specialised way of knowledge transmission (teaching), if you are new to supervision then you need to be trained. Secondly, even if a supervisor has assisted many students to complete their postgraduate studies successfully, s/he still needs continuous training to be well informed about the changing research environment and new practices associated with supervision.

4. BUILDING A RESEARCH CULTURE

An important dynamic in the supervisory process is the fostering of a culture of scientific values. Some of these values are:

- free scientific enquiry;
- respect for life and the environment;
- research paradigm of own choice;
- the integrity of researcher;
- integration of ethical principles into the project;
- promotion of accountability.

The researcher should avoid

- routine work;
- repetition of what is already stated;
- not having an own opinion.

In fostering a research culture, the following should be subscribed to:

- be critical
- add a new meaning
- stick to the point
- lead the discussion

Based on these requirements, valuable tips for researchers are:

- keep in touch with the latest developments in your field of study;
- liberate yourself from the narrow focus of your discipline and embark on multidisciplinary research;
- engage in team research;
- value partnerships;
- involve students in your projects;
- publish your research;
- present papers at conferences;
- be a mentor for fellow researchers and students;
- focus on sustainable projects;
- secure funding.

5. BEST PRACTICES IN DOING RESEARCH

There are a number of best practices for a researcher. These best practices should inform the commitment towards research and the research project:

- The researcher is a subject specialist.
- The researcher takes part in the research debate on his/her subject.
- The researcher is informed about the broader research debate.
- The researcher has a pronounced opinion on research issues.
- The researcher fosters scientific values.
- The researcher promotes the social value of research.
- The researcher manages research.

6. CONCLUSION

In building a research culture, two issues cannot be compromised, namely intellectual skills and scholarship, and quality:

- Intellectual skills and scholarship cannot be compromised in favour of professional skills only. The responsibility of higher education is to **educate** people and not to **train** students for a particular profession.
- Quality is important in all aspects of postgraduate education. Quality is defined in this context as fitness for purpose. The question that needs to be asked repeatedly is whether postgraduate education can deliver to the world of work a student who is able to identify a problem, solve the problem and then manage the solution.

THEME 2

WHAT IS POSTGRADUATE SUPERVISION ABOUT?

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The focus of this section is to:

- understand what postgraduate supervision is all about;
- outline the roles of the supervisor and the postgraduate student; and
- confirm the importance of securing quality in the process.

1. INTRODUCTION

Both expert and first-time postgraduate supervisors are continuously faced with increasing challenges and diverse complexities within the postgraduate supervision context (Mapesela and Wilkinson, 2005; Hodza, 2007). This can easily result in academics feeling unsure about what is expected of a postgraduate supervisor. Supervisors might even feel like ships on a stormy sea; but they need to navigate their way through this process. In so doing, supervisors will need to ask themselves constantly how to be proactive, effective and efficient in carrying out this multi-faceted task.

This theme will explore proactive, effective and efficient ways to improve postgraduate supervision practices. The most important advice is firstly to step into the postgraduate student's shoes and try and see things from his/her point of view. Then shift towards quality assurance management of the studies. Record keeping is also crucial for keeping the postgraduate supervision boat sailing.

2. FIRSTLY, STEP INTO YOUR POSTGRADUATE STUDENT'S SHOES

The research process for many postgraduates is a complex and daunting endeavour. The reasons for this entail the involvement of a number of aspects such as academic writing, statistics, research design and methodology, referencing etc. In addition, Manathunga (2005:223) highlights key warning signs in the timely completion of postgraduate studies. These centre around four behaviour types (which supervisors have to detect and deal with), namely constantly changing the topic or planned work; avoiding all forms of communication with the supervisor; isolating themselves from the institution and other students and avoiding submitting work for review. Supervision is not an easy road to follow (for either the student or the supervisor), but for those of us who are lifelong learners, it is the most rewarding and fulfilling experience (especially when the final product has been approved).

There are numerous competencies that should be accomplished along the way, and it is evident that the final academic writing product is the end result of good systematic and integrated thinking and knowledge production (Henning, Gravett and Van Rensburg, 2001).

The following are important aspects of the research process:

- **Preparation:** Idea and formulation of a research problem, and the selection of your supervisor.

- **Planning:** Literature study and research proposal.
- **Process:** The two main areas in the research process are the literature study and the empirical study.
- **Product:** The writing of the dissertation/thesis.

2.1 Dynamics influencing the research process

The following are some of the aspects that play a role during the research process:

2.1.1 Motivation

Motivation and determination are two of the major requirements for a postgraduate student to make a success of his/her studies (Franek, 1982; Rademeyer, 1994). NEVER, NEVER GIVE UP, but rather continue with determination and utilise your own creative problem-solving skills for those research process barriers!

2.1.2 Isolation

The postgraduate student often follows a lonely road (those lonely, late nights/ weekends) when conducting the research.

2.1.3 Planning and management

One of the challenges for postgraduate students is to become the manager of the research study. This is possible by starting with a well-thought-out time schedule (Franek, 1982; Mouton, 2001) – not only to plan, but also to keep track of own progress and deadlines.

2.1.4 Research design and methodology

One of the most difficult parts of the research process is to decide on the most appropriate research design and methodology. Look objectively at the context, consider all the pros and cons, and then align these with the most appropriate research design and methodology(ies) by motivating your choice. Ask experts to assist you.

2.1.5 Empirical study

This part of the research process has many hurdles – allow enough time for this part, especially to obtain permission to conduct your research. Another hurdle could be with the computerisation of your data – book a statistician in advance to avoid frustration in your research process and with your progress.

3. QUALITY ASSURANCE MANAGEMENT OF POSTGRADUATE STUDIES

Research includes a diversity of activities and services, which follow a series of accepted scientific rules. Due to the complexity of the research process, students/ clients are not fully in the position to assess the quality of service(s) they receive. They depend mainly on the expertise and competence of the supervisor(s).

The responsibility of quality in postgraduate studies is on different levels and with different role players. In general the following aspects are crucial:

- **Institutional quality management:** The first step is to have an effective institutional quality management system in place. This implies that certain clear processes and strategies are present to oversee the implementation of quality assurance. With

regard to postgraduate studies, the above-mentioned system should determine and monitor quality-related steps and precautions within the research practice. Therefore a quality management plan should be drawn up which will assist the postgraduate student with the individual steps of the research process, and also with exactly how postgraduate studies are to be conducted and assessed.

- **Responsibility for quality assurance:** The responsibility for quality management and safeguarding the quality of research activities should be joint institutional ventures [i.e. between postgraduate student (quality end product), supervisor (ensure quality in collaboration with heads of departments and deans) and industry (as partners)]. In contract research, however, the responsibility lies with the research officer, who has the necessary formal competence and authority to align organisational structures within the office with the quality-related aspects of the research process.
- **Management of quality research:** In order to manage research effectively and to enhance quality the following elements form an intrinsic part of quality research:
  - *Policy framework*: Firstly, an institution should adopt a research policy which specifies the following: the research approach, procedures to conduct research and execution of research-related activities, postgraduate code of conduct (directive way of setting standards for both student and supervisor), institutional admission criteria according to which the institution is expected to formulate the students' qualifications and experiences required to enrol for postgraduate studies. In addition, other aspects that should be in place are policies regarding supervisor qualifications/accreditation, supervision guidelines, the use of half-yearly reports and other forms of interim assessments, amongst other things.
  - *Organisational support:* Embedded in the management structure of the institution should be strategies for supporting academic staff and maintaining excellence in research (e.g. adequate sources for workload adjustments where necessary, additional support for postgraduate students related to research design, conducting of research, academic writing, critical thinking, etc.)
  - *Staff development:* The need for training and support within the higher education context has been confirmed by literature (Whittle, 1994:45; Erasmus and Kapp, 1998). For example, staff development programmes such as workshops, ongoing support programmes, induction programmes for novice supervisors, etc. are crucial to keep up-dated with the various challenges and complexities within postgraduate studies.

3.1 Requirements from the Higher Education Quality Assurance Committee (see Theme 16)

Nationally there are various policy documents that stress the importance of and ways to ensure quality postgraduate outputs by developing research capacity and increasing research productivity. However, the throughput rate of postgraduates remains an area of concern. Within the South African higher education system the strategic goal is to increase postgraduate enrolments and research outputs. In addition, the Higher Education Quality Committee (HEQC) includes research quality management in its audit system to ensure that research is conducted within an integrated quality framework – where this is included in the institutional planning and resource allocation of the institution's key mission areas. The HEQC's criteria

for institutional research stipulate a research management system that allows for planning, implementation, and monitoring of research participation, research output and the increasing of the pool for the funding of research.

Research is one of the three core activities of higher education institutions. It is therefore imperative that the quality of research be of such a standard that it is nationally and internationally recognised. Institutions therefore need a quality research plan, which will lead to continuous improvement in the quality of research. In ensuring the quality of research and postgraduate outputs all stakeholders involved should take ownership to enhance continuously the research practices of the institution.

4. KEEPING RECORD IS CRUCIAL

Specific practices for improving postgraduate supervision are as follows:

- *Keeping a logbook*

Keeping record of a postgraduate students' progress is imperative. Therefore you as supervisor have to have good administrative skills (e.g. keep record of personal detail, title registration, appointment of external supervisors, etc.) to address any queries from the administration side. It is also important to keep a record of progress and contact sessions of individual postgraduate students. This is especially important to avoid conflict situations with regard to failure of returning feedback in time or not sticking to deadlines. One of the suggestions is to keep a logbook for each postgraduate student – by using this logbook both supervisor and postgraduate student keep track of contact sessions and decisions.

- *A postgraduate students' progress should be reviewed regularly*

The first step is to encourage postgraduate students to work independently and diligently. In order to support this, a schedule for submission and feedback of written work as well as discussion of certain sections of the research should be drawn up – according to both parties' workload and responsibilities. Regularity within postgraduate studies will assist in identifying problem areas beforehand and allowing them to be addressed on time.

- *Avoid misunderstandings*

Supervisors must keep records of written work as well as feedback given/provided. This will support an open relationship within the postgraduate studies. In addition, transparency and independency can be improved by informing postgraduate students of examination procedures as well as assessment criteria for dissertations/ theses.

- *Co-supervisors*

Co-supervisors are valuable not only to novice supervisors, but also to add expertise where required. It is paramount that the supervisor remains responsible for supervision and coordinating the communication between the three parties.

- *Grievances/appeals*

It is the right of a postgraduate student to complain or even obtain legal advice if necessary. Supervisors should be open to solving problems; alternatively the head of department should be contactable to solve problems internally.

- *Study/learning contract*

A crucial activity is to draw up a contract between the supervisor and the postgraduate student. Such a contract will not only structure learning activities, but will also stipulate the responsibilities of both parties and indicate ways in which the postgraduate student will acquire knowledge. In addition, the following should be specified in a learning contract:

- *Learning goals:* The knowledge, skills and attitudes that should be achieved by the postgraduate student.
- *Sources of learning and strategies:* How the postgraduate student will achieve these goals.
- *The target date of achieving these goals/objectives (time scale)*.
- *Criteria/standard/grade:* What evidence should be presented to demonstrate that the specific objectives have been achieved in a satisfactory manner?
- *Evaluation procedure:* How will this evidence be evaluated?

This section has hopefully convinced readers about the importance of record keeping. Although it may sound like a lot of paperwork it is worthwhile investing in a structured method of supervising.

5. THE ROLE OF THE RESEARCH SUPERVISOR

The research supervisor should steer the academic research in such a way that the postgraduate student grows intellectually and develops new insights and skills in his/her field of study. The student should also be transformed into a quality researcher. This is not an easy task, and it could trigger frustrations within both parties. The challenge is how to accomplish a quality end product, in terms of which the following should assist:

- Provision of guidance and assistance in the formulation of the research proposal.
- Guidance towards the availability and applicability of relevant literature review study.
- Monitoring of the execution of the research (i.e. research processes and procedures).
- Interpretation of results and conclusions should be based on scientific grounds.
- Ensure the accuracy of the research dissertation/thesis.

Although the above-mentioned process is not easy, the support of the supervisor is considered the most valuable contribution that any external person can make towards postgraduate studies!

Research creates situations where both the postgraduate student and his/her supervisor can benefit substantially from the experience. Therefore:

- Students, appreciate your supervisors, they are trying their best with their assignment.
- Supervisors, appreciate and respect your students, they are the cream of the crop and are doing their best.

6. CONCLUSION

Postgraduate supervision is a complex, but diverse core higher education function. Based on this notion we discussed proactive, effective and efficient practices for supervisors to survive the challenging and stressful postgraduate environment. This was followed by the implementation of quality assurance management to the benefit of all stakeholders involved. Finally, the importance of teamwork was emphasised for the successful conclusion of the partnership!

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THEME 3

THE RESEARCH PROCESS

Werner Vermeulen, Laetus O.K. Lategan and Reginald Litheko

The focus of this section is to:

- revisit questions that the potential researcher should pay attention to before writing a proposal;
- turn a topic/idea/question into a researchable problem; and
- indicate steps to follow in doing your research project.

1. INTRODUCTION

The word research was derived from the French word *"rechercher"* meaning to search again or to investigate thoroughly. Research can therefore be described as a process of looking again or more intensively at the object of research. Research is based on the following assumptions:

- the research process may differ from discipline to discipline;
- the application of the research process may even differ from supervisor to supervisor; but
- all research is based on scientific fundamentals.

2. THE NATURE OF RESEARCH

As workers and citizens we are continually in contact with and exposed to research. Changes in our working practices are justified by the reports of in-house research teams, or those of an external consultant and/or outside work. You may also have taken part in research through a consumer survey held in a shopping centre.

Yet for many students and non-students alike, there is no doubt that the very word "research" can be daunting. This may be particularly so for new researchers, who may feel that to conduct and complete even a small-scale research study is well beyond their capabilities. The next section gives an outline of the many faces of research.

The 14 facts and myths about research:

- research is very time-consuming;
- research is subjective;
- research can be undertaken by anyone;
- research can be fun;
- research can take over your life;
- research is about being nosy;
- research can be done in many ways;
- you can research anything;
- research uses everyday skills;
- spies do research, so do newspaper reporters;

- research can turn theory into action;
- research can lead you in unexpected directions;
- there are no definite answers (or are there?);
- you CAN DO research.

Yes, you can do research! The main lesson to learn is that you need to practise your research skills; read; think about research; build up your confidence and then start doing it.

3. THE PURPOSE OF RESEARCH

Research has been with us from the earliest days. Everything around us has been researched in one way or another. Mankind has endeavoured by means of research and his/her inquisitive mind to improve the living conditions and standards of all.

The main reasons for research are therefore:

- to explain why things are the way they are (e.g. why the sun rises every morning);
- to predict phenomena (e.g. human behaviour);
- to add value (e.g. improved methods of doing things);
- new discoveries (science and other inventions speak for themselves).

In some ways research can be seen as a process of extending the boundaries of our knowledge. The man who believes he knows everything reveals not only his arrogance but also his ignorance. Research is about answering unanswered questions or creating that which does not currently exist. It is not just information gathering. The discovery and the creation of knowledge lie at the heart of research.

4. WHY DO YOU WANT TO DO RESEARCH?

Research should not place an obligation on one's shoulders. Research should be planned and executed because:

- a problem must be solved (e.g. a problem at work may lead to a research project to solve that problem);
- of personal interest (e.g. a hobby which may develop into further research);
- this aids in developing skills;
- job advancement is possible;
- qualifications will be improved (the most general reason why research is executed);
- information can be shared with others.

It is therefore important that a definite goal or aim for research should be established. Defining a goal or aim will make the research process much easier.

5. ORIGIN OF RESEARCH PROBLEMS

One of the problems experienced by a potential researcher is the search for a feasible research problem or project. Research problems usually originate from:

- practical problems (e.g. work-related, environment, society, economic, management, etc);

- previous research (usually a project will indicate further research which is an extension of previous research);
- historical research (e.g. events in the past – an analysis of the Second World War);
- a case study (usually pertaining to groups or institutions);
- action research (finding a solution to a practical problem, implementing the solution; reflecting on the results);
- personal interest (keen to know ....).

6. MAKING KEY RESEARCH DECISIONS

Before venturing into research it is important to remember the following:

- Do not start from scratch (as indicated above some research in your field of interest may have been carried out).
- Write down what you want to do. Have a notebook at hand to capture all information, ideas and references.
- Do not rush into a decision about the project. When one is eager to commence a research project, one may be inclined to continue with the first good idea. Rather play with ideas. It is better to spend time on planning the project than rushing into it.
- Evaluate all alternatives and get a second opinion and a third or more!

Finally, take responsibility, as it is your project and your time and efforts that will be invested in the research project.

7. THE RESEARCH PROBLEM

The research problem is the heart of the research project because it explains exactly the reason for the research. Therefore the research problem must be linked to the research topic and the objectives of the project. Figure 1 represents an outline of the research cycle. It is clear that a research project begins and ends with the research problem.

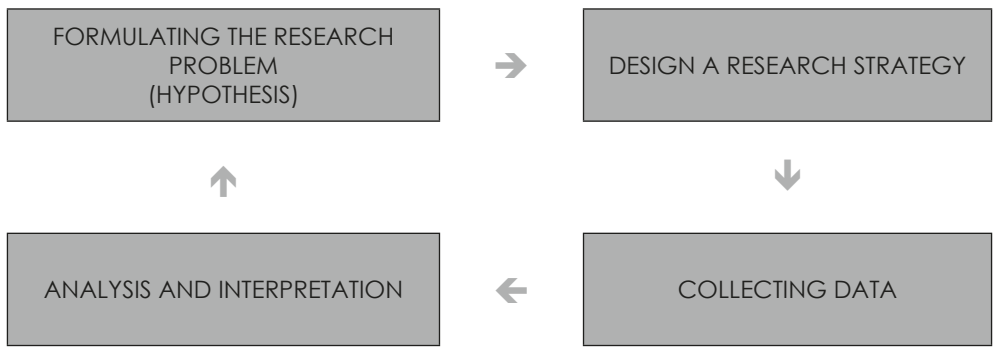

Figure 1: The Research Cycle

As indicated in Figure 1, the research process starts with the formulation of the research problem. This includes a hypothesis statement which is the assumption made about the research problem (hypothesis can either be accepted or rejected).

A research strategy must then be designed. This is the plan of action or the methodology to be followed in researching the problem. The next step involves the empirical part of the cycle, namely the collecting of relevant data followed by the analysis and interpretation of the gathered information. The results must then be compared with the stated hypothesis, which will either be accepted or rejected. The research cycle therefore starts and ends with the research problem.

8. TURNING A TOPIC (IDEA) INTO A RESEARCHABLE PROBLEM

After the initial identification of a topic it is important to define very clearly the aim(s) of the project. In this regard it is important to consider the most problematic aspects of the topic. It will be helpful to state the topic as a series of questions. Usually one question leads to another, until a pertinent research question is identified. The following example will illustrate this:

Hypothesis:
(Statement which must be tested) (e.g. commuters have lower rates of participation in campus extracurricular activities).

Do commuter students participate less in extracurricular activities on campus? (*ideal/topic*).

Research problem:
If commuter students spend less time on campus than residential students, then commuters will have lower rates of participation in campus extracurricular activities than students on campus.

It is important to note that there is a direct link between the research topic and the research problem, e.g.:

If commuter students spend less time on campus than residential students, then commuters will have lower rates of participation in campus extracurricular activities than students on campus (*research problem*). An investigation into the participation rate of commuters in campus extracurricular activities (*research topic*).

9. SEARCH FOR INFORMATION

Find out what is known about the identified topic and make sure enough resources are available. This is particularly important in certain disciplines where not enough literature is available. A thorough literature study is always necessary for all disciplines.

10. BRIEF SUMMARY OF INTENT

Although not compulsory, the compilation of a brief statement of intent (one or two pages) may be advantageous for the prospective researcher. This may serve as a "selling document" when approaching institutions and/or possible supervisors, which will immediately indicate the intention of the researcher.

11. CHOOSING YOUR SUPERVISOR

The conclusion of an informal "contract" between the supervisor and the researcher will really help to create an atmosphere of collaboration and coordination.

- The department usually allocates a supervisor to the researcher.
- It is however important to decide on the compatibility with the prospective supervisor as this relationship will have a huge impact on the progress of the project.
- Certain guidelines and/or rules must be determined (e.g. how long it will take to revise a chapter, etc.)

12. PREPARING A PROPOSAL (PROTOCOL)

Following the steps outlined in the previous paragraphs will eventually lead to the compilation of a proposal, which will be addressed in Theme 5.

13. STEPS TO FOLLOW IN DOING YOUR RESEARCH PROJECT

The research process is one of interaction and support. No student can be successful without the support of his/her supervisor and the administrative assistance of the university. The following steps, which roll out as phases of the research project, are recommended:

Step 1: Meet the supervisor and identify the project

A prospective student will visit the head/director of a department/school to discuss his/her research interest in a specific area of that discipline. It is during this conversation that the student will be referred to a staff member to act as possible supervisor.

It is important that during this phase, the department/school must indicate to the student whether they will be able to accommodate him/her. If the department/school has embarked on a specific research area, the student must be informed accordingly to decide whether his/her individual topic will fit within the boundaries of the wider research area.

Step 2: Registration

After careful analysis of the discussions, the supervisor may invite the student to register for a master's or doctoral degree. The student will be referred to the person in the department/school responsible for postgraduate studies to assist him/her with all the administrative issues.

Step 3: Prepare the protocol

The format of the preparation may differ from discipline to discipline and even amongst academics in the same faculty. It is therefore advisable that a *pro-forma* protocol be developed to assist the student in his/her preparation. This is also important from a quality assurance viewpoint, so that all protocols in a specific discipline will be evaluated in a more or less "fixed" format.

The supervisor plays an important role in the drafting of the protocol. Drafting and redrafting may occur, but usually this is to the benefit of the student. The protocol

will eventually determine the whole course of the project, therefore is it advisable that enough time be spend on the preparation thereof.

Many institutions have a title registration committee where the title of the project will be approved or may be amended. The protocol may then be referred for notification and appointment of a co-supervisor (if necessary) and the appointment of an assessment panel.

Step 4: Approval of the protocol

After approval of the protocol the student's topic will be registered and s/he can actually start with the research project.

Step 5: Apply for grants

If applicable the student may now apply for a grant to assist him/her in the completion of the research project.

It is important to note here the role of the supervisor during this whole process e.g. provision of study guidance, feedback to the research administration, etc.

14. DISSEMINATION OF RESEARCH RESULTS

Research must be placed in the public domain, and there are many ways to do this. They range from publications (such as journals, conference papers, contributions to books, newspaper columns) to innovations that will lead to commercialisation of research products. Disseminating research results contributes not only to the sharing of knowledge but also to the creation of new opportunities for new research projects. Without the dissemination of research results, the research process is not completed.

In disseminating research results the researcher should identify the appropriate opportunities. For publications and conferences the researcher has to identify a suitable journal or conference where the paper will meet the criteria of the journal and/or conference.

In the case of possible commercialisation the industrial partner is as important as the project.

15. CONCLUSION

The first step in the scientific research process is to clearly formulate the specific problem to be examined. To define a problem correctly, the researcher must know what the research problem is. The researcher should rephrase the research problem to put it in terms that are as specific as possible to make it operationally viable; to help in developing the hypothesis and to execute the research project successfully.

THEME 4

PROPER RESEARCH PROPOSALS

Ryk Lues, Laetus O.K. Lategan and Werner Vermeulen

The focus of this section is to:

- outline the characteristics of a research proposal;
- provide a framework for a research proposal; and
- identify common weaknesses of research proposals.

1. INTRODUCTION

Just as any large project requires proper planning in the form of a project or business plan, prior to the commencement of any research project a proposal should be compiled (Borg and Gall, 1989:61; Maree, Creswell, Ebersöhn, Eloff, Ferreira, Ivankova, Jansen, Nieuwenhuis, Pietersen, Plano Clark and Van der Westhuizen, 2007). A research proposal is defined as a carefully delineated statement of a research problem, an outline of the research design and a clear indication of the significance of the proposed study (Schumacher and McMillan, 1993:563). Although the length of the proposal depends on the discipline and extent of the research, the document should be concise, unambiguous and to the point, but at the same time containing all the information required for a proper analysis. A research project proposal *circa*, but not limited to 10-15 pages in length should be sufficient for a typical postgraduate project. A research proposal (or protocol as it is sometimes referred to) is a "business plan" that the prospective researcher compiles for the envisaged study. However, as with the rest of the reporting methods for research, this proposal or business plan should be compiled in a format and chronology unique to the research discipline. The research proposal plays a pivotal role in the planning of research as it leads the researcher to confront the following issues: a) is the project viable, applicable and well structured? b) are there enough literature and other resources available to complete the project successfully? c) are the human resources and expertise (e.g. researchers, assistants, study- leaders etc.) involved in the project sufficient and competent for its successful completion? and d) are the infrastructure and finances adequate?

Apart from facilitating the planning of the project, the proposal is also a formal document that serves a number of other very important purposes. In short, a research proposal is an offer to sell *something* to *someone* in *some time* at *some price*. For example, the research proposal predominantly serves as the source-material through which financial assistance from funding agencies and industry is applied for. Apart from the key issue of funding, the proposal:

- indicates to the head of the department, who must appoint a supervisor, what the field of specialisation is and what type of problem you want to investigate;
- serves as an evaluation procedure to determine your ability to do research, i.e. amongst other things, to comprehend, summarise, generate and organise knowledge;
- gives you an opportunity to become acquainted with the demands and constraints of doing research and writing the text;

- compels you to identify and formulate clear and unambiguous problems/goals/outcomes and to think of the significance of the research project; and
- compels you to make a thorough study of research methods, to consider what methods will be appropriate for this particular research problem and how these methods should be applied.

The formulation of a research proposal is a comprehensive and often daunting task and a thorough literature study is an essential prerequisite for this. In some cases, it may be necessary to conduct a preliminary investigation or pilot study prior to finalising the proposal. Alternatively, the pilot study could form part of the planning phase stipulated in the proposal. The researcher will thus, for the purpose of the research proposal, have to anticipate the course and outcomes of the project (Mouton, 2001:45).

2. CHARACTERISTICS OF A RESEARCH PROPOSAL

Although the key elements of a research proposal are universal throughout all spheres of research, individual research institutions have specific requirements regarding the details and format of the research proposals submitted (Lues and Lategan 2006). An increasing number of institutions prefer the compilation of research proposals as well as the management of the actual project through software programmes such as *Research Toolbox* and *Microsoft Project*. The following are the general characteristics of a research proposal:

- it should be set out as briefly and concisely as possible;
- the problem statement should be clearly defined;
- the use of language should be clear and unambiguous; and
- a clear preview of the course of the project should be given.

Particular attention should be paid to the preliminary title, the importance of the project and aspects such as time division, financial requirements and apparatus. Ultimately decision makers, funding agencies and superiors have to ascertain the feasibility and probable success of the proposed research and make decisions regarding funding, institutional support etc. based on the research proposal. It is thus evident that a research proposal is a fundamentally important document and its proper compilation should fall well within the repertoire of a competent researcher.

3. RECOMMENDED FRAMEWORK FOR A PROPER RESEARCH PROPOSAL

3.1 Preliminary title

The title should be stated in the least possible number of words and yet provide as much information about the study as possible (Lues 2008). The most important variables should be in the title whereas emotional and personal wording and wording that indicates the result of the research should be excluded. Expressions such as "A study of...", "A comparison between..." and "An investigation of..." can be omitted without losing any impact. Summarised, the title should adhere to the following specifications:

- it should be concisely formulated (preferably not more than 12 words);
- it should include the variables only;

- it should not include indications of the educational fields of specialisation such as "a didactical perspective", "a socio-pedagogical study", "an empirical investigation", etc; and
- it should not include concepts such as "Black education", "Black students", "Coloured first-year students", "White students, etc. (such concepts should be avoided because they may be interpreted as racially biased thinking).
- A title such as: "An evaluation of group discussion as a teaching method in the subject History in Historically Black Universities – A Didactical Perspective" should, for example, preferably be reduced to: "*Group discussion as a method of History teaching in selected higher education institutions*".

3.2 A synopsis of related literature

The literature review that forms part of a research proposal need not be as comprehensive as that of the final thesis or dissertation, but should enable the prospective researcher to: a) get an adequate perspective of the latest research findings; b) get an indication of the best methods, measuring instruments and statistical analyses that can be used; interpret his/her own research results better; and c) determine the actuality of the project. When compiling an exploratory literature review for the purpose of a research proposal, one should try to use a variety of sources, including books, journals, government documents, etc. However, the sources included in the research proposal should be those closest and most relevant to the particular study, whilst the sources on the "fringe" of the particular topic should be excluded for later inclusion in the final thesis/dissertation. Unless the study is a historical investigation, the sources should preferably have been published during the past 10 years; otherwise the information contained therein might already be outdated.

3.3 Rationale

The rationale for the study entails a concise problem statement (with sub-problems if necessary), aims (and objectives if necessary) and hypotheses (if applicable). The statement of the problem should identify all the variables in their conceptual, and not operationalised, form, i.e. the variables should be named, but no description of how they were measured is necessary at this point. One or two sentences will normally suffice to state the problem. The way in which the problem is formulated should convince the reader that the research project is worthwhile. The problem statement should be followed by specific aims (the purpose of the research and objectives, usually in the form of questions which will serve as directives or stepping-stones to solving the problem).

It is not always feasible to formulate research hypotheses where relationships between variables are not investigated. However, if they are, the research hypotheses should be well formulated in the research proposal. Such research hypotheses are directly related to the stated problems and expected outcomes in the sense that they provide a tentative answer to, or an explanation of, the research problem. Throughout the study the hypotheses give direction and meaning to the research. In the final stages the researcher should be in a position either to reject or retain the original tentative answers or hypotheses to the problem.

3.4 Methodology

In the methodology section the researcher should first confront the type of research method needed to execute the project, for example whether he/she needs to do quantitative (positivistic research in which the findings are usually expressed by means of statistical data) or qualitative (naturalistic research in which findings are verbally reported) research. Secondly, the research design needs to be identified, for example whether an experimental design, case studies, action research or ethnographic observation will be used. In the case of experimental research, this section should mention aspects such as the sampling protocol, inclusion and exclusion criteria, methods and techniques, nature and scope of data needed, method of data collection and method of data analysis. In the case of data collection through surveys, questionnaires, structured interviews and/or focus-group discussions, information relating to the method and size of sampling, respondent selection, concept questions and general organisation regarding the collection and the processing of the data should be listed. When the project touches on aspects related to amongst others medical, animal or biotechnological research, issues of ethics and morality should be discussed in the context of ethical committee approval.

With historical research, the methodology section will primarily focus on the sources and acquiring of literature, the coverage of historical events and the inclusion of certain participants (De Vos, Strydom, Fouché and Delport, 2005). Depending on the stature of statistical analysis in a specific discipline, such information can either be listed separately or as part of the methodology. All the envisaged *descriptive* statistics (description, organising and summarising of the data through graphs, figures and tables) and *inferential* statistics (allowing the researcher to draw a definite comparative conclusion on the data through tools such as correlations, significance, probability, confidence, multivariate analysis etc.) should be included. Computers and software programmes used in the calculations and presentations should be mentioned. Finally, your methodology section should address design limitations, which may influence reliability, internal and external validity as well as inclusion and exclusion criteria.

3.5 A section outlining the financial implications

This category is addressed by drawing up a detailed budget of the funds needed to execute all aspects of the research. The budget should include both the incomes (sources of funding) and expenditures. Expenditures for a typical research project may include but are not limited to:

- literature searches (Internet costs, interlibrary loans, subscriptions);
- consumables (sample collection, media, chemicals, parts and accessories, photocopies for questionnaires, stationery, telephone and fax expenses, courier costs);
- costs related to outsourced analysis and sub-contracting (e.g. statistical services);
- apparatus (any apparatus/equipment needed for the analyses. This includes hardware and software requirements as well as servicing of existing equipment);
- travel and subsistence (costs for collection of samples and meetings with peers, study leaders, experts and industry);
- attending of conferences, symposia and related scientific meetings;

- editing, proof-reading, copying and binding;
- bursaries and scholarships.

3.6 A time frame and list of expected outputs from the project

Planning and allocating of time is undoubtedly one of the most important aspects of the research proposal and lack of proper time-management has been the cause of disappointment to many a student who has had to extend his/her studies beyond the initial submission date. A relatively simple project planning outline (Figure 1) should be adequate to manage the time and various tasks of a research project, provided that the researcher and study leader are disciplined enough to adhere to the target dates. Software programmes typically utilising Gantt-charts exist and can be used to facilitate time and project management.

3.7 A draft plan for the division of chapters and related outputs

Confronting the compilation of the various chapters of his/her thesis/dissertation will inevitably lead the researcher to evaluate the nature and extent of outputs that may be derived from the research. For example, in cases where the document is compiled in article format, the researcher should be able to estimate the number of articles that may be published from the work, as well as the critical mass needed in each chapter for submission to particular journals (Figure 2). By stating the expected outcomes of the research, the researcher sets an expectation as to the "mileage" that could be expected for the project. Typical research-related outputs include:

- qualifications;
- publications;
- patents and other artefacts;
- conference contributions; and
- scientific reports.

Other outcomes such as community awareness programmes as well as novel technologies to industry or academia are also significant and should be mentioned.

3.8 List of literature reviewed

The format of the reference list should be according to a specific, internationally acknowledged format such as the Harvard method, the augmented Harvard method, the numerical reference method or the running notes method. However, it is important to note that various disciplines, institutions and research groups prefer specific styles of referencing. A golden rule is to select an authoritative, acclaimed journal in the specific field and select the style of referencing in accordance with that specific journal.

Layout 1	Layout 2
1) CHAPTER 1: Introduction	1) CHAPTER 1: Introduction
Overview and background	Overview and background
Literature review	Rationale
Rationale	References

References	2) CHAPTER 2: Literature review
2) CHAPTER 2: Materials and methods	References
References	3) CHAPTER 3: Materials and methods
3) CHAPTER 3: Results and discussion	References
References	4) CHAPTER 4: Results
4) CHAPTER 4: Conclusion	References
Recommendations	5) CHAPTER 5: Discussion
Acknowledgements	References
Future research	6) CHAPTER 6: Conclusion
References	References
APPENDIXES	7) CHAPTER 7: Recommendations
	Acknowledgements, Future research, Appendixes, References

Layout 3	
1) CHAPTER 1: Introduction	4) CHAPTER 4: Article 3
Concise overview and background	Concise literature review
Aims and rationale	Materials and methods
2) CHAPTER 2: Article 1	Results and discussion
Concise literature review	References
Materials and methods	5) etc.
Results and discussion	6) CONCLUDING REMARKS
References	Acknowledgements
3) CHAPTER 3: Article 2	Future research
Concise literature review	References
Materials and methods	Appendixes
Results and discussion	
References	

Figure 1: Typical chapter lay-outs for postgraduate theses and dissertations (Lues, 2008).

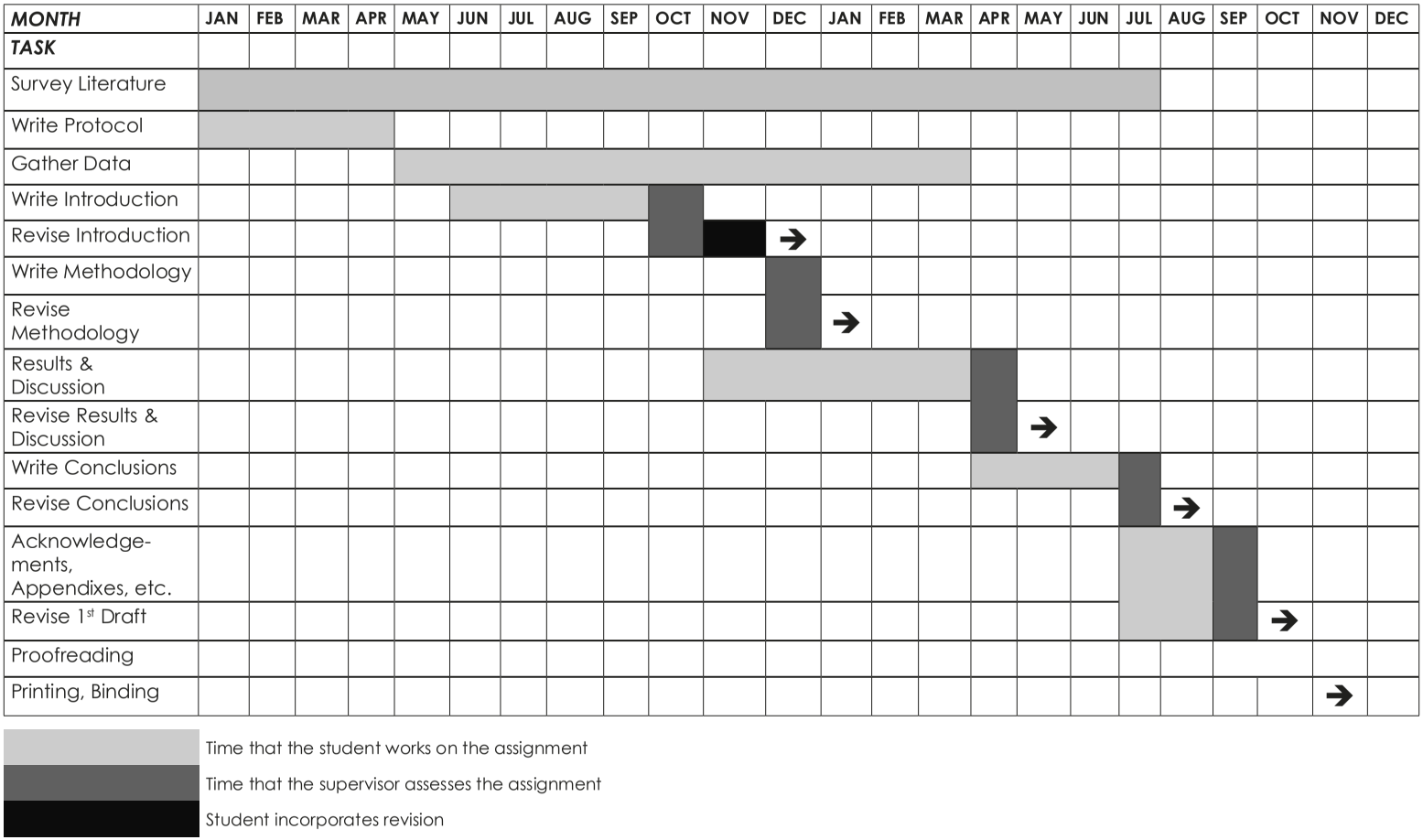

Figure 2: Typical chapter lay-outs for postgraduate theses and dissertations (Lues, 2008).

4. COMMON WEAKNESSES OF RESEARCH PROPOSALS

The following common weaknesses of research proposals can be identified:

- *The problem is trivial:* Often the research problem is only of peripheral interest. The research results neither add to existing knowledge nor do they improve practices. It is therefore essential that you convince the reader of the significance of the problem (Hay, 2005).
- *The literature review is limited:* The literature consulted is not relevant, not wide enough, not specialised enough or outdated. Once in the public domain, such a literature review is unlikely to withstand scrutiny by peers who wish to use it as a launch pad for their own research (Hopkins and Antes, 1990:23-24).
- *The problem is not demarcated:* The research problem is stated in an extremely broad fashion, which makes it impossible to determine what the focus point, or real issue, actually is. This is an indication that you, as the prospective researcher, do not have clarity regarding what the specific problem or area to be investigated is.
- *Aims and expected outcomes:* The expected outcomes of the research project are not scientifically justifiable or they do not logically match the problem statement.
- *The methodology is lacking in detail appropriate to the proposed study:* The design and methodology for quantitative research should be described explicitly, while for qualitative proposals it may be less specific. The sampling protocol, in particular, is an area that requires much attention. This does not imply that aspects such as purposeful sampling strategies, data collection strategies, data analysis strategies, the developing of categories, as well as techniques of pattern seeking should be described superficially.
- *The budget is unrealistic:* Newcomers to the research process often submit a budget that lends itself to under- or over-expenditure. In addition, budgets are often not detailed enough, excluding vital information or not keeping track with the true costs of consumables and equipment.

5. CONCLUSION

This theme shows how important each step is in the proposal writing process to ensure the success of the final product. The chapter starts with the characteristics of a research proposal and continues with a recommended framework for a proper research proposal. It then highlights possible weaknesses in research proposals.

The ultimate ideal of any research proposal is that a person other than the researcher him-/herself should be able to execute the research on the grounds of the contents in such a manner as to successfully accept or reject the hypothesis (Lues 2005). The research proposal therefore has to be a tangible research recipe that really works.

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THEME 5

EMPIRICAL RESEARCH

Cay van der Merwe

The focus of this section is to:

- explain general aspects of empirical research;
- define sampling and sampling characteristics;
- introduce experimental design characteristics; and
- describe surveys and questionnaires.

1. INTRODUCTION

Research is not an aim in itself, but a process whereby new knowledge is gained, shared with others and applied to the benefit of all who wish to avail themselves of it.

Empirical research is based on observation or experiment and not on theory alone. It is derived from the Greek word for "experience" and hence also alludes to having learned from a process of which the outcome was unknown, but had a measure of probability attached to it, hence called stochastic.

Most empirical research contains both qualitative and quantitative data, and even the former can often be quantified and therefore measured in a numerical form. The moment one analyses stochastic data, the field of statistical science must be applied to the research. If the appropriate statistical techniques are not used, all the conclusions drawn are invalidated and have no justification or credibility. This is where the term "significant" appears, referring to the level of truthfulness and credibility, linked to the probability of error.

Introductory courses to the field of Statistics usually cover descriptive statistics of location (mean, median, mode), spread (variance), skewness, frequency (tables of counts of occurrence) and relationships (correlation). At this stage the data is being turned into information, and it may also be graphically displayed by means of bar charts, pie charts, scatter plots, sun ray plots, etc. This phase draws the researcher's eye to certain patterns and/or anomalies in the data and an overall picture of the outcomes of the experimental research is gained.

Turning the data and information into knowledge requires specialist knowledge of the correct statistical tests needed to determine whether the suspected outcomes have become real. Clearly the statistical consultant must be approached during the crucial planning stage. If the investigation was not scientifically designed, no tests can be applied. Conclusions have no basis if the underlying assumptions of the tests are not met. It is therefore clear that simply including some well-known terms like "t-test" or "regression" at the end of a thesis is worthless to responsible and ethical research.

One cannot condense the many aspects of (empirical) research methodology into one session, and hence we present overviews on a few important aspects, under the following headings:

- General aspects of empirical research
- Sampling
- Experimental design
- Surveys and questionnaires

2. GENERAL ASPECTS OF EMPIRICAL RESEARCH

A logical and methodical approach to a research project is a worthwhile investment. Years of experience as a consultant have taught that those aspects that seem so commonplace and are applied automatically, may not be so obvious to the novice researcher. Hence the steps and approaches below, although certainly not exhaustive, try to cover aspects most commonly required or applied in empirical research.

2.1 Planning

- Approach the research project in a logical, methodical and systematic manner.
- Invest more time (than you envisaged) in planning and reap the fruits later.
- Bring together all role-players, especially knowledgeable supervisor(s).
- Identify other resources.
- Know what you want to achieve before you consult the statistician; but don't carry out the experiment or survey before you do so.
- Allow enough time for the various steps in the project.
- Make provision for other people's schedules.

2.2 Topic

- Clearly define your topic of research.
- Lay down the scope of the project.
- Ensure that the topic is relevant and original.
- Approach the topic with interest and enthusiasm.
- Think it through.

2.3 Hypotheses

State clearly your main hypothesis or hypotheses to be investigated – not your preconceived assumption(s), otherwise it's not 'research'! In statistical science the so-called null hypothesis is usually that of 'no change' or 'no relationship' i.e. there has been no shift in value or certain items are independent. That which you suspect to be true (a difference or relationship manifests itself) is formulated (if necessary in a statistical way) in the alternate hypothesis.

The experiment which you perform yields numerical results and these are used "in evidence" against the null hypothesis. Only when the *appropriate* statistical test yields a result which cannot be attributed to coincidence alone, can one start attaching significance to the conclusion.

2.4 Background information

Gather information relevant to your topic by:

- literature searches
- talking to people
- focus groups
- telephone interviews
- written solicitation (post, email, Internet)

Try to confirm, to the best of your ability, whether your proposed research will be original.

2.5 Consult statistician

If the research has any quantifiable values, consult the statistician at a fairly early stage in the project. It is incumbent on your supervisor(s) to accompany you to the first consultation. Decide, however, what exactly are the variables of interest. Variables are those items of which the outcomes are not deterministic/certain and to which change/probability is attached.

At this stage you and the statistician will make some important decisions:

Firstly, does your project warrant:

- experimental design? This is used mainly in biological (in its widest sense) research, where techniques and/or materials are compared or where the behaviour of variables obtained by observation under the influence of factors or in relationship to each other is measured and analysed;
- surveys? They are used more often in sociological topics and where the respondents are approached for characteristics or opinions, such as in market research. The researcher is more an observer of phenomena in their natural state than an active director or participant;
- a combination of both techniques, with/without other methods.

You will also clarify:

- whether the population under investigation is uniquely defined;
- what method(s) you will use to obtain the data (e.g. which sampling technique is appropriate/feasible);
- an efficient and cost-effective design;
- which main statistical analyses are envisaged to investigate the hypotheses (besides data clean-up, descriptive statistics, etc.)?

Note that the data is not tailored to statistical tests, but the correct choice and application of statistical techniques lead to valid and ethical research. In practical terms this means that one does not include a 't-test' or any 'p-value' to add glamour to the thesis; nor does one negate the findings if they do not concur with what you expected from anecdotal or incidental observations.

You may also sort out whether you will be using:

- scalar / univariate vs. multivariate data and analyses: e.g. measuring the blood pressure (one variable) for 50 people, vs. measuring the blood pressure, age,

weight, waist girth of the same people, as these variables relate to one another in a person, and differ collectively amongst people;

- categorical vs. continuous data: e.g. male or female, percentage to pass or fail, width of a butterfly wing by species or weight of the paint on a jet.
- differences vs. relationships: e.g. are girls on average more clever than boys, or what is the relationship between the level of fluoride in the water and the number of tooth cavities?

2.6 Pilot study

Perform a pilot study, the scope of which was determined beforehand. Some data capture and preliminary analysis will highlight aspects which need attention and will save time and money in the long run.

- Do this trial run yourself, including the data capture.
- Re-visit your methodology, if necessary.

2.7 Perform experiment or survey

When carrying out the survey remember the following:

- Have logistical arrangements in place as far as possible.
- Maintain your enthusiasm and you will keep the project interesting
  - to yourself
  - to your supervisors
  - to the respondents
  - to the lab rats.
- Administer the project carefully.
- Schedule tasks and appointments regularly and keep to them.
- Discuss the report in depth; the format, findings, interpretations etc. must be cleared with the supervisor(s) and statistician.

2.8 Statistical analysis of results

The data gathered by the experiment or survey needs to be

- captured
- cleaned up (allow time and appointments)
- summarised with descriptive statistics.

Decide whether and which inferential statistics are to be applied.

Inference may only be drawn on the particular population and if the sampling was valid.

Apply the appropriate statistical analyses; often additional tests emerge as indicated by the results. The main indicators towards the appropriate tests are whether one uses tests for:

- univariate vs. multivariate methods
- differences
- relationships

- groupings/classifications
- predictions

2.9 Report

- Plan the report.
- Explain your methodology.
- Write up results fully at each phase, as if for the final publication.
- Maintain the logical flow and valid cross-references.
- Acknowledge participants/sources.
- Attach the data (and questionnaires).

3. SAMPLING

3.1 Background to sampling

The practice of tasting or testing a tiny part of the whole is an ancient one. The purpose is usually to determine characteristics of the whole (population), where examining the population would be too expensive or time-consuming or destructive or impractical or simply impossible. Hence one takes a "SAMPLE" from the population one is interested in.

Traditionally, the census was the ultimate purpose, as in Biblical references; but in the early 1800s Sir FM Eden was already estimating the population of Britain, prior to the 1801 census, based on the number of people per household and registered births. In the late 1890s, the Hollerith cards were being used to speed up the counting process for the large American population. Today, many sophisticated census techniques are used all over the world, although many people are still reluctant to accept the scientific validity of sampling.

The correct sampling procedure will invariably lead to cheaper, more immediate yet reliable information about the population under investigation.

3.2 Definitions

Population	▪ Universe or totality about which inference (conclusions drawn) is made. [Examples: students at CUT, frogs of a species, car doors, etc.].
Element	▪ single unit of a population on which an observation or measurement is made or an opinion requested.
Sample	▪ selected subset of a population (observations are made on the elements of the sample).
Survey	▪ process of obtaining data and information, using a sample, by telephone, on paper, electronic, often via a questionnaire.
Questionnaire	▪ structured set of open-ended or closed questions, eliciting quantitative or qualitative information on one theme or topic and lending itself to data capture and analysis.

Sample size	▪	the number of elements included in a sample, often indicated by an "n", (where n is chosen to minimise sampling error and increase representativeness).
Sampling frame	▪	a list of all the elements in the population from which the sample is drawn.
Sample bias	▪	difference between sample and population data that can be attributed to faulty sampling; a consequence of poor sampling methods such as a non-random method.

3.3 Sampling characteristics

The most important characteristics of a sample are its **randomness** and **representativeness**.

Random sample	▪	Every element (member) of the population has an equal probability (same opportunity or chance) of being selected for the sample.
Representative sample	▪	The sample is as much like or reflects the population in as many ways as possible.

3.4 Sampling methods

3.4.1 Under the non-probability or non-random methods are included the following:

- Convenience (chunk, accidental, incidental).
- Quota (proportionate, yet like 'convenience').
- Purposive (expert's choice).
- Snowball (network, recommendation chain).

These methods are *not recommended*, since they are often biased, non-representative, contain large sampling errors etc. Correct statistical inference (i.e. conclusions drawn about the population on the basis of the sample) cannot be done, since the underlying assumptions are not met.

3.4.2 Randomization sampling methods or probability sampling includes the following types, often in combinations of the various techniques. The random sample, where every element has an equal probability of being selected, reduces sampling error, reduces bias, increases representativeness, ensures independence of individual observations and hence lends validity to the analyses and conclusions.

Random sample:

Number/list each element of the population, in a way that has no relation to the variable(s) of interest i.e. establish sampling frame. Using either a table of random digits or a computer generating (uniformly distributed) random numbers with a random seed or starting number in both cases, select **n** unique items from the population.

The stirring or mixing process, still used in game shows, was the forerunner of this process.

Stratified random sample:

The population is divided into subgroups called strata, which are homogenous (the same) with regard to some particular characteristic (e.g. age, gender, faculty etc.). Random samples are drawn from each stratum, often, but not necessarily, in sample sizes proportional to the size of each stratum or sub-groups within that group.

Cluster sampling:

Divide the population into clusters or categories and then randomly select clusters.

Systematic sampling:

The elements of the population are listed, in an order with no relationship to the variables measured. Starting at a random point, every m-th item is chosen and analysed. If the population size is "N", and the pre-determined sample size is "n", then $m \approx N/n$. (If the end of the list is reached, continue counting and start again at the top of the list, till the m-th item is reached). Ensure that the total population is listed or targeted.

3.5 Sample size

The sample size must be large enough to reduce the sampling error (deviations caused by random fluctuations) and to reduce (spurious or deliberate) bias. "How large a sample must be drawn?" is one of the most frequent questions asked of a statistical consultant, yet one of the most difficult to answer. It depends on various factors, starting from the size of the population, economic considerations, the variation in the data, the number of variables to be measured and so forth. If the precision with which a mean or proportion is to be estimated and the level of confidence is specified, there are formulae by which the sample size can be calculated. For normally distributed data, a minimum sample of 30 is often recommended. In multivariate analyses, the number of cases (participants, experimental units) must always be much more than the number of variates (e.g. 10 times as many questionnaires as questions).

3.6 Drawing a stratified random sample

As an example, let's consider the current student population at the Central University of Technology, Free State (CUT). Many surveys are done to obtain information from students that are not available on the official database. A complete list of the (say) 10 000 students is available, by e.g. student number and name.

Depending on what aspects we wish to cover in the questionnaire, we can stratify this population into various groups, such as 3 faculties or 4 race groups or 12 home language groups etc.

If we wish to sample 500 units, or 5% of the population proportional to the three faculties (which are of sizes (A) 6000, (B) 2500 and (C) 1500), then we would require 5% of each i.e. 300, 125 and 75 units from the three faculties respectively. We now list the students per faculty by student number, for example, and then we number them as 1,2,3 … 6000; as 1,2,3, …, 2500 ; and as 1,2,3, … ,1500.

For the first faculty we now obtain random numbers between 0 and 1, multiply them by 6000 and round off to the nearest whole number and then we select the students on the newly numbered list by those numbers. If a number (from random numbers generated) appears again, we take the next number generated – not the next student on the list – and hence we would probably have generated more than the 300 we require for the sample from A. We wish to ensure that we have chosen 300 unique, random students for the survey – hence eliminating sampling bias in the listing – as well as reducing bias in the survey or experiment content.

To summarise, some methods to obtain random numbers between zero and one are:

- **Method 1:** Use a table of random digits (see Appendix 1). Choose a random starting point, move down or across (choose one direction and stick to it) and use 4 digit pairs (in this case where the population/stratum has less than 10 000 items) at a time. The random tables may group their digits in two's, three's, four's or more, and you use digit-groups forming numbers according to your situation. Write down the unique (don't repeat) numbers selected, up to the pre-determined sample size.
- **Method 2:** Use a calculator or spreadsheet software, generate numbers between 0 and 1, multiply each by sample size and add 1, truncate and list cases. Now follow up with measurements and/or questionnaires as demarcated on a prior list and selected according to the random numbers.

3.7 Inference by hypothesis testing

The classical type I and II errors in statistical tests of hypothesis are to a large extent controlled by the correct sample size and sampling technique, and then of course by the appropriate methods of analysis and inference, with valid interpretation of findings – objectively and without bias – in the spirit of research.

4. EXPERIMENTAL DESIGN

4.1 Introduction

In a research experiment, a treatment is deliberately imposed on a group of objects or subjects, called experimental units. The responses of these units are the data, as generated by the experiment and measured, and this data is analysed statistically to determine whether the treatment had a significant effect on the outcomes. Examples could be types of fertilizers' influence on crop yields, kinds of cream applied in skin treatment, reading improvement methods for school children, etc.

The researcher therefore in a systematic manner introduced one or more factors (treatments) which s/he suspects might influence the observed variable(s). S/he then performs statistical tests (often Analyses of Variance or ANOVAs, regression or other appropriate methods) to confirm or reject the null hypothesis of no difference in the mean/average outcomes of the independent variable(s) due to variance attributable to the factors.

The validity of an experiment is affected by its construction and execution, as is the inference or conclusions drawn about the population from which the sample units came. It is therefore vital that the experiment be designed appropriately.

4.2 Experimental design characteristics

Purpose

The research experiment is performed with the aim of answering specific questions, which must be clearly determined beforehand. We wish to subject the independent variable(s) (measured on the units) to one or more factors/treatments, but we need to identify known or expected sources of variability that will or may influence the observations. Removing or controlling these sources forms an integral part of experimental design.

Factors

The factors are usually applied at various levels (in the fixed effects model there are only a predetermined number of levels, whilst the random effects model selects a few levels from many possible ones). The statistical analyses of these designs can become quite complicated, since the effect of each factor as well as interactions between pairs, triplets etc. of factors play a role in the statistical conclusions drawn and hence the role of the statistician in the design of the experiment as well as in the conclusions and their interpretation is important in the research team. For example, the fertilizer experiment could use 3 kinds of fertilizers but also 4 levels of irrigation, and there could be interaction between certain fertilizers and water levels. Crop yields should take both factors as well as interaction into account.

Control

In order to eliminate the possibility that factors other than the factor(s) of interest have an effect on the measurements, a control group is often introduced, which does not receive the treatment(s) on the experimental group(s). In this way experimental bias can be eliminated to a large extent.

For example, the suitability of the soil types for crops planted and tested in the examples above, could influence the yield measurements. Another example is where volunteers were injected with arginine, to measure the secretion of a growth hormone. However, those injected with a saline solution or even just shown an injection needle also secreted more growth hormone.

The bias introduced in this way could be ascribed to the 'placebo' effect i.e. subjects respond in a particular way if they think they are receiving a treatment such as a new medicine. The skewed results could also come from the 'Hawthorne' effect, where subjects react in a certain way simply because they know they are involved in an experiment and are being observed or measured. The first effect is overcome in a 'blind' experiment, where the subjects don't know whether they receive a placebo or an actual treatment (drug); or a 'double blind' experiment, where neither the subject nor the investigator knows what the experimental unit is receiving (observers sometimes write down what they think they should be observing).

Randomization

Although it may be difficult to remove all bias in an experiment, even when sampling large numbers of units and very large numbers of observations, an important and straightforward way to ensure unbiasedness and validity of statistical techniques most commonly applied, is randomization.

The objects or units are randomly assigned to each experimental group as described by the level of each factor or combinations of levels e.g. fertilizer A with low irrigation; fertilizer A with medium irrigation; fertilizer A with high irrigation; …; fertilizer C with high irrigation. In this reliable way you create fairly homogenous treatment (or treatment combination) groups and the sampling units are independent of each other.

From a simple, completely randomized, single factor design, one could move to various multi-factor, partially randomized, repeated measures on same units and combinations of these into a highly complicated design. It could, however, yield valid and useful results for a much lower cost and effort and the use of only a few sampling units.

Randomized block designs are an example where one can control for a factor that is present in the experiments and which will cause differences, yet it is not the factor/ treatment of interest. The method involves assigning experimental subjects to more or less homogenous blocks i.e. minimum variation within blocks and maximum variation between blocks. The individuals within the blocks are then randomly assigned to each of the treatments/levels of treatments. The randomized blocks design therefore caters for control as well as randomness, since the 'block' factor is the one in which we aren't interested and which is known to cause variation.

Replication

The investigator must ensure that enough replication takes place, which means that one must attempt to repeat or obtain observations on a large number of subjects, large enough that each group (treatment level combination) has a sufficient number of observations. This reduces spurious variation and sampling error and supports the validity of the conclusions.

Validity

Internal validity refers to the certainty that conclusions on the statistical significance of findings (such as differences in means) are owing to the experiment alone and not to extraneous factors. Various threats exist to internal validity, namely maturation (subjects age, die, become tired or bored over long experiments); testing experience (subjects gain experience in test procedure); observers vary and record measurements differently; selection or assignment of subjects during set-up, such as too much variation within groups; external occurrences (e.g. 9-11 on stock-market prices); *et cetera*.

External validity is threatened mainly by:

i) population validity, which refers to the similarity between the accessible population (on which the experiment is based) and the target population about which one wishes to generalise (statistical inference) and

ii) ecological validity, which answers the questions of whether the same experiment would yield similar findings in a different environment. This validity can be threatened by, *inter alia*, the Hawthorne effect, artificial circumstances (subjects not in natural environment), the investigators themselves, non-availability of subject for post-test after completing pre-test, etc.

The researcher is advised to take all the above aspects into consideration, yet at the same time not let scientific justification get in the way of legal or ethical norms e.g.

if withholding a vital treatment from a control group can result in physical harm to its members.

5. SURVEYS AND QUESTIONNAIRES

5.1 What is a survey?

The word 'survey' is used to describe a method of obtaining information from a sample of individuals from a specific population. The individuals are asked questions, according to standardised procedures, with the intent of obtaining a composite profile of the population, with regard to particular aspects.

Since there are many technical details surrounding the various facets of a survey, we cannot cover this comprehensive topic in too much depth, but will present only a broad outline. A few references to surveys are included and the researcher should read up on these before jumping in boots-and-all and drawing up the questionnaire. If this has been done, and the topic has been clarified between the student and supervisor, a tentative questionnaire can be brought to the statistical consultation meeting.

5.2 Main steps in a survey project

Before going into detail, summarise the following in a broad sense:

- What do you want to learn? (purpose; goals)
- Who will you ask? (sample; population)
- How will you ask? (methodology: interviews, Internet, etc.)
- What will you ask? (questionnaire)
- Will it work? (pilot study; pre-test)
- Answers please? (conduct surveys)
- What are the results? (capture; analyse; interpret)
- Who wants to know? (reports; applications)

The next step is to draw up a time schedule for the events:

5.3 Schedule of steps

Step	Task	Duration in hours	Target date for completion
S1	Clarify goals		
S2	Design methodology Determine feasibility		
S3	Develop instruments (cover letter, questionnaire etc.)		
S4	Select sample(s)		
S5	Conduct pilot study Revise instruments		

Step	Task	Duration in hours	Target date for completion
S6	Administer and conduct survey		
S7	Follow-up non-response		
S8	Prepare data (code, capture, clean)		
S9	Analyse data		
S10	Prepare report		
S11	Distribute report		

Brief remarks regarding the steps listed:

Step 1: Object of the survey

Clarify what you want to learn, about whom, from whom and for what purpose – the purpose being spelt out more clearly than "making money" or "improving quality". Be certain to define clearly the scope of the project, to ensure that you don't leave out essential elements, yet at the same time don't overload the investigation with superfluous aspects that contribute very little to the main purpose of the research.

The secret is in KISS – keeping it short and simple. Focus on the "need to know" and not the "nice to know".

Step 2: Methodology

In line with:

- the population to be targeted i.e. the environment within which the survey is to conducted
- the resource constraints (time, technology, money, people available)
- regulatory and ethical requirements
- time frame and context of subject,

draw up a sampling framework, in collaboration with the whole research team, which describes the:

- method of sampling (personal interviews, mail, telephone, email, digital capturing, web-based etc.)
- type of sample (random, stratified, etc.)
- size of the sample (as a whole or per sub-groups)
- budget for costs and time
- ways in which sampling error will be minimised.

As pointed out in sampling theory, the sample must be representative of the population being investigated. It is even more important to avoid bias in survey sampling, since surveys are more vulnerable to deliberate, mistaken or simply unforeseen bias. The classic case often quoted is the opinion poll prior to an election in the USA, many decades ago: people with cars (from the vehicle registration list) and telephones were polled, indicated their party preference, which was used as a prediction and

then the opposing party won! Why? The opposition drew the majority of votes from a very poor section of the population.

Another way that bias is introduced is when respondents decide whether they wish to include themselves: e.g. readers of a particular magazine might indicate a different preference to readers of another. Be careful of making assumptions, for example of equality, that may not be met – gender differences could occur not only in opinions but also in physiological reactions to medication, for example. The method of approaching respondents can even influence results: questions related to contraceptives elicited different rates when asked face-to-face as opposed to by phone.

The feasibility of the study is often determined at this stage, with adaptation of scale often occurring.

Step 3: Develop survey instruments

The design of valid, reliable and purposeful questionnaires is a science on its own. It is advisable that the researcher first obtains clarity on the purpose of the survey, then consult some of the hundreds of texts dealing with the subject.

Cover letter

A crucial component of a survey is the cover letter/explanation at the start of the questionnaire. Although brief and to the point, it must cover these aspects:

- Who is conducting the survey? (Make it look important and professional, use a letterhead, supervisor/company head signs the letter). Remember, you are making a first impression and establishing rapport.
- Briefly outline the purpose behind the questionnaire (not "for a Master's study", but pertaining to the subject area).
- What is expected of the respondent? Appeal to their interest; gain participation; play on loyalties or respondent's potential gains.
- Address anonymity and confidentiality issues.
- Promise follow-up or feedback, where appropriate.
- Say thank you, be polite and provide a deadline.
- Add the date (month and year).

Questionnaire design

The questionnaire serves many masters, namely research purpose, respondent, data capturer, analyser etc. Some key points are listed below:

- Keep the questions, instructions and whole questionnaire short and to the point.
- Provide clear instructions – general and/or per question (remember to have a "not applicable" where relevant, and to state whether one or at most so many choices are allowed).
- Target the vocabulary and style of the questions to the target population.
- Avoid ambiguity, confusion and vagueness. (What is your 'income'? Do you still hit your wife? Do you jog 'regularly'?)
- Avoid emotional, leading, discriminatory, biased etc. questions.
- Avoid double-barrelled questions – there should be unique or distinct possible answers (Does your company have health and car benefits, Yes or No?).

- Avoid questions beyond the respondents' capabilities, or memory span; predictions or guesswork; avoid double negatives.
- Pay attention to question layout – order and position of biographical/sensitive/ interest-building/logical flow of questions; also look at appearance in physical layout i.e. overall presentation.
- Use different question types, appropriate to the question.

Open-ended vs. closed options

Open-ended: Text or numeric (avoid as far as possible, although they can be advantageous in certain cases).

Closed-ended:

- Dichotomous (usually Yes/No)
- Multiple (3 or more choices, avoid overlap)
- Likert scale (ranked agreement or rating; ordinal variables – numeric or nominal, which influence type of analysis performed later). There are advantages and disadvantages to even vs. odd-numbered scales; reliability increases with more steps; in summary 3 to 7 steps on scale advisable.
- Specialised rating scales (e.g. semantic differential or eco system).

A good contrast between the advantages and disadvantages of close-ended questions is provided in the analytic tech references.

Remember to add a "thank you" and to repeat submission directions at the end of the questionnaire (and previously if earlier exit points were indicated).

Prepare questionnaire

Allow ample time for typing, editing and proof-reading (and web-layout, if applicable) of the questionnaire. Make sure that it is legible, blocks for answers large enough and well positioned, text clear and so forth, even after (photostatic) duplication.

Step 4: Select sample

You have meanwhile prepared for sampling (electronic list, for example) and now select the individuals per the sampling framework.

Step 5: Conduct pilot study and revise instruments

The pilot-study or pre-test is one of the most important, yet often neglected, components of a survey. It can be a comprehensive, formal study or an informal ad hoc procedure, like approaching friends or colleagues. At this stage the researcher has become so involved that an objective perspective is difficult and honest and constructive feedback is valuable. It provides a return, not only on content but also on duration for completion.

- Experience has taught that it is very important for the researcher to do personal hands-on data capture during the pre-test. It is the best way to get a "feel" for the way respondents react to the questions, the type of responses obtained, the validity of the coding structure in the questions, the ease of capture from the hard/electronic completed copies and the prescribed format in which the bulk of the data should be presented.
- Now update the return date in the cover letter and in the questionnaire.

Step 6: Administer and conduct survey

"Send out" the questionnaire, but remain in touch with all the role-players and closely monitor the prescriptions of the design framework, to ensure validity throughout the process.

Step 7: Follow-up non-response

The researcher can extend the deadline, re-sample respondents, test areas for penetration, check field-workers' actions in ways appropriate, similar or supplementary to the techniques of the survey itself.

Step 8: Prepare data

The data is captured according to a pre-tested procedure. It should be checked and proof-read and then the actual clean-up begins.

Preliminary descriptive statistics should be calculated at this stage and many data errors appear which should be corrected immediately. Bona fide outliers should not be altered or left out.

Examples of anomalies that appear are maxima or minima that are way out of line (e.g. age is 248 or –9). Graphs that show the spread of the data also highlight aspects that merit attention e.g. many "don't know/not applicable" responses need to be accounted for in later analyses.

Means of dealing with missing data per variate must be determined as well.

Step 9: Analyse data

Perform descriptive statistical analyses, as well as test of hypotheses, in close collaboration with the statistician involved in the project.

Make sure that you understand why the technique was chosen and what type of conclusion(s) can be drawn. Ensure that the terminology is accurate – descriptive statistics pertain to the respondents answers and hence cannot be generalised, whereas inference with regard to the population must be commensurable with the level of significance.

The whole purpose of formal statistical analysis is to determine whether the findings or conclusions are purely spurious or incidental, or whether they can be attributed to the influence of particular factors.

Be very careful, however, to not attribute causality to a correlation or significant difference, if that causality is not implicitly or explicitly unique. Relationships between ice-cream sales and drownings or liquor sales and salaries are examples of these.

Another word of caution pertains to looking very carefully at the implications of statements – often unwittingly altered by language editors. An example is "the annual number of high school suicides has doubled since 1990" vs. "the number of school suicides has doubled annually since 1990". If the number was 10 in 1990, the first statement leads to 20 in 2002; but the second statement implies the number grew from 10 to 20 to 40 to 80 to …. to 40960.

Step 10: Prepare the report

Once again, invest at least a day in planning the layout and contents of the report. Decide on which tables and/or graphs to include, on the use of colours and shadings

etc. Although one cannot always show all results, be careful that selective inclusion does not lead to misrepresentation.

Make sure that the software used for the analysis yields results that are compatible with the word processor in which the report is compiled, so that one complete electronic version is the end result. Make frequent back-ups and store them in remote locations. Arrange access to printing facilities.

Remember that the report must contain a description of the methodology applied, with motivation, and that the questionnaire and the data (if data set is not too large) must be attached to the report. Acknowledgements of contributions (advice, analyses, typing, etc.) must be included in the report or thesis.

Another word of caution, learned from experience: when the researcher thinks that the report is ready for final presentation to the client or supervisor, allow at least another two weeks for further publishing and editing, because this is one aspect of the survey that always takes longer than you think and technical hitches have a frustrating habit of presenting themselves in direct proportion to the approach of the deadline.

Step 11: Distribute the report

Ensure that the important stakeholders agree with the report before you start reproducing it. When consensus has been reached, disseminate the final copies. Be prepared to defend the contents to examiners or clients and be ready to prepare a presentation of the salient conclusions to an audience.

At this stage your whole data to information to knowledge cycle has been completed.

Appendix 1

Random Digits

Row										
1	695	7741	8254	4297	0	5277	6563	9265	1023	5925
2	437	5434	8503	3928	6979	9393	8936	9088	5744	4790
3	6242	2998	205	5469	3365	7950	7256	3716	8385	253
4	7090	4074	1257	7175	3310	712	4748	4226	604	3804
5	683	6999	4828	7888	87	9288	7855	2678	3315	6718
6	7013	4300	3768	2572	6473	2411	6285	69	5422	6175
7	8808	2786	5369	9571	3412	2465	6419	3990	294	896
8	9876	3602	5812	124	1997	6445	3176	2682	1259	1728
9	1873	1065	8976	1295	9434	3178	602	732	6616	7972
10	2581	3075	4622	2974	7069	5605	420	2949	4387	7679
11	3785	6401	540	5077	7132	4135	4646	3834	6753	1593
12	8626	4017	1544	4202	8986	1432	2810	2418	8052	2710
13	6253	726	9483	6753	4732	2284	421	3010	7885	8436
14	113	4546	2212	9829	2351	1370	2707	3329	6574	7002
15	4646	6474	9983	8738	1603	8671	489	9588	3309	5860
16	7873	7343	4432	2866	7973	3765	2888	5154	2250	4339
17	3756	9204	2590	6577	2409	8234	8656	2336	7948	7478
18	2673	7115	5526	747	3952	6804	3671	7486	3024	9858
19	187	7045	2711	349	7734	4396	988	4887	7682	8990
20	7976	3862	8323	5997	6904	4977	1056	6638	6398	4552
21	5605	1819	8926	9557	2905	802	7749	845	1710	4125
22	2225	5556	2545	7480	8804	4161	84	787	2561	5113
23	2549	4166	1609	7570	4223	32	4236	169	4673	8034
24	6113	1312	5777	7058	2413	3932	5144	5998	7183	5210
25	2028	2537	9819	9215	9327	6640	5986	7935	2750	2981
26	7818	3655	5771	4026	5757	3171	6435	2990	1860	1796
27	9629	3383	1931	2631	5903	9372	1307	4061	5443	8663
28	6657	5967	3277	7141	3628	2588	9320	1972	7683	7544
29	4344	7388	2978	3945	471	4882	1619	93	2282	7024
30	3145	8720	2131	1614	1575	5239	766	404	4873	7986
31	1848	4094	9168	903	6451	2823	7566	6644	1157	8889
32	915	5578	822	5887	5354	3632	4617	6016	8989	9482
33	1430	4755	7551	9019	8233	9625	6361	2589	2496	7268
34	3473	7966	7249	555	6307	9524	4888	4939	1641	1573
35	3312	773	6296	1348	5483	5824	3353	4587	1019	9677
36	6255	4204	5890	9273	634	9992	3834	2283	1202	4849
37	562	2546	8559	480	9379	9282	8257	3054	4272	9311
38	1957	6783	4105	8976	8035	883	8971	17	6476	2895
39	7333	1083	398	8841	17	4135	4043	8157	4672	2424
40	4601	8908	1781	4287	2681	6223	814	4477	3798	4437

THEME 6

PRINCIPLES OF MODELLING IN RESEARCH AND DESIGN

Gerrit Jordaan

The focus of this section is to:

- conceptualise modelling as research methodology.

1. MODELLING

Mathematical and physical (scale) modelling of prototypes (the planned, final product, structure or phenomenon under consideration) are important research practices in both natural and human sciences. This is also referred to as simulation, where it describes the representation of an actual situation by a mathematical model, or alternatively laboratory apparatus in the case of a physical model (Doebelin, 1995).

Even though modelling inevitably facilitates a better understanding of the expected functional characteristics and limitations of a real-life system, many researchers still do not use these research techniques optimally in the study of phenomena that can be modelled successfully. For a long period of time there was a tendency to use mathematical modelling predominantly for the study of engineering-related problems. Fortunately this is no longer the case, and it is increasingly being used to model phenomena that occur in other natural science disciplines and in the human sciences.

2. MATHEMATICAL MODELLING

Compared to experimental research, mathematical modelling has the following characteristics:

Time saving

The development of a mathematical description of a system under investigation, as well as the production of working computer programmes to simulate its functioning, can be a difficult and time-consuming process. However, once these steps have been completed successfully, it is normally a simple and quick process to investigate a large number of possible alternatives simply by varying the relevant variables.

Cost saving

It has been repeatedly found that the cost of mathematical modelling is invariably cheaper than an experimental procedure of a similar value to the researcher.

Access to information

It is often impossible to secure sufficient, relevant information about the functioning of a system experimentally. This problem is particularly severe when studying transient events. However, the mathematical simulation of a system usually provides the researcher with ample opportunity to execute the simulation repeatedly and to obtain the required information in this manner.

Replication

It is typically impossible to replicate any physical situation exactly, whereas the mathematical replication of the same situation is feasible and allows for repeated, careful consideration of the findings.

Safety

Extreme conditions that might be dangerous to individuals or the environment are often simulated. In this manner the consequence of such conditions can be studied in safety, without the researchers having to face situations such as hurricanes or tsunamis.

Mathematical modelling is the process of describing the behaviour of an element of a physical system, or a comprehensive system or phenomenon, by means of a mathematical expression, or a series of mathematical expressions. This can only be done after the identification, definition and quantification of the interrelationship of those variables with a substantial effect on the functioning of the system to be modelled. Thus, the effects of these variables on the performance of the system should be determined and represented mathematically to enable mathematical modelling of the system.

A system is usually a set of interacting or independent elements, real or abstract, forming an integrated whole and functioning collaboratively. The functioning of the system under specified conditions depends on the characteristics of each of its constituent elements. It is common to identify and describe the different elements of a system and to express the operation of each mathematically. By sequentially varying the values of one variable between predetermined limits, whilst monitoring the effect of this on the functioning of the system (the output) it is possible to investigate the effect of the particular input condition on the functioning of the system. In this way a better understanding of the different elements, and its expected effect on the functioning of the complete system, is developed.

Very complex systems can be described and studied as combinations of relatively uncomplicated, understandable subsystems (elements) – for each of which there is an approximate analytical solution available.

The mathematical description of a system usually consists of a number of equations, each defining an element of the complete system. To facilitate easier modelling of a problem, the system is often simplified by limiting the number of variables to the most critical in a description of the function of the system. Obviously this can only be done if there is a thorough understanding of the underlying functional principles of the system, otherwise variables critical to the functioning of the system may be ignored with a consequent fatal decrease in the accuracy of the developed model.

A defined model is usually simulated by the sequential solution of a large number of calculations, each set done with one varying variable - such as the reaction of the system over a period of time or a range of temperatures, etc., whilst the other variables are kept constant. In this manner the sensitivity of the system to change of a specific variable can be ascertained.

Figure 1 below shows a particularly accurate simulated response of an electric motor under certain specified input conditions (Nigrini, 1993). It depicts the expected (predicted) speed and torque of the motor under certain conditions, whilst Figure 2 shows a set of measured values for the motor when it was actually exposed to the same input conditions (Nigrini, 1993). From this it is evident that the

mathematical model of the expected torque and speed characteristic of the motor was such that the characteristics of the motor could be predicted very accurately. Careful inspection of Figure 2 reveals substantial electrical noise on the measured characteristic – which does not necessarily detract from the validity of the simulation.

With increasing evidence that an accurate model successfully describes the behaviour of a modelled system, the confidence of the modeller in his model will increase and it will usually be used increasingly.

However, successful modelling also requires substantial intuition and foreknowledge on the part of the researcher. Experienced modellers working in their field of expertise normally have a fairly accurate idea of the expected outcome of a simulation, often enabling a preliminary, intuitive assessment of the validity of the result.

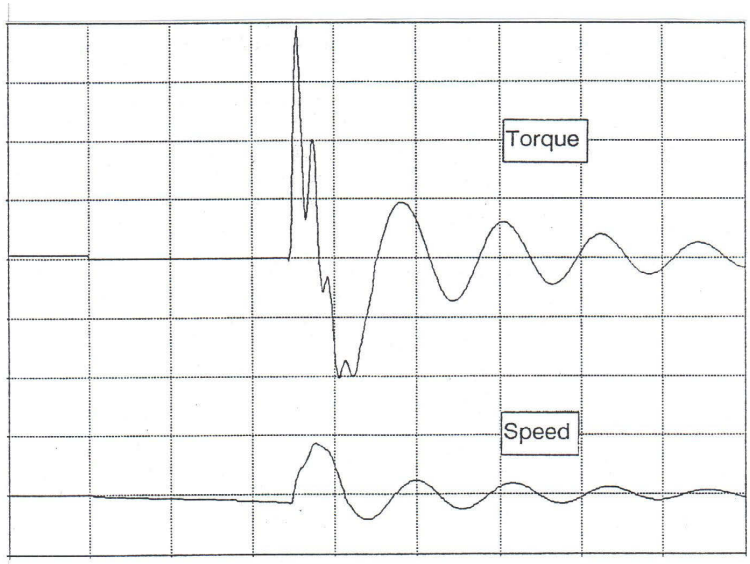

Figure 1: Simulated functioning of an electric induction motor under specified conditions

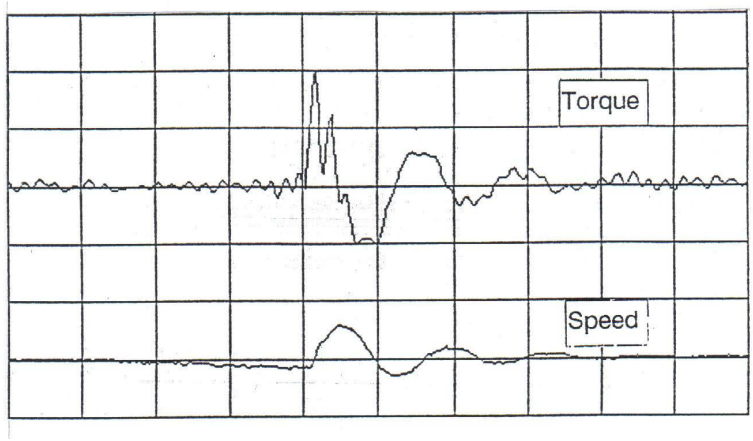

Figure 2: Measured performance of the simulated induction motor under the same, specified conditions

3. AVAILABILITY OF ANALYTICAL SOLUTIONS

Any system for which an approximate analytical solution is available – or can be derived – can be modelled mathematically and its functioning simulated numerically. This is normally done by considering the system as a combination of interactive elements as referred to above.

Table 1 shows a number of typical examples of physical phenomena that can be modelled successfully.

Table 1: Typical phenomena to be modelled

Modelled phenomena	Description of possible modelled characteristics
Prevalence of ailments	The prevalence of a certain ailment in the population of a particular community under specified conditions.
The effect of population size of certain kinds of game	The effect of an expected growth in the number of lions on the presence of a particular kind of game in a specified area over a period of time.
The flight path of an aircraft	The expected flight path of a specific aircraft with a defined load under a complete loss of power condition.
The growth of a tumour	The effect of certain drugs on the rate of growth of a tumour.
The operating characteristics of an electrical system	The expected speed and torque characteristics of an electrical motor under specified electrical supply conditions.
The effect of a particular change in the environment on an insect population	The relative population growth of a certain species of insect if subjected to a specified change in environmental conditions.

The expected behaviour of the system under consideration can be predicted with varying degrees of accuracy depending on the correctness of the mathematical formula(e) used to describe the system, as well as that of the boundary conditions and the initial conditions in the case of unsteady or time-dependant phenomena.

It is obvious that mathematical modelling is an extremely useful tool that can be used in a very wide variety of applications and is limited only by the mathematical abilities and understanding of the modeller of the system under investigation, rather than the discipline in which he or she is working.

4. SIMULATION SOFTWARE

The programming ability of the modeller, and availability of dedicated simulation software, normally determines the manner in which the modeller would do the actual simulation.

Mathematical simulations are often executed using a standard mathematical software package such as Matlab, Mathcad, Mathematica or Maple. Alternatively application-specific software with good graphic interfacing or a custom-written

programme can be used for this purpose. However, good graphic interfacing is an imperative since the evaluation of a simulation is normally easier if the results are provided in a graphical format.

A number of special-purpose computer languages for system simulation have been developed – where the use of any of these languages can eliminate a large amount of effort compared with starting with a general-purpose language such as FORTRAN. The General Purpose Simulation System (GPSS), as an example of application-specific simulation software, is a language orientated toward engineering situations and is used for production-flow problems and inventory analysis (Dieter, 1986).

A finite element model of a problem gives a piecewise approximation to the governing equations of a structure response. This technique facilitates the modelling of extremely complex shapes (Ertas and Jones, 1993) and structures – often under varying loads. With the recent increase in the availability of good, user-friendly finite element analysis (FEA) software and the exponential growth in the computing power of modern computers, FEA software is increasingly being used to determine the expected dynamic behaviour of complex systems and structures. With this type of software it is relatively common to accurately determine the expected performance of a complex system at more than, say, a million points of calculation – which, even with today's extremely powerful computers, may take hours of computing to simulate.

5. PHYSICAL MODELLING

Although physical modelling is used predominantly in engineering applications, it can also be used for the execution of controlled experiments in other natural science disciplines.

Aerodynamics plays a vital role in many engineering fields, such as aerospace, architectural, automotive and marine engineering. These phenomena are usually modelled physically in either wind or water tunnels (Ertas and Jones, 1993).

Mathematical modelling superseded scale modelling to some extent and facilitates a shorter reaction time in terms of possible changes in the design of a modelled system. However, the use of physical modelling is still very much the order of the day – particularly in terms of the modelling of hydrodynamic and geographical phenomena. In these cases there is often no analytical solution available and scale modelling is the only viable method to accurately investigate the characteristics of the prototype. Even with mathematically defined structures, physical modelling - such as wind-tunnel tests to assess the design of aircraft designs – is still being used. However, the need for large numbers of such tests has decreased substantially in the recent past.

Physical models are often used to visualise a planned construction and can also be used to investigate possible assembly procedures for the eventual product. However, its main application is probably to measure the expected functioning of a system under a specified range of varying conditions. Typical examples of cases where such measurements are made include:

- the effect of an increase in wind speed on the performance of a wind generator,
- the effect of a rise or fall in water level on the deflection of a dam wall,
- the aeronautical characteristics of a system,

- the vibration of structures due to varying loads or environmental conditions.

A physical model of a system typically consists of a scaled down (or in some cases scaled up) version of the complete system, or specific portions thereof. Often the system is simplified by limiting the accuracy to which some, non-critical, elements of the system are modelled. However, a thorough understanding of the underlying functional principles of the system is required to ensure the safe identification of non-critical variables.

As with mathematical simulation, the performance of scale models is often ascertained with one varying variable - such as the functioning of the system over a period of time or a range of temperatures - whilst the other variables are kept constant. The design of the experimental apparatus and procedure must take into account the preferred degree of automation appropriate for the experiment (Doebelin, 1995).

6. ADVANTAGES OF MODELLING

The ever-increasing use of mathematical and physical modelling techniques is ample proof of the immense value of these practices for modern day researchers and practicing engineers and technologists. The following examples are indicative of the advantages that normally flow from modelling and simulation in research activities:

- the resultant ease of performing controlled pseudo-experiments;
- the determination of the anticipated effect of any change in the operating conditions that will influence the functioning of the eventual prototype;
- time compression in the sense that a simulated experiment can take a small fraction of time compared to an actual system under test;
- sensitivity analysis for observation of the behaviour limits of a system;
- experimentation without requiring the financial outlay for the real system;
- it is an effective training tool.

7. THE ROLE OF DATA ACQUISITION IN MODELLING

In order to study the functioning of any physical model under specific conditions, the acquisition, storing and assessment of certain operational parameters of the model are required. Hence, data acquisition, i.e. the process of obtaining and recording primary experimental information, is an important step in the study of the functioning of a model. This facilitates subsequent data analysis and generalisations.

It is common for researchers to compare the outcome of experimental procedures – and the values obtained in such – with the expected or mathematically simulated values in order to substantiate the validity of their mathematical model. Normally this also enables the generalisation of such models that may be required for further studies on the relevant topic.

Most modern systems incorporate a vast number of mechanical or electrical elements, the status of which is continuously changing. When studying such a system researchers are interested in the values, such as location, magnitude and speed, and use a variety of instruments to measure it. Once measured with an appropriate device – usually a transducer – these values must be processed to meet specific criteria and stored in a computer for eventual processing.

The structure and functioning of a particular data acquisition system usually depends on the project under consideration, but typically consists of:

- a variety of transducers, each measuring a specific parameter and converting it into a corresponding electrical value;
- signal processing apparatus such as filters to limit the presence of electrical noise and amplifiers;
- analogue-to-digital converters; and
- a computer to store the measured values.
- appropriate software that facilitates the processing of captured data with a user-friendly human-machine interface that usually provides the researcher with a graphical representation of the results.

The design, installation and use of a data acquisition system typically require technical expertise and is often done by a suitable qualified individual in support of the researcher.

8. SUMMARY

It is frequently required to ascertain the expected performance of a system or structure under development. This would normally be done in one of the following two ways:

- A physical model of the system, with its size normally scaled up or down and with the main physical features that should impact on its performance being prepared in great detail, is built. Its functional characteristics are measured in physical conditions that approach those in which the prototype will be expected to function. From these measured results the expected functioning of the actual prototype is derived or predicted.
- A mathematical model of the system under consideration is developed and its expected functioning is simulated mathematically. From these calculated results the expected functioning of the actual prototype is derived or predicted.

Either of these two methods of investigation can be used, depending on circumstances, to validate a new design or the expected performance of a system. After construction of the prototype it would be normal to validate the accuracy of the modelling that took place by evaluating the performance thereof experimentally. These alternatives are shown schematically in Figure 3.

Both mathematical and physical modelling are well-respected research techniques frequently used by researchers in almost all fields of study to determine the expected performance of a system under development. It is imperative that researchers who are serious about the development and optimisation of new designs should be *au fait* with the relevant principles governing the use thereof.

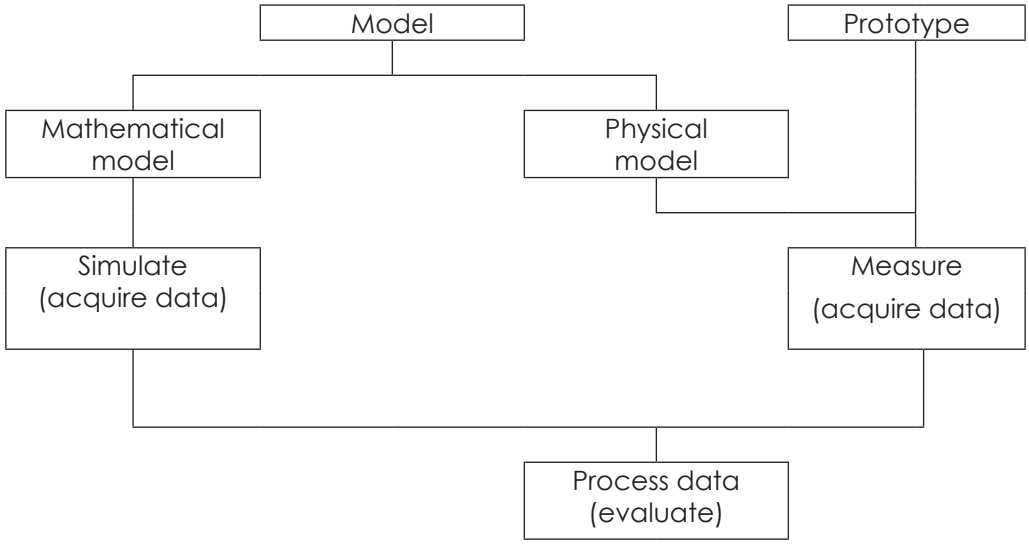

Figure 3: Alternative methods to determine the expected functioning of a system or structure under development

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THEME 7

THE QUEST FOR ACADEMIC INTEGRITY

Anita du Toit and Gerda Lamprecht

The focus of this section is to:

- describe the concept intellectual property (IP);
- define plagiarism; and
- outline steps to avoid plagiarism.

1. INTRODUCTION

Since World War II research has contributed to exponential growth in the creation of scientific and scholarly information, ideas and creations. Current technology enables students and researchers to be in direct contact with creations, ideas, literary works, compositions, and artistic works of variable quality. Students and researchers are exposed to such ideas and creations, and sometimes the inspiration they receive from this exposure inspires them to original thoughts, creations and ideas, but sometimes it contributes only to a simple and easy way to produce a requested assignment or thesis. It is becoming increasingly difficult to determine whether an idea or concept is indeed original, or just a skilled imitation.

For creators of original ideas, works of art or literature, it is very important to protect the originality of their creations. To address the need for protection of original ideas and creations, the notion of intellectual property (IP) rights came into existence, and this has developed into one of the most dynamic areas of modern law.

2. INTELLECTUAL PROPERTY

Intellectual property is a concept used to describe any creation of the intellect that has commercial value, including copyrighted property such as literary or artistic works, and ideational property, such as patents, appellations of origin, business methods and industrial processes (Sandiegobusinesslawfirm, 2008:online). Intellectual property includes works of art, literary works and publications, theories, inventions, websites, curriculum projects, discoveries and computer software, amongst others.

Intellectual property is protected by different mechanisms, for example:

- patents
- trade marks
- trade secrets
- copyright.

A *patent* is a legal document consisting of a set of exclusive rights granted by a state to an inventor or his assignee for a fixed period of time in exchange for a disclosure of an invention (Wikipedia the Free Encyclopaedia, 2008:online). These rights grant the patent holder the right to prevent others from making, using, offering to sell, or selling the invention claimed in the patent.

A *trademark* is a name, symbol, or other device identifying a product, officially registered and legally restricted to the use of the owner or manufacturer (Answers.com trademark, 2008:online). It is denoted by the symbols ® and ™.

Trade secrets can be described as information that is not generally known within the trade or industry, and that provides a competitive advantage (Answers.com trade-secret, 2008:online). Trade secrets are not protected by law in the same manner as trademarks or patents. Probably one of the most significant differences is that a trade secret is protected *without* disclosure of the secret.

The Copyright Act No 98 of 1978 protects all publications, whether they are of high academic standard or assignments submitted by first year students in their first semester of study. However, this does not mean that the usage of other people's ideas, creations or arguments is prohibited. Under the concept of "fair dealing", the Copyright Act provides for ways in which a researcher or individual person may make photocopies of information resources.

2.1 Copyright and fair dealing

Copyright is a legal term describing the economic right afforded to creators of literary and artistic works, including the rights to reproduce the work, to make copies, and to perform or display the work publicly.

Works protected under the Provisions of the Copyright Act are:

- literary works
- musical works
- artistic works
- sound recordings
- cinematographic films
- sound & TV broadcasts
- programme carrying signals
- published editions
- computer programmes

For the purpose of academic writing, the focus is on literary works. Literary works, irrespective of the quality of the work, may be any of the following:

- novels, works of fiction and poetry;
- textbooks;
- dramatic works, stage directions, film scripts and broadcasting texts;
- manuals, dissertations, historical works, biographies, essays and articles;
- encyclopaedias and dictionaries;
- letters, reports and memoranda;
- lectures, addresses and sermons;
- written tables and compositions;
- examination question papers; and
- minutes and policies.

If an individual researcher needs to make photocopies of literary works, the Act on Copyright makes provision for this under the concept of fair dealing. Any fair dealing with a literary or artistic work does not infringe copyright when it is:

- for the purposes of research or private study by, or the personal or private use of, the person using the work;
- for the purposes of criticism or review of that work or of another work; or
- for the purposes of reporting current events in a newspaper, magazine etc. or by means of broadcasting.

The question arises as to how much a person may copy of a book or a literary work. The answer to this question is that this will depend on the circumstances of each case. In the case of all the works mentioned, fair dealing must be accompanied by appropriate acknowledgement: the source of the work and the name of the author must be mentioned. If a work is used without proper and appropriate acknowledgement, the user can be found guilty of plagiarism.

3. PLAGIARISM AND HOW IT CAN BE AVOIDED

"Plagiarism" is derived from the Latin term *plagiarius,* which referred to a person who stole or kidnapped slaves or children. Plagiarism can be traced back to the first century AD when Fidentius borrowed poems of Martial, a Roman poet, without acknowledgement. Martial referred to this as the "stealing of servants of the imagination" (Lathrop and Foss, 2000:161). In 1710 the English *Statute of Anne* legalised an author as the possessor of his/her own written works (Sutherland-Smith, 2005:2). Over the centuries, plagiarism has remained a sticky subject because experts differ on what plagiarism is or isn't, and it is still a trap into which even professional writers fall from time to time. Roig (2003:1) acknowledges that plagiarism is "the most widely recognised unethical lapse" in scientific writing despite the fact that the academic world interprets plagiarism as a serious form of unethical writing.

There are a number of differences in the outcomes of studies done to determine why students plagiarise. Hale's (1987) study indicates that 55% of students surveyed admit they have plagiarised material and according to this study students were well informed on what plagiarism is. In direct contrast to Hale, Roig's (1997) study indicates that students are often confused about the difference between correct paraphrasing and plagiarism. In Roig's study students were asked to rate paragraphs that had been paraphrased from the original text. The students correctly identified most of the paraphrased paragraphs as having been plagiarised, but over 60% of the students incorrectly identified some of the more subtly plagiarised paragraphs as correctly paraphrased, because the original source was cited. This study indicates that students believe, incorrectly, that when the original author and source are cited, plagiarism is excluded. The reason for this may be that most definitions of plagiarism only focus on the importance to cite the original author and source to avoid plagiarism. Roig (1997:1) confirms this with the words: "…plagiarism may occur even when the "borrower" acknowledges the author of the original material." For example, consider the situation where a writer takes a paragraph of text and changes only one or two words such as prepositions or articles, repositions the subject and predicate and includes a reference note or some other indication that the writer has credited the original author. A strict interpretation renders such "paraphrasing" as constituting a case of plagiarism, particularly if the "voice" of the original author is preserved in the rewritten version"

3.1 Definition of plagiarism

Plagiarism is an act of fraud when words, ideas, images, sounds, or the creative expression of others are presented as one's own, without an indication of where the work was copied from. It means stealing someone else's words or ideas. Plagiarism can further be defined as:

- copying directly from a text, word-for-word, without acknowledging the original author and source;
- using an attractive phrase or sentence you have found in another source without acknowledging the original author and source;
- downloading text from the Internet without acknowledging the original author and source;
- giving incorrect information about the source of a quotation/paraphrase;
- paraphrasing words of text closely by only changing some of the words or the sentence structure, without acknowledging the original author or source;
- using statistics from another source/person without acknowledging the original source, or presenting false data;
- copying a fellow researcher's work without acknowledging that researcher;
- copying or paraphrasing from work you have published elsewhere without a citation;
- copying so many words or ideas from a source that it makes up the majority of your work, whether you give credit or not;
- downloading or copying pictures, diagrams, tables, photographs etc. without acknowledging the original author and source;
- paying another person to write your research findings.

3.2 Types of plagiarism

It is important to recognise the various forms of plagiarism with a view to prevention.

- **Ghostwriting plagiarism** occurs when somebody else (a ghost-writer) is writing or doing the assignment on your behalf, whether you pay such a person or not. This is not acceptable in higher education.
- **Patchwork plagiarism** occurs when one uses text from various sources and puts it together in one document, replacing some of the words with synonyms, or inserting and/or deleting some words, and does not give credit to the original sources.
- **Complete plagiarism** occurs where a learner turns in another's work, word-for-word, as his/her own. This also refers to direct translations from another language. Plagiarism cannot be avoided even if the original source is acknowledged.
- **Near-complete plagiarism** occurs when a substantial portion of the original text is copied without acknowledging the author by using inverted commas and a reference citation.
- **Self-plagiarism** occurs when a researcher reuses his/her previous research and presents it as new and original. To prevent self-plagiarism one has to rewrite the duplicate sections and cite the original research in the source list of your other research papers.

3.3 How to avoid plagiarism

When doing research you may apply, analyse, criticise, summarise and quote other people's work as long as you are citing the original sources and presenting a list of references at the end of your research. A citation informs the reader that certain material in the work came from another source and it gives the readers the necessary information to find that source again. Such a reference includes:

- Information about the author
- The title of the work
- The name and location of the publisher
- The publication date and the page numbers of the material you borrowed from
- Referencing and citing will emphasise the originality of your own work

The following strategies can be used to prevent plagiarism:

3.3.1 Quotations

Quotations are words or sentences that you copied directly from an original source. Quotations should always be placed in quotation marks (") with an in-text reference and cited in the source list. If quotations are not placed in quotation marks, it is plagiarism, whether you have referred to the original text or not. Don't use too many quotations, as quotations are meant to support what you say and not substitute for it.

Only use quotations when:

- you want to include the author's words to support your argument;
- you want to disagree with an author's statement;
- you want to highlight particularly powerful phrases;
- you are comparing opinions; and
- you want to emphasise the important research that precedes your own (Valenza online:2003).

3.3.2 Paraphrasing

Paraphrasing means to express the words or ideas of an author in your own words. A paraphrase must be followed by an in-text reference and cited in the source list.

When you make use of paraphrasing ensure that you use your own words and change the sentence structure completely. Paraphrasing does not mean changing words here and there; omitting sentences or scrambling the sentence structure while changing a few words in someone else's sentence by using synonyms. You can paraphrase when you want to avoid overusing quotations and rather want to use your own influence to present information (Valenza, 2003:online).

The following example of paraphrasing is borrowed from the PowerPoint presentation of the College of St Benedict/St John's University by prepared by David Arnott (2006:online):

> "Coldplay didn't seem destined for bigness. Their 2000 debut, *Parachutes*, was full of drizzly but pretty rock ballads that were almost memorable enough to prevent American listeners from confusing the band with Travis. Of course, that

album also included a huge, soaring song called 'Yellow,' which may well be inspiring a drunken sing-along in your local bar as you read this".

An inappropriate example of paraphrasing may look like this:

It did not seem that Coldplay was destined to be big. In 2000 their debut Parachutes was full of misty but beautiful songs which almost convince Americans that they are the group Travis. In this album, the song "Yellow", which is quite memorable, was included. This song might as well motivate drunks to sing together in bars.

An appropriate example of paraphrasing may look like this:

When Coldplay first arrived on the music scene, it seemed they were just another band; popular but nothing special. Their first album was a collection of typical post-alternative pabulum surrounding a single selection, *Yellow*, which has inspired many a drunken rendition with the jukebox late into the evening.

3.3.3 Summaries

A summary is a shortened version of the original words and ideas of the original author in your own words. You must give credit to the original source by using an in-text reference, which is also listed in the source list. Summarise when you want to establish background or offer an overview of a topic, if you want to illustrate knowledge used from several sources about a topic or you want to determine the main ideas of a single source (Valenza, 2003:online).

3.3.4 Citing or referencing

The accurate acknowledgement of the sources used in the preparation of your assignment is called **citing** or **referencing.** Citation or referencing is the process of letting your reader know whether the content you have used was written by you or by someone else. References are cited in the text itself where you referred to a specific source. This is called in-text referencing. All the in-text references are also cited at the end of your assignment in the bibliography or source list. References form an integral part of an assignment and ensure that plagiarism is avoided.

Why should you give references? You should grant recognition to the author whose particulars or information is used. You need to specify what you have borrowed, i.e. facts or opinions. By giving references you further enable the reader to consult the original sources. A list of references also proves that your research is up to date and supports the originality of your work.

Interestingly enough, there are instances where a reference is not needed. It is not necessary to cite (i) happenings considered to be common knowledge, e.g. Nelson Mandela was the first president of the democratic South Africa; (ii) when a fact is found in at least 5 sources and one is quite certain that one's readers already know it, as it is likely that it is common knowledge. However, when in doubt, it is safer to over-cite; (iii) your own experiences or research results, except in the case where these results or experiences have already been published in another information resource.

3.4 Recommendations to study leaders and facilitators

It is crucial that researchers and learners ensure that they understand what plagiarism is and that they are aware of the implications of making themselves guilty of plagiarism. Lathrop and Foss (2000) offer various recommendations to develop a climate of academic ethics and integrity regarding the usage of information. Educators and academic institutions should develop academic integrity policies. These policies should form a part of learner guides. Each assignment should be structured in such a way that it develops and inspires original, creative thinking. In an academic environment, where education should be taken seriously, learners and researchers should be expected to hand in a total portfolio of resources, structures, outlines and notes used and developed during the creation of their assignments or research process. Honesty, integrity and ethical usage of information should be of equal importance with grades, and should be acknowledged. Annotated lists of references or bibliographies should be required, asking learners and researchers to defend and describe their sources.

4. CONCLUSION

Currently researchers and users of ideas debate whether intellectual property rights contribute to the creation of new inventions and ideas, or whether they limit these endeavours. It may however be argued that unlimited, unethical use of information may result in diminishing original thought, development and expansion of the creativity of the individual mind. Recognising and respecting the thoughts and ideas of authors and inventors gives the user thereof the freedom and the opportunity to contribute to the original idea or creation. This also motivates the user to take ownership and responsibility for personal development of thought and creativity, as well as to respect and acknowledge the intellectual property of others. Education and leading by example can, in a nutshell, be described as a panacea to sensitise users of information to the ethical usage thereof, and to stimulate and develop individual originality and creation.

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THEME 8

SCIENTIFIC WRITING

Laetus O.K. Lategan

The focus of this section is to:

- outline the scientific writing steps.

1. TEN STEPS TO WRITING SCIENTIFICALLY

In this book, several themes have captured the research process in four broad activities, namely the *research problem, research design, evidence to solve the research problem* and *conclusions based on the research evidence*.

The question that this theme wants to address is how to write scientifically. This theme proposes ten steps to be considered when one is writing scientifically – whether it is for a degree study, a scientific paper or a conference paper. These ten steps can be identified through the following questions:

- What exactly is the research problem of the study?
- Are all the concepts linked to the research study identified?
- What ethical considerations should be taken into account when one is dealing with the research problem?
- Which research design is most appropriate for the study?
- What are the results of the literature review?
- What are the results of the data collection?
- How will the literature review and data collection be used to address the research problem?
- What new conclusions can be drawn?
- How should the research be assessed?
- Were all the references collected?

In the next paragraph these steps will be highlighted in more detail.

2. HOW TO DEAL WITH THE TEN STEPS IN WRITING SCIENTIFICALLY

2.1 What exactly is the research problem of the study?

No research can be without a research problem. The research problem should not be regarded as a negative approach to research. It refers to what the problem in the research project is, and how solutions for this problem are sought. The aims and the objectives indicate what the science paper wants to achieve via the stated research problem. The way in which a research problem is formulated will direct all the steps in the research process. Kumar (2005:41) correctly states that "The research problem serves as the foundation of a research study: if it is well formulated, you can expect a good study to follow." It is for this reason that he compares the research problem to the foundation of a building.

2.2 Are all the concepts linked to the research study identified?

All sciences work with concepts. An explanation of a concept creates a common understanding of the concept. This is a necessity, especially because of the influence of the philosophy of science, various paradigms, scientific traditions and schools of thought.

2.3 What ethical considerations should be taken into account?

Research ethics makes one aware of scientific misconduct. The most common notions of scientific misconduct are the fabrication and falsification (including plagiarism) of data. But scientific misconduct is not limited to these two acts only. Questionable research practices and violating traditional values of the research process also have a negative impact on the research integrity. Scientific misconduct includes issues such as falsification and/or fabrication of information and/or data, plagiarism, self-plagiarism, the absence of informed consent, conflict of interest, poor supervision, the lack of responsibility in laboratories working with hazardous material, the ignorance of personhood, the environment, animal rights, etc.

2.4 Which research design is most appropriate for the study?

The research design refers to how will one approach the research project informed by the research problem and based on the existing research methodologies. The research methodology consists of the "tools" used to execute the research project. Many research papers fall short, either in using an appropriate research methodology for doing the research or in explaining why a particular methodology is used.

2.5 What are the results of the literature review?

The literature reflects on (and not lists) the latest published research results on a particular topic. The researcher interacts with the literature to identify new trends, results and methodologies. Burns and Grove (2007:161) expand on this by saying that the literature review is a summary of current knowledge about a problem and includes what is known and not known about this problem. Du Toit (2005b:59) rightly reminds us that the integrity of the text should be protected. To avoid misinterpretations the reading should be shaped around the text itself.

2.6 What are the results of the data collection?

A research project very often requires the verification of the results via qualitative and/or quantitative research techniques. Through data collection new knowledge can be added to a particular topic.

2.7 How will the literature review and data collection be used to address the research problem?

A science paper is about using one's research results based on the interaction with literature, and the integration of the literature review results with the qualitative and/or quantitative data capturing. The results should be analysed (evidence taken apart) and discussed (including the execution of various forms of critique) to build a new understanding of the identified research problem and to identify new problems that need to be addressed. Botes (2005:176) remarks that valid scientific knowledge is distinguished from pre-scientific knowledge through the following characteristics:

- systematic problem-solving methods
- supported by empirical and theoretical statements
- accepted by a particular research community
- accurate reflection of a given case

2.8 What new conclusions can be drawn?

In this section the author needs to present the findings of the research project. If the findings are simply repeating what is already known, then it is a mere confirmation of research results. This is repetition and cannot be regarded as the production of new knowledge at all.

2.9 How should the research be assessed?

The successfully completed science project should be subjected to quality assessment. Four assessment activities are essential: firstly the assessment of ethical practices associated with the research, secondly technical issues associated with scientific writing, thirdly whether the research problem has been solved and fourthly whether any new results were presented. The science paper will never be completed unless the research problem is addressed. If the research problem is not addressed there cannot be evidence of the creation of new knowledge. The researcher should engage in a self-assessment exercise and evaluate whether the research is a mere repetition of what is already stated in the literature or similar studies or whether a new understanding of the process is added.

2.10 Were all the references collected?

Here one has to verify if all the references are cited and if credit is given to those scholars on which the research project has been built.

3. CONCLUSION

The steps identified for writing scientifically are a generic set of actions and (the major part thereof) can be found in the written project. If the sequence of problem, design, evidence and conclusions are followed then it is safe to say that this framework will be the foundation of all scientific writing – regardless of the discipline.

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THEME 9

WRITING A RESEARCH REPORT

Liezel Lues

The focus of this section is to:

- provide guidelines on how to write research reports;
- outline some of the reasons for writing reports; and
- discuss the general layout and content of a research report.

1. INTRODUCTION

Successful report writing requires a combination of substance and technique: having something worthwhile to say and knowing how to write it effectively. The emphasis of the writing as an activity is integrated with a number of academic functions. Writing is critical because in a mass higher education setting, it is an essential communication channel to lead people to take action and help them to make decisions. Furthermore, the research report communicates the results of research and is evidence of the quality of the research. This section outlines some of the reasons for writing reports, the general layout and content and concludes with comments on matters of written expression.

2. A REPORT IS A REPORT IS A REPORT – ALL THE SAME?

A report is a well-structured, objective, informative document or presentation, which aims to provide the reader or listener with information on a specific subject (Erasmus-Kritzinger, 2003:273). The purpose of a report is to give readers a quick overview of a situation, while also giving them answers to particular questions that they may be seeking (Hay, 1999:125). A very simple report may have a standard format, in other words, a title, introduction, main body and a conclusion. However, longer reports may contain other sections as well and possibly even an appendix. It is important to note that a report differs from a thesis or an article. A **thesis** refers to a research project submitted in fulfilment of the requirements set for the awarding of an advanced degree. A thesis must verify that the student is capable of doing original research, contribute new knowledge and be persistent with logical arguments and evidence (Day, 1998:255). An **article** includes comparisons and evaluations of ideas and statements, as well as methods of several research projects and researchers. The main purpose of an article is to convey new knowledge (research) and not to sell ideas as such. Several articles may flow from a thesis.

3. WHY A RESEARCH REPORT?

There are several reasons why a research report may be required. First, a research report provides the reader with a valuable means of assessing one's overall development as a researcher as the report will reflect critically the depth of one's understanding of the entire research process. Second, research reports often involve the communication of research findings and are presented to an audience which anticipates answers to a certain set of questions that must be answered (Hay, 1999:125). Third, it keeps the information classified into particular sections that makes

it more accessible and easier to read. These sections in the research report not only provide an overview of the entire project but also prohibit any misunderstandings.

There are different kinds of reports for covering different topics and having different purposes, such as the research or laboratory report, or a report to evaluate a project. For this reason reports have different structures and are made up of a variety of combinations or report sections. The importance of each report, however, lies in the fact that each provides particular emphases associated with each report type (Erasmus-Kritzinger, 2003:274).

Reports answer five investigative questions (Eisenberg, 1992:276). What did you do? Why did you do it? How did you do it? What did you find out? What do the findings mean? According to Eisenberg (1992) the person reading your report seeks clear and concise answers to these questions. For example a research report could be written primarily for educational reasons, or prepared for consultancy purposes. Some research reports are used for appraisal and audit purposes, whereas others may have the sole purpose of demonstrating the progress of the project (Vassallo,2004:278). Laboratory reports will investigate questions through a highly structured progression (i.e. introduction, methods, results, discussion) and written in a manner which would allow another researcher to repeat the experiment (Hay, 1999:127). Research reports involving qualitative research methods (e.g. interviews, participant observation) will answer the five questions identified above, although in a more literary and less rigidly structured form. Reports in the private and public sectors that focus on evaluating projects will rely strongly on what works well, will determine what does not and will implement the proposed corrective actions (Vassallo, 2004:278). As a result of these different expectations, the balance of content within research reports may also differ. However, all of these reports have the common goal of providing comprehensive feedback on a purposeful event and of assisting the reader to make decisions.

4. RESEARCH REPORTS – GENERAL LAYOUT

It should be clear from the paragraphs above that although research reports will usually answer Einsenberg's five questions there is no single prescribed style for the report. The key to good report writing is well-executed research and the will to communicate your results effectively. Although most research reports contain the same major sections, it is possible to omit sections or add others (American Chemical Society, 2005:online). Generally a research report will include the following sections.

Title and title page

The title should be stated in the least possible number of words and yet provide as much information about the study as possible (Lues and Lategan, 2006:7;39). The title needs to reflect the major emphasis of the research report whilst preparing the reader for the information that will be presented. A title should also be interesting to the reader and should stimulate him/her to read the whole of the research report (Hay, 1999: 128).

The title page of a research report usually contains the title of the report, reporter's name, position, organisational affiliation, the name of the institution for which the report has been prepared and the date the report was completed (American Chemical Society, 2005:online). All of the above should appear on a single cover page.

Abstract or executive summary

An abstract is a summary and not an in-depth account of the paper: it appears at the beginning of a research report (typically 200-300 words in length) (Lues and Lategan, 2006:39). It is the abstract that is likely to contribute to the vital first impression of the reader. An abstract should provide answers to each of Eisenberg's (1992) five questions: What did you do? Why did you do it? How did you do it? What did you find out? What do the findings mean? The abstract should be written in "introduction-body-conclusion" style. Abstracts are located at the beginning of a research report, although they are often the last section written (Hay, 1999:129).

Acknowledgements

A large percentage of research projects could not be successfully completed without the input of institutions and individuals. Inputs such as technical assistance, comments, feedback, time, advice, support, audiovisual and printed materials, should always be acknowledged (Lues and Lategan, 2006: 42). As a general rule, thank only those people who genuinely helped with aspects of the report, such as proofreading and assistance with statistics. However, when writing acknowledgements, be aware of the possible need for confidentiality and clarify the proclamation thereof beforehand.

Table of contents and supporting pages

A table of contents is required in longer research reports to assist the reader in following the structure of the research report. It should list all headings and sub-headings of the report together with their page numbers (American Chemical Society, 2005:online). Using descriptive headings will assist the reader in getting a holistic view of the content, structure and flow of the report. The table of contents occupies its own page in the research report and must be organised with appropriate spacing (Hay, 1999:129). Other guiding pages that will strengthen a logical presentation of the report must also be included here. This includes abbreviations, acronyms, definitions and/or jargon.

Introduction: why did you do the research?

Begin the introduction at the top of a new page. The **introduction** provides the context for the research through briefly stating the background, purpose and scope of the research (Hay, 1999: 130). The **background** provides facts that the reader must have in order to understand the discussion in the report. It can include information on theories, conditions, events, problems and/or previous research that caused the research to be executed (American Chemical Society, 2005:online). State what was known about the subject at the beginning of the research. Give reasons for the research and discuss the events that led up to it. Assess the importance of other, related work. The **purpose** of the research indicates to the reader what the research discovered or proves. It should be clear as to why this problem was researched and why this report is deemed necessary (American Chemical Society, 2005:online). The **scope** refers to the coverage of the subject. It should provide reasons for the parameters being used as well those that were omitted (American Chemical Society, 2005:online).

Materials and methods: how did you do the research?

Once the readers know something about the background to the research, it is necessary to let them know how the research was carried out. This section should lend validity to the research report and will include a description of the actual work carried out in chronological order. Sufficient detail should be provided in order for other researchers to be able to repeat the method and obtain comparable results (American Chemical Society, 2005:online). This part may be written and presented as a single section or under separate headings, for example:

- Sampling and case selection - this section includes the size of the sample; how the sample was dealt with; how were the variables measured; how many samples were collected, etc. Explain the experimental OR sampling design (i.e. how the experiment or study was structured).
- Apparatus – the equipment and materials used. Provide a list of items of apparatus, materials and details of their arrangement.
- Procedure – account of how the data were collected and the methods you used to interpret the findings (Hay, 1999:131).

If you report on a test or experiment, its findings and its conclusions, the test or experiment must be accurately carried out and results recorded before you can write the report. It should be borne in mind that accuracy, sensitivity and safety with regard to equipment used, is very important. Ensure that you know how the equipment works and then set it up in the most sensible way for you to take the required measurements and make observations. Ensure that you observe and record accurately. If the results do not make sense or are inconsistent, then do the test again. In this case the usage of scientific apparatus, theory and methods of experiments would form an important component. This kind of research report could be published in a scientific environment.

Results or findings – give the final results that tie in with the purpose of the experiment.

The result section of a research report is typically a dispassionate, factual account of the findings. Concentrate in this section on each objective of the research and structure the results around these objectives. Discuss the results, and build up an inclusive picture. Summarise relevant data, observation and findings neatly tabulated with graphs. "A tabular presentation of data is often the most important section of a scientific paper" (Morgan cited in Day, 1998:61). Give accounts of the estimated limits of error. What did your experiment discover or prove? A discussion of your interpretation of the facts should always be presented in a positive way (Hay, 1999:132). This section will often have a series of subheadings in it that are usually listed numerically (Lues and Lategan, 2006:41).

Discussion and conclusion – what do the findings mean?

The discussion is the heart of a research report and may require critical thinking and evaluation from the researcher. The discussion has two fundamental aims (Hay, 1999:132). The first is to explain the results of the study and second to explore the significance of the findings. Thereafter interpret the findings obtained and explain their significance.

The conclusion, however need to be brief and to the point. Conclusions should flow naturally from the results and therefore each conclusion must be supported by your

findings and/or other research. A conclusion never contains NEW information as this can open a whole new discussion (Lues and Lategan, 2006:42).

Recommendations - optional

Recommendations should include suggested actions and further investigation, if any (Hay, 1999:133). They should flow naturally from your conclusions, with no surprises. It is important to spend time on the writing of this section, as it is sometimes the only part, which readers look at. The recommendations may include suggested actions, who should take them, and any further investigations necessary. A recommendation section should only be included in the report if it is deemed necessary, otherwise it is a waste of the reader's time (Laflen, 2001:online).

Appendices and references

Include information as appendices, which could disturb the flow of the report (e.g. surveys and questionnaires). This information must be relevant to the research report but needs to be kept separate from the main body (Laflen, 2001:online). Each appendix should be clearly labelled with a letter A, B, C and so on. They should be arranged in the order in which they were referred to in the research report (American Chemical Society, 2005:online).

An informal or short research report may not require a reference list. However, if you included a section on the background to the research or discussed theories and models related to the research, this will necessitate a reference section (Laflen, 2001:online). A reference section in the research report allows future researchers to verify the credibility of the report (see themes 11 and 12 for referencing methods).

With these examples as a guide in structuring the report, it will also be necessary to pay attention to matters of written expression. The English language often offers several ways of saying the same thing. For research report writers, however, there will usually be one or two versions of a phrase or statement that will convey a message more effectively than others. For this reason the following section will look briefly at the methodology for writing informatively, in other words to convey information in such a manner that it informs an audience and equips them with enough information to make a decision.

4. INFORMATIVE WRITING

Informative writing is applied in a range of publications and factual documents including research reports. The main aim of informative writing is to inform the reader rather than to impress or to entertain.

In the writing phase of your report, the objective should be to seize and retain the reader's interest and to write the most informative and legitimate paragraphs possible. It often happens that the sequence of words that we use for speaking is not the most effective for writing. The reason might be that when we speak we often compete for "speaking space" and therefore tend to put our main points first. For intellectual capacity, however, the context should be first (Goddard, 1998:37).

The following aspects are important pointers to apply when writing a research report:

- In research reports the author is not referred to in the first person. Instead of using "I found …" rather use "It was found…". The writer should not express a personal

opinion, but state the facts – the reader is interested in the information and not your opinion (Erasmus-Kritzinger, 2003:274).

- Similarly to keep the report as objective as possible you should avoid humour or exaggeration, being biased, showing prejudice, or expressing emotion (Erasmus-Kritzinger, 2003:273).
- Within scientific reporting the experiment has already been done and therefore the text should be in the past tense (Erasmus-Kritzinger, 2003:274).
- Be specific rather than general. Rather use short, familiar words and sentences than longer, less familiar ones.
- Use accurate words rather than vague ones (Goddard, 1998:40). In this regard Day (1998:210) is of the opinion that euphemisms should not be used, especially in scientific writing. The author refers to the example of laboratory animals that are not "sacrificed" but simply "killed" (1998:210).
- If a report contains jargon (technical terms), provide a glossary at the end of the report. However, the research and scientific reports are written for an educated audience and therefore Day (1998:215) suggests that only unusual technical terms need explanation.
- Break up your text into paragraphs. Combine sentences into a paragraph that contains the development of one complete thought.

According to Weideman (2003:111) informative writing starts and ends with reading. Not only is reading critical for becoming academically literate, it also enhances one's vocabulary, develops one's skill to assess the merit of each source and is a prerequisite for writing well (Kirszner and Mandell, 2002:139).

5. CHARACTERISTICS OF A WELL-WRITTEN ACADEMIC REPORT

Organising and structuring one's writing carefully is the hallmark of all research reports. Writing cannot progress before your have organised your thoughts. A report is often the written presentation of an argument and if this argument is not logical and clearly presented it might be evaluated as a weak argument (Weideman, 2003:171).

Organising one's report is also important to arrive at a logical and meaningful structure as illustrated in Figure 1. This involves decisions about the type and structure of the report, the usage of figures and the format. According to Bowden (1997:18) a suitable framework of a report will entail a beginning, middle and an end.

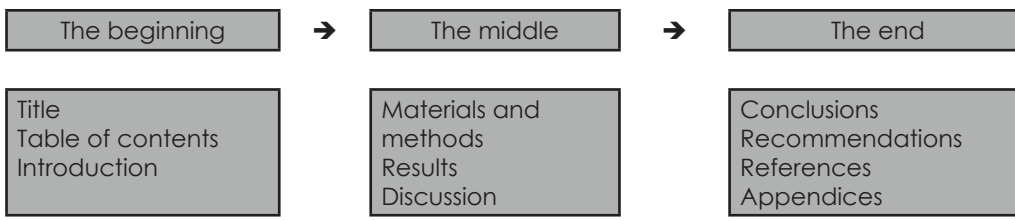

Figure 1: Logical flow of presenting information in an academic report

- Make a report interesting to read. Combine relevance, logical consistency, surprise and readability, using analogies, interesting layout, graphs and pictures.

However, use an illustration only if it makes the point more effectively. It must at all times be useful and relevant. Clear graphs are as important as clear writing.

- Make sure that your report is a readable document and that it is a pleasure to read. Bearing the readers in mind throughout will assist you in knowing what to say and how to say it.
- Though reports are usually written for the interest of people in a senior position, writing the report in a subservient style should be avoided. A report should always reflect the exchange of information between equal professionals.
- Spend enough time interpreting and explaining your results in clear language, but by no means sacrifice clarity for the sake of briefness. Always read through the report and ensure that each section is complete. This applies to the content as well as the use of language and the transitions between sentences and paragraphs.
- Always support your judgments with specific examples from authors, previous research or your own findings (Lues and Lategan, 2006:11).
- Be sure to separate the results and discussion. The results section should include only what you have found and the discussion what the results mean.
- Pay attention to the reference list. Vague or incomplete references are not acceptable. Keep a record of all the sources you encounter that might be relevant to your report.
- Never make a report longer than it needs to be (Erasmus-Kritzinger, 2003:274).

6. CONCLUSION

Writing a research report means more than just reading about other people's work and ideas. You need to think critically, evaluating and interpreting the ideas explored. It requires discipline, strategic planning and a constant keenness to rethink ideas and rewrite discussion.

In the aforementioned section guidelines were provided on writing research reports. The section also outlined the necessity for writing reports and then proposed a general layout. Comments on matters of written expression were also provided.

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THEME 10

SOME GUIDING PRINCIPLES FOR LEGIBLE ACADEMIC REPORTS

Rudi W. de Lange

The focus of this section is to:

- comprehend how best to present a legible report.

1. INTRODUCTION

The successful presentation of your research results is based on several interrelating factors namely the writing style, the readability of the text, the interest that the reader has in your work, the tone of your voice during a presentation, the legibility of the text, appropriate visuals, the chosen mode of presentation and the type of journal in which it is published, to name but a few.

These interrelating factors can, for the sake of this presentation, be grouped into three areas: the internal, the external and the human factors.

A research project, for example, on the safety of a drug for animals, will be of value to the veterinarian fraternity but will have a low impact if it is badly written (poor readability), badly presented or if it is presented, for example, to a group of nurses (of low interest to the audience). The interaction of these factors is illustrated in Figure 1.

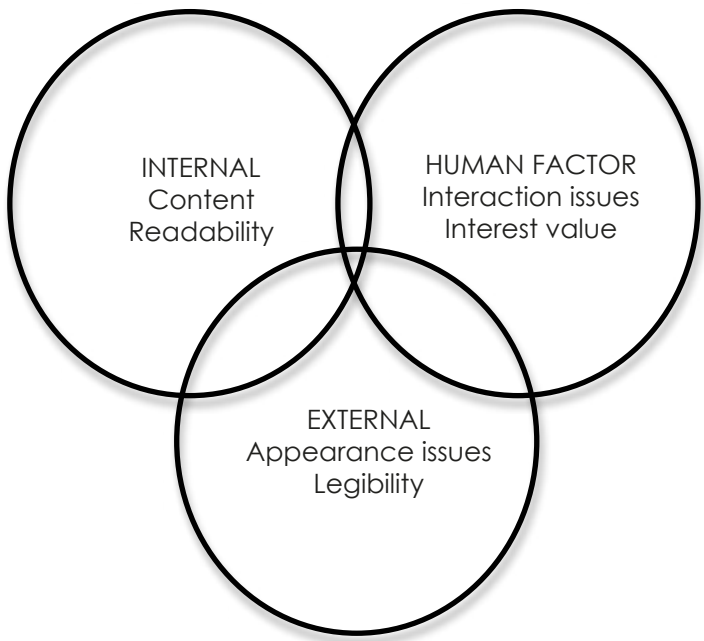

Figure 1: Graphic representation of the main factors that affect the effective presentation of research results

We are intuitively aware that the manner in which an oral presentation is made is important, that the audience must have an interest, that presentation of research

results must have a logical order, that the writing style must be appropriate and that the audience must be able to decipher the presented text, whether on screen, projected or on paper.

This section focuses on one of the external factors, namely the legibility of the text, and in particular the presentation of research results in a dissertation, script or thesis format.

2. WHY MUST TEXT BE PRESENTED LEGIBLY?

Researchers have indicated that there is a correlation between comprehension, reading speed and legibility. Reading speed cannot necessarily be taken as an indicator of legibility, and an increase in comprehension cannot *per se* be attributed to the legibility of text. The correct use of typefaces and typographical matter can however make text easier and more inviting to read, and possibly increase reading speed and comprehension.

Researchers have calculated that an office worker may spend between sixty and eighty thousand hours reading documents, books and instructions as part of his/her job during his/her career. For office workers, legible documents and books are essential. A script, a thesis or a dissertation must likewise be legible if anyone is to profit from reading it.

A higher education student doing a three-year course may have to read between three and ten million words, depending on the particular subjects taken during the study period. The personal preferences of the printer and other aesthetic considerations must thus be secondary to the legibility of the material. Research findings of psychologists, educators and typographers have provided valuable information about factors of legibility. This information can now be used by researchers to design and manipulate typographical matter to make their reports legible and inviting to read, in order to communicate more effectively.

The reason for focusing on text presentation on paper is that this is the first mode of fixed communication with the supervisor and the examiner. The rest of this section will provide a background to legibility, scientifically established guidelines on legibility, some examples and then some suggested formatting guidelines for academic reports in a script, dissertation or thesis format.

3. BACKGROUND TO LEGIBILITY

Studies in the field of legibility research date back more than one hundred and ninety years. Typographers, psychologists, oculists, physiologists and educators are amongst those who have done research and have written about legibility and related matters. These researchers have provided valuable information about factors of legibility. As early as 1878, Professor Javal of the University of Paris established that a reader's eyes move along a line of print in a series of quick jerks. Apart from eye movements, other factors, viz. illumination, colour, heart rate, blink rate, visual fatigue and typographical factors were investigated. Research has provided guidelines concerning the legibility of telephone directories, newspaper headlines, backbone titles, line spacing, the length of a line of type and electronic text, to name but a few.

Typography is a vital element that makes electronic and printed communication more effective and efficient. Typography is an integral consideration in most facets

of visual communication, whether these are purely functional or aesthetic in nature. Legibility research is, amongst others, involved in establishing how orthographic material can be designed and applied to solve typographical problems.

Designing the text for your academic report will require decisions such as which typeface must be used, its size and its weight. Other factors, namely, line spacing, column width, printing process, size and types of paper, and costs must all be considered in the text-design process. The size of the typeface will, for example, influence the line length. Your supervisor or examiner might find it difficult to find the beginning of the next line with the return sweep if the typeface is small and the line length is too long. Apart from text content and the text's readability scores, legibility is the key factor in making text easier to read.

Legibility is a very wide concept and is defined by various authors in different ways: it is the speed and accuracy of visually receiving and comprehending meaningful running text; it is the ability for text to be read continuously, by the kind of reader for whom the text is intended and in the kind of circumstance in which he/she may be expected to read, with the greatest possible speed, accuracy and pleasure, and with the least possible effort and distraction; and it is concerned with perceiving letters and words, with the reading of continuous textual material. The shapes of letters must be discriminated, the characteristic word forms perceived, and continuous text read accurately, rapidly, easily and with understanding.

The following are some guiding principles for the design and formatting of textual matter:

These guidelines are a synthesis of published research results on the legibility of text, with specific reference to printed matter. You should be able to use this as a guideline when formatting your academic report.

Choice of letter, line space and line length

- Italics are read somewhat slower than normal upright romans.
- Italics, bolds, and slanted typefaces can be used to attract attention.
- Larger type sizes and large line spaces decrease legibility.
- Small type sizes require more line space and more letter space.
- The larger the type size the closer the letters can be set to each other.
- Black type on matte white paper is the easiest to read.
- Long line lengths require more line space.
- The ideal type size for normal text matter is between 10 and 12 points.
- The ideal line space is between 10% and 30% of the size of the type size.
- The ideal line length is between 1.5 and 2 alphabet lengths – including spaces.
- It is not a good practice to use decorative and unfamiliar typefaces for the main text of an academic document.

Layout of a document

- Legibility is improved when the first line of a paragraph is indented and when an indented paragraph is in the middle of a block of text.
- Avoid justification in narrow columns – large word spaces might occur, especially when the text is in Afrikaans or an African language.
- Justified text looks better but is not necessarily more legible.

Letters with or without serifs

- Serifs are important and useful in the perception of small individual characters.
- Serifs increase spacing between letters and words and therefore aid perception and legibility; however it is possible to increase the letter space of any type style with modern typesetting equipment. Readers do not read by perceiving individual letters, but by recognising individual words or portions of words.
- Serifs create greater irregularity in characters, which helps to distinguish them from one another and therefore to make them more legible; however readers do not read individual characters, but rather fixate on words or portions of words when they read. Serifs are, therefore, not necessary for increased legibility.
- Serifs are strokes that bind characters into cohesive patterns and make it easier to recognise and read words set in a roman typeface; however words without serifs (sans) are normally set closer to each other and serifs are not required to bind the characters into a cohesive pattern.
- There is reason to assume that under normal conditions no significant difference exists between typefaces in common use by adults for running text.
- Some investigators have argued that serifs in printed text increase the spacing between the letters slightly, and that this makes the text easier to read, but there does not seem to be any conclusive proof for such assumptions.
- No tests have either refuted or confirmed the belief that romans are more legible than sans serifs.
- It is not necessarily serifs, or the lack thereof, that increase or decrease legibility. It is rather a complex interaction of known and unknown factors that affect a subject's reading performance and the legibility of reading material. Subject matter, the readers' interest in the material, intellectual ability, and their emotional and physical condition, can all play a role in reading performance.
- Results from experiments using eye movement machines have shown that a reader's eye movements do not flow but that they move in small steps. Serifs are therefore not required to assist in the reading process.
- Roman typefaces, with their fine serifs and thinner horizontals, lose definition and quality more than sans serifs when they are duplicated on low quality paper and copied several times. Definition of sans serif compared to roman letters will also be higher when reading material is set on printers with a lower resolution than laser printers.
- It is rather other typographical and uncontrollable factors, for example, line spacing, the interest shown by the reader, and the quality of print that play a greater role in legibility than the typographical differences between sans serifs and roman typefaces.

4. WHAT ABOUT THE ABOVE GUIDELINES?

You may ask, what about the above guidelines? How can I use them to design, or format my academic report? Can't I choose a good-looking typeface and use double line spacing?

Well, maybe you can. Institutions normally provide some form of formatting guidelines and specify a one-and-a-half or double line space. You must however remember that such guidelines are given at times in ignorance of legibility principles. Typewriters were able to space in single lines, one-and-a-half or double line spaces. Double

line space enabled supervisors (the pre-computer generation) to write comments between the lines.

Rather make use of the formatting functions of a computer and design your text so that it falls within the optimum legibility parameters. This will aid in the reading, marking and the communication of you results. If the best form of travel between two countries is by aeroplane, why go by donkey cart?

The following are some visual examples of what paragraphs of your script can look like if you design (format) it according to legibility principles:

5. EXAMPLES OF A LEGIBLE DESIGN FOR YOUR SCRIPT, THESIS OR DISSERTATION

Use Times Roman, 11 point or 12 point, as the typeface for the text of your document. The line space for your text can be 1.5 line space or slightly smaller. In typographical terms it would mean 18 point line space if you are using a 12 point typeface. There will therefore be 6 points (18 minus 12) space between the lines. This will enable your supervisor to make comments or write suggestions between the lines. This particular paragraph is set in a 12-point typeface with 18 point leading, or in more popular terminology, 1.5 line space.

You can also use Arial, a popular typeface available on most computers, as the typeface for your text. This typeface does not have serifs and might give a "cleaner look." This particular paragraph is set in 12 Arial with 1.5 line space. This typeface is bigger than Times Roman. It might be a good step to finalise the typeface and the size with your supervisor.

It might be better to use a smaller typeface if you use Arial. This paragraph is set in 11 points. This typeface does not have serifs and might give a "cleaner look". This particular paragraph is set in Arial 11 points with 1.5 line space. This typeface is about the same size as Times Roman 12 point. It might be a good step to finalise the typeface and the size with your supervisor.

Another option is to use Times Roman 11 point with a line space of 16 points. This is a more compact layout. This paragraph is set in 11 points. This typeface has serifs. This particular paragraph is set in 11 point Times Roman with 16 points line space. This typeface is about the same size as Arial 10 points. It might be a good step to finalise the typeface and the size with your supervisor.

What you should avoid is BIG letters with lots of line space. Avoid padding your document – that is making it bigger to

look more impressive. It does not work. It is the quality of your document that counts, not how thick it is.

Times Roman and Arial use proportional space for each letter. The letter W is for example wider than the letter i. The result is that the letters in your documents are evenly spaced. Typewriters use letters that all have the same width. The result is that wide letters like the w, m, and H are the same width as the I and 1. Text that is set in this type of letter could occupy up to 40% more space! It is better to avoid this type of letter. The following paragraph is set in such a letter type to show the effect.

```
Times Roman and Arial use proportional space for each
letter. The letter W is for example wider than the letter
i. The result is that the letters in your documents are
evenly spaced. Typewriters use letters that have all the
same width. The result is that wide letters like the w, m,
and H are the same width as the I and 1. Text that is set
in this type of letter could occupy up to 40% more space!
It would be better to avoid this type of letter.
```

The supervisor, department or institution normally prescribes the required typeface and line space. If none exists, use Times Roman 11 point with 16-point line space. The rest of this document is set in Times Roman 11 point with 16 point line space.

Another factor that you must consider is the margins. The size of your letter determines your line length. Longer lines and lines that are too short are difficult to read. Long lines require more line space. A good rule is not to exceed 60 characters per line (including empty spaces). This line is slightly longer than 60 characters per line. The margins of this document are 4cm on left and right, with 3 cm on top and bottom.

Ensure that your formatted document is placed on an A4 size paper and not a Letter Size paper. Many word processors automatically revert to Letter Size. You must set this in page setup or in the options section of the software.

Some institutions want all paragraphs to be justified – that is, a straight line on the sides of the text. It does make a document look neat but can create irregular spacing in a document with narrow columns.

Indent all your paragraphs by 0.5 cm. Do not leave a blank line unless it is absolutely necessary. Do not indent a paragraph if there is a line open above the paragraph. Indenting is a graphic cue and gives an indication if there is a change in the text. You can leave an empty line if you change the thought process in your paragraph or if you

start with a new concept. Set the title of your script in Times Roman Bold, 16 point, and use a single line space. Leave two open lines before the author is listed. State the authors' affiliation on the next line followed by an address or email address. Centre the title, authors, affiliation and address. Leave two lines open before the abstract. Print all your headings in bold and in capitals.

6. SUB HEADINGS

All your subheadings must be bold and in upper and lowercase letters. Do not indent your sub headings.

- You could use an asterisk if there is a sub division under a sub heading.
- Indent these asterisks by 0.5 cm.
- Leave one open line between headings and sub headings.

7. PAGE NUMBERS AND FIGURES

Number the pages of your document. Use Roman numerals for all the pages before page 1 of the first chapter. Use Arabic numbers thereafter. Place the numbers on the top right hand side or the middle of each page. Use Times Roman, 11 point, for your page numbers. Use Arial, 10 point, or a similar typeface for captions of all photographs, figures, illustrations or graphs. Place the captions underneath your figures, illustrations, graphs and photographs. Centre all of these captions. List all your figures (graphs, photographs etc.) as Figure 1, Figure 2 etc. with an appropriate caption or title. Leave two lines open at the top and one line at the bottom of the figures. Place all the figures in the middle of a page or flush with the left margin. Keep your layout consistent. Figures and their captions must appear on the same page.

8. CONCLUDING REMARKS

Always consult your supervisor about his or her preferred layout and format for a script, thesis or dissertation. Do not ignore your institution's formatting guidelines. Some institutions prescribe rather large line space and letter size as they place theses and dissertations on microfiche. Produce your work on a high quality printer and use the information above as a guideline to improve the legibility of your academic report.

THEME 11

MATTERS OF LINGUISTIC STYLE

Michele Truscott, Ryk Lues and Victor Teise

The focus of this section is to:

- comprehend matters of linguistic style in science writing.

1. INTRODUCTION

This theme provides a brief introduction to matters of style with regard to writing an article, thesis or dissertation. These guidelines are intended to help young researchers in preparing for publication. There are, however many excellent guides on writing research papers and these should also be consulted.

A well-written scientific paper is the product of a well-trained scientist. Learning to write well takes practice and it is necessary to consult one or more of the various guides that exists for the purpose.

Furthermore you are encouraged to read works of acclaimed scientists and try to learn from them (Baker, 1995).

Whether you are writing fiction or a scientific article, the basic tools remain the same. It is necessary to identify and acquire the skills to write well. According to Stephen King some good advice that scientists would do well to adhere to are the following:

- Read a lot and write a lot — practice is invaluable.
- Develop a writing "toolbox" that includes vocabulary, grammar and the basic elements of form and style.
- Find a place to write — close the door and avoid distractions.
- Revise your work using 2-3 drafts — leave two or three days between revisions.
- Get several friends (colleagues) to review and critique your work; incorporate those suggestions into the final manuscript (King, 2000; Stirling, 2001).

Good writing skills or the ability to write well can be regarded as one of the cornerstones of good scientific research. The writing process, where these skills are put to the test, can also be viewed as a planned process of communication where there is a *sender, message, receiver* and *feedback*. The *sender* (in this case the *researcher)* has a *message* (the *idea* or *proposal)* that s/he wants to convey in a particular code *(language)* through a specific channel *(research report, thesis or dissertation) to* a specific *receiver or group of receivers* (the *readers* of the report or dissertation) who in turn reacts *(feedback)* to the message. Like oral communication, written communication is not free from barriers, in other words, factors which can render the message ineffective. Barriers or disturbances like *language errors, ambiguities, vague formulations, undefined words, illogical sentences,* etc. may result in a message being misunderstood or misinterpreted by the receiver or group of receivers. The objective should be to attract and retain the reader's interest and to write the most informative paragraphs possible.

Being a competent writer also means being an editor. You cannot read the report to check its content, structure and argument and at the same time check the

grammar and expression, because the first requires you to look at the report from a distance, while the second requires you to look at it from close up (Mawson n.d.).

According to Weideman (2003) good informative writing starts and ends with reading. Not only is reading critical for becoming academically literate, it also enhances one's vocabulary, develops one's skill to assess the merit of each source and is also a prerequisite for good writing (Kirszner and Mandell, 2002).

2. GRAMMAR AND EXPRESSION

When checking grammar and expression it is necessary to be attentive to the following:

2.1 Spelling

Using the correct spelling for a word is important. Your computer package can assist you with this to a certain extent. You need to specify the language preference before a spelling and grammar check can be done. However, keep in mind that your PC does not check meanings. Consider the following (Mawson n.d.):

> I have a spelling checker,
> It came with my PC.
> It plainly marks for my *revue,*
> Mistakes I cannot *sea*.
> I've run this poem *threw* it,
> I'm sure *your please* to *no.*
> *Its* letter perfect in *it's weigh,*
> My checker told me *sew*.

2.2 Sentences

The *sentence* can be regarded as a word or a series of words that constitute a complete unit of thought. William Strunk Jr. once wrote in his work *Elements of style* (1918) the following about the conciseness of sentences and paragraphs:

> "Vigorous writing is concise. A sentence should contain no unnecessary words, a paragraph no unnecessary sentences, for the same reason that a drawing should have no unnecessary lines and a machine no unnecessary parts. This requires not that the writer make all his sentences short, or that he avoid all detail and treat his subject only in outline, but that every word tell".

It is good to read a report out loud, because your ear will pick up mistakes that your eyes miss. The grammar check on your PC will highlight lengthy sentences. You need to consider the following aspects:

- Do the sentences make sense?
- Do you have to read sentences twice?
- Are the sentences too long?
- Can you replace fancy words with plain ones?
- Can you improve the punctuation?

Shuffle the parts of a sentence so that it makes sense. Place the topic at the beginning, less important information in the middle and new information at the end. Keep to the subject-verb-object pattern in the construction of the sentence. Keep sentences short and do not use 'and' to join vaguely related ideas. Long sentences destroy the reader's interest and concentration (Mawson n.d.).

In scientific research reports the author is not referred to in the first person. Instead of using "I found" rather use "It was found". Combine sentences into a paragraph which contains the development of one complete thought (Eunson, 1994).

2.3 Active versus passive voice

There is continuing debate over whether scientific articles should be written in the active or passive voice. Simply put, the active voice says 'I did', the passive voice says 'it was done'. Depending on the nature of the publication, the choice between styles is up to the author and depends on personal preference (Stirling, 2001).

The passive voice can lead to grammar mistakes, dull prose, vagueness and much longer sentences and eventually your reader will fall asleep (Mawson n.d.).

Examples of active and passive voice are given below:

Active voice:

I incubated the sections in buffer for ten minutes then labeled them using antibody solution.

A compressor supplies compressed air to the vortex tube.

Passive voice:

The sections were incubated in buffer for ten minutes, then labeled with antibody solution.

Compressed air is supplied to the vortex tube by a compressor.

The passive style came into use around 1900 with the idea that it made science more objective and professional. Before this, most writing was in the active voice. However currently there is a strong swing back to the active voice with Lord May, the President of the Royal Society, quoted as saying that he regarded the use of passive voice in a research paper as the mark of second-rate work. Most journals now accept, or encourage, papers in the active style (Stirling, 2001).

2.4 Verbs versus abstract nouns

Abstract nouns refer to qualities, states or actions (e.g. jealousy, destruction, knowledge). Although we cannot do without them, abstract nouns are used far too often where we could use a short, strong verb. Use your computer to search for part-words *ion; ions; ment* and *ments.*

Example:

The defendant made a confession that.....

The defendant confessed that.....

Table 1 shows examples of verbs that can replace abstract nouns.

Table 1: Verbs versus abstract nouns

ABSTRACT NOUN	VERB
acquisition	acquire
application	apply
assessment	assess
determination	determine
investigation	investigate

(Mawson n.d.)

2.5 Language and tone

You have to make sure you are using language and tone that ease understanding. The following pitfalls should be avoided:

- **Verbosity:** Why take 200 words to say something when 50 will do? Discipline yourself to write less than you want. Keep it short and simple.
- **Jargon:** Jargon is the turn of phrase, the word, and the descriptor that we develop as a means of private shorthand. We know that we are familiar with it, our colleagues are familiar with it, but the reader is completely lost. Read your material carefully and ask yourself whether your readers will understand. Provide a glossary if the report contains jargon (Goddard, 1998).
- **Really big impressive words:** Words are there to convey meaning, not to impress. The best writing is always the simplest and the clearest (Literati Club, n.d.).
- **Ambiguity:** Unclear sentences with more than one interpretation can lead to misunderstanding; instead use language that is connotative.
- **Clichés:** Overused expressions or words may cause the reader to lose interest in what he/she is reading. Try to keep your expressions innovative or different.
- **Malapropisms:** Beware of the incorrect use of similarly-structured or similar-sounding words (e.g. aspire vs perspire).
- **Redundant language:** Academic writing should at all times be concise and clear. Refrain from cramming your sentences with unnecessary words or phrases that convey the same message.

Table 2: Simpler words versus complex words

COMPLEX	SIMPLER
the results propose	Suggest
employed a grid	used
fish occur	live, are found
they consume	eat
analyses reveal	show
prior to	before
owing to the fact that	because, as, since
due to the fact that	
considering the fact that	

(Mawson n.d.)

2.6 Paragraphs

Paragraphs can also be regarded as units of thought. Murphy and Snell (1992) define the paragraph as "a unit of thought, not of length. It should deal with only one main idea from all the ideas that come under your topic."

According to Combrink (1995) this *main idea* or *central theme* is expressed in a *topic sentence*. Related thoughts are expressed in *supporting* or *subordinate* sentences. The topic sentence forms the *subject* of the discussion while the supporting sentences provide the *finer detail*.

The topic sentence should not contain all the particulars of the main thought of the paragraph but rather one central idea (Combrink, 1995). The supporting sentences should carry this central idea forward.

The paragraph is intended to form a unit of coherence. Different transitional devices exist to construct unity in the paragraph structure.

Certain words can be used to establish links between different sentences or different thoughts or to make transitions between them possible. This will ensure the maintenance of unity within the paragraph. Murphy and Snell (1992) state it as follows:

> "(...) transitional devices should tie your thoughts together, guide the reader from one point to the next, and tie the whole paragraph together. They should also link one paragraph to the next, so that all the paragraphs together form a logical presentation of your whole subject".

It can also be said that these transitional devices are "words and phrases that show how sentence ideas relate to each other" (Barnwell and Dees, 1995). An illustration of this might be the following example adapted from Barnwell and Dees (1995):

> "Each one of us can make a more productive effort to cut down on the use of fossil fuels in this country. *To begin with,* all of us can start reducing gas and oil consumption by driving only when we have a real need. That won't be easy, I know, *but* we have to start somewhere. *In addition,* we can begin car-pooling to work once or twice a week, and we can also buy smaller cars with better gas mileage. *Another way* to reduce our fuel consumption would be to use less gas and electricity at home. How many times, *for example,* have you walked out of a room and left the lights or the television on when no one else was there? *Furthermore,* why not use a microwave to cook that baked potato in seven minutes instead of the forty minutes it usually takes in a traditional gas oven? I'm positive, *however,* that each of us could start immediately to do some of them or other things to cut down on our use of limited fossil fuels"

Link words or phrases can be used to:

- *accentuate* (indeed, really, actually, etc.)
- *add* (furthermore, also, thereby, besides, in addition to, together with)
- *list* (firstly, secondly, finally, etc.)
- *illustrate* (for example, for instance, etc.)
- *show contrasts* (on the other hand, over against that, on the contrary, etc.)
- *illustrate cause, effect* and *reason* (thus, therefore, for this reason, with the result that, consequently, hence, etc.)

- *compare* (likewise, similarly, just as much, equally)
- *put in other words* (in other words, as stated previously, etc.)
- *conclude* (to summarise, finally, in conclusion, etc.)

Another way of ensuring the coherence of paragraphs is by making use of repetition. Certain keywords or phrases are repeated to link ideas or thoughts.

When the researcher is about to round up his/her discussion it is always better to indicate his/her intentions to the reader in a *clincher statement* (Barnwell and Dees,1995:73). This will signal the end of the discussion and also provide the researcher with ammunition for his/her final statement.

3. COMMON STYLISTIC CONCERNS

Informative writing must be to the point, unambiguous and reliable, and easy to read. In achieving this, spelling, grammar and punctuation assist in eliminating uncertainty and retaining trustworthiness (Inglis and Lewis, 1995). Punctuation was developed to help printers and readers. The modern method is to punctuate only where necessary for logic.

3.1 Semicolon (;)

Use a semicolon to join closely linked sentences and to separate elements of a series.

Example:

Down came the rain; up went the umbrellas.

....as close to building entrances; kerbs in the route should have kerb cuts; and all walks should be level.

3.2 Colon (:)

The colon indicates the concept "as follows".

Example:

You should remember one thing: don't try to fool your lecturer.

3.3 Full stop (.)

The full stop marks the end of a sentence. A full stop must not be used after phrases (e.g. titles of papers and headings). One space follows a full stop.

3.4 Comma (,)

The comma is used before and after any element and to separate clauses.

Example (Ebbitt and Ebbitt, 1982)*:*

The experiment was, she thought, quite useless.

When Anne left, the office was locked.

3.5 Hyphen

Hyphens are used when two or more words are treated as a single unit or a single thought.

Different types of hyphens are used:

- Ordinary hyphen or permanent hyphen: " - " (e.g. *co-ordinate; mother-in-law)*
- Temporary end-of-line hyphen: (e.g. *knowledge can be hyphenated to know-ledge at the end of a line)*
- *Em* dashes: "—" (e.g. *Legionella, Streptococcus, Escherichia* — all examples of bacteria)
- *En* dashes: "–" (e.g. *20–30)* (Mawson, n.d.).

3.6 Apostrophe

The different ways of using an apostrophe are given below:

- An apostrophe indicates the place where a letter has been left out (e.g. *it's = it is; I'm = I am)*
- The 's indicates possession (e.g. *John's book.* In other words the book belongs to John)

The placing of the apostrophe is important. The following rules should be considered:

- If the noun that "owns" the object or idea is singular put the 's at the end of noun (e.g. *John's book, Thomas's poetry: Mr Jones's house)*
- If the noun that "owns" the object or idea is plural put ' alone (e.g. *the Joneses' house)*

An apostrophe is not used in dates (e.g. *1970s)* and not in unusual plurals (e.g. *NCOs)* (Mawson n.d.).

3.7 Quotation marks

Punctuation marks, such as full stops, commas, and semicolons, should appear after the quotation marks. However, question and exclamation marks should appear within the quotation marks if they are part of a quotation but after the parenthetical citation if they are part of your text (Using APA Format n.d.). Double quotation marks and not single quotation marks should be used (e.g. *Members of "normal" society…* and not *Members of 'normal' society)*.

3.8 Numbering

- Spell out numbers one through nine and use numerals for 10 and above (Student Manual, 1995).
- Only number a list of items or tasks if it indicates a definite sequence that must be followed, otherwise use bullets or nothing at all.
- If you are numbering it is best to use the straightforward Arabic numerals (1, 2, 3...). The Tables in a report, thesis or dissertation should also be numbered in Arabic numerals.
- Do not make use of more than three numbering levels (e.g. 1; 1.1; 1.1.1).

3.9 Brackets ()

Brackets are used to enclose material interrupting a direct quotation.

3.10 Other

- In scientific or research papers, the use of the percentage sign (%) must be placed next to the numeral (e.g.*3% not 3 %]*.
- Units of measurement are placed one hard space from the numeral (e.g.3 *km not 3km)* (Hard space= ctrl+shift+spacebar).
- When typing thousands and larger insert a hard space between the numeral indicating the thousands and the rest (e.g. 3 000 *not 3000)*.
- Always insert a hard space between Figure and the figure number (e.g. Figure[hard space]6).

4. CONCLUSION

In this discussion an effort was made to come up with ideas on how to manage the writing process in research. The writing process in scientific research was approached from an artistic point of view. It has also been postulated that meticulous planning is essential for the writing process to be successful. In this regard the *aims* and *objectives,* the *different phases* of the writing process, the structure of *sentences* and *paragraphs* have been expounded.

Finally, the writing process is not finished until the researcher is absolutely satisfied that the end product is a well-structured research report.

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THEME 12

REFERENCING – THE HARVARD METHOD

Alna Beukes

The focus of this section is to:

- provide guidelines on how to use references in the text according to the Harvard method of referencing; and
- compile a bibliography according to the Harvard method of referencing.

1. INTRODUCTION

References form an integral part of all academic writing. The aim is to grant recognition to the author whose particulars, information or intellectual property is used.

The under-mentioned is a guideline to the Harvard method of referencing. Students and researchers are requested to first clarify the requirements regarding reference methods with their lecturers, heads of departments and supervisor(s) since reference methods can differ from supervisor to supervisor and from faculty to faculty.

References should be made:

- as soon as a specific person, viewpoint or conclusion is referred to;
- when information, such as statistics, etc. is used;
- when quotations are taken directly from the source; and
- to enable the reader to consult the specified source to gather more information, or to check the information.

According to the Harvard method of referencing, (author - date method), references are made in the text and the source is fully recorded in the bibliography. ***Only those sources, which are referred to in the text, may be included in the bibliography (source reference list).***

2. REFERENCES

In this section examples of referencing in the text and in the bibliography are provided.

2.1 Referencing in the text

Referencing or citation is to be used within research projects:

- for direct quotations;
- to validate ideas and opinions; and
- for paraphrasing or indirect quotations.

The Harvard system uses:

- author's surname;

- year of publication;
- page reference.

The order is:
bracket Author's surname comma space Year colon space Page/s bracket

e.g. (Smith, 2009: 45-54)

2.1.1 Examples of in-text referencing

a) The **initials or first names of the authors are not used in the text**, except where there is more than one author with the same surname.

e.g. can occur in various instances (Huskisson, 2007: 89).

b) When the **author's name makes up part of the sentence**, only the year of publication and the page number are placed in round brackets.

e.g. according to Huskisson (2007: 90) diabetes can appear in …

c) **Summarising an author's opinion:** no page references, you refer to the entire assignment.

e.g. 1st reference: David Birdson (2005) made a strong plea … OR

2nd reference: Birdson (2005) made a strong plea …

d) If a book has been written by **two authors**, both are mentioned.

e.g. Redelinghuys and Steyn (2001: 112) saw the quantitative …

e) If sources by **two authors with the same surname** are used, their initials are also included.

e.g. J. Huskisson (2000: 10) and D. Huskisson (2004: 34) allege …

f) In the case of **three authors**, all three are mentioned in the first reference, and thereafter only the first author, followed by *et al.*, is mentioned.

e.g. 1st reference: variables can be discrete or continuous
(Redelinghuys, Steyn and Benade, 2002: 200).

2nd reference: The following guidelines can be followed, according to Redelinghuys *et al*. (2002: 213).

g) In the case of sources with **more than three authors**, a researcher can choose one of two referencing methods:

Case 1*: In the case of sources with* **more than three authors** *the title of the source is given as the author.*

e.g. (Teaching and Learning, 2003: 39)

Case 2*: In the case of sources with* **more than three authors,** *all the authors are mentioned in the first reference, and thereafter only the first author, followed by et al., is mentioned.*

e.g. 1st reference: ... symptoms may change over treatment (Wilson, Loeb, Walsh, Labouvie, Petkova, Luit and Waternaux, 1999: 451).

2nd reference: High frequencies of binge eating and vomiting can be identified as symptoms of bulimia (Wilson *et al*., 1999: 455).

h) The works of **authors who have written more than one book in the same year** are differentiated from each other by placing a small letter in the text after the date. This letter is repeated in the date in the source reference list.

e.g. many teenagers follow quick diets (Huskisson, 2007a: 45; Huskisson, 2007b: 30)

i) In the case of an **editor**, the name of the editor and year of publication are placed in round brackets in the text.

*Note that the "(Ed.)" is not included in the text reference.

e.g. (Codagen, 1999: 67)

j) When a **quote** is from a **secondary source**, both sources must be quoted in the text.

e.g. The atmospheric temperature does seem to be rising, according to trends discovered by Kuhn (cited in Harvey, 2001: 16) or (Kuhn cited in Harvey, 2001: 16).

k) When referencing **different material from the same author**, arrange them in chronological order.

e.g. Dwyer (1997: 19-20; 1999: 43) claimed that …

l) When referring to **more than one source to prove the same fact**, all the sources are mentioned in the same reference.

e.g. (Fisher, 1990: 12; Krikbush, 1994: 10, Chappel, 1998: 27 and Laonde, 2000: 65)

m) When referring to **sources where the date cannot be determined**, one of two methods can be used:
Method 1: The abbreviation [s.a.] (*sine anno* - Latin for without date) in square brackets.

e.g. (Van Biljon, [s.a.]: 45).

Method 2: The abbreviation [n.d.] (no date) in square brackets.

e.g. (Van Biljon, [n.d.]: 45).

n) When referring to sources written or published by institutions etc. The author is a **corporate author(s)**.

e.g. (HSRC, 2007: 35)

o) Referencing **government publications**.

- **Departments**

If reference is made to material from a government department and the author is known, treat the document like a book. If the author is not known, the department is assumed to be the author (Country. Department name, Year: Page/s).

e.g. (South Africa. Department of Education, 2000: 13)

- **Acts**

(Country. Act name Date: page/s)

e.g. (South Africa. Labour relations act 1995: 14)

Reference to an article in an act:

e.g. (South Africa. Labour relations act 1995, art. 38)

- **Government Gazettes**

(Country. Government Gazette, Date of publication: page/s)

e.g. (South Africa. Government Gazette, 2002: 8)

- **White papers**

(Country. White paper's name, Date: page/s)

e.g. (South Africa. White paper on safety and security, 1998: 15)

- **Bills**

(Country. Bill name, Date: page/s)

e.g. (South Africa. Anti-terrorism bill, 2002: 5)

p) Quoting from **non-book resources.**

- **Electronic/internet sources**

(Author, date: online)

e.g. (Smith, 2008: online).

- **Personal communication**

(Surname and initials of person with whom the communication was, year: personal communication)

e.g. (Endeman, L.C.P. 2005: personal communication).

- **CD-ROM**

(Title, date: CD-ROM)

e.g. (Swanepoel, Pienaar & Bolleurs, 2005: CD-ROM).

- **Video**

(Author (if available) date: video)

e.g. (Jones, 1995: video).

- **Film**

(Title, year of publication: film)

e.g. (Macbeth, 1948: film).

- **Broadcast**

(Title, date: broadcast)

e.g. (News at seven, 2006: broadcast).

2.2 Referencing in the bibliography (source reference list)

In the bibliography (source reference list) complete bibliographic particulars of the sources are given. These sources are listed alphabetically according to the author or the title. **The title is either in italics, underlined or in bold.** Consistency in the choice of this format is very important. ***Under no circumstances may a source be recorded in the bibliography if it has not been referred to in the text.***

2.2.1 Examples of referencing in the bibliography (source reference list)

a) Books

Determining authorship

Entries in the bibliography are made as follows:

- One author: Huskisson, J.M. 2007.
- Two authors: Steyn, B.L. & Benade, F.C. 2002.
- Three authors: Peters, E., Plow, E.G. & Tric, J.M. 1988.
- More than three authors: Researchers can choose one from two methods:
  i) Written under the title of the source
  e.g. *Teaching and Learning*, 2003.
  ii) All authors of source must be mentioned.
  e.g. Broglia, R.A, Schelpe, E.I.A.E., Hall, A.V., Mair, J. & Rourke, J. 1977.
- Editors: Use the abbreviation Ed. for editor or Eds for editors, after the initials of the editor.

e.g. Louw, W.J. (Ed.). 2003.

- Where **no author** can be identified, the source is entered under its title.

Date of publication

This is the date of publication as it appears on the title page, on the reverse side of the title page, or in any other place in the publication. If a date cannot be determined, the abbreviation [s.a.] (sine anno) is used in square brackets.

e.g. Kotler, [s.a.]. *Organisational behaviour*. Cape Town: Kagiso

Title

The full title, as it appears on the title page, is provided and is in italics in the bibliography.

e.g. *History of the Basuto*.

A **subtitle** is separated from the title by means of a colon.

e.g. *Media ethics: an introduction and overview*.

Edition or print

Print and first editions of sources are not mentioned, only 2nd, 3rd, *etc*. The following abbreviation is used: 2nd ed.

e.g. Connolly, T.M. *Database systems: a practical approach to design, implementation and management*. 2nd ed.

Place of publication

If there is more than one place of publication, only the first one is mentioned.

e.g. Greenstein, M. 2000. *Electronic commerce: security, risk management and control*. Boston:

If the place of publication cannot be established, the abbreviation [s.l.] (sine loco) in square brackets is used.

e.g. Greenstein, M. 2000. *Electronic commerce: security, risk management and control*. [s.l.]

Publisher

The initials of the publisher are not included.

e.g. Kotler, C. 1978. *Organisational behaviour*. London: Taylor & Francis

If the publisher and the author are the same person, the publisher is not included.

If the publisher of a source cannot be determined, the abbreviation [s.n.] (sine nomine) in square brackets is used.

e.g. Kotler, K. 1989. *Consumer behaviour*. Britain: [s.n.]

Series

If the source being used is one of a series of sources, the entry is written between round brackets and is placed at the end of the description.

e.g. Rosandich, R. G. 1997. *Intelligent visual inspection: using artificial neural networks*. London: Chapman & Hall. (Intelligent engineering series no. 1)

b) Contribution in a book

Elements to cite

Contributing author's surname, INITIALS. Year of publication. Title of contribution. Followed by In: surname, INITIALS. of author or editor of publication followed by (Ed.). or (Eds). if relevant. *Title of book.* Place of publication: Publisher, Page number(s) of contribution.

e.g. Bantz, C.R. 1995. Social dimensions of software development. In: Anderson, J.A. (Ed.). *Annual review of software management and development.* Newbury Park, CA: Sage, pp. 502-510.

c) Editorial works

Elements to cite

The surname of the person who wrote the chapter in the book, INITIALS. Year of publication. Title of the chapter in the book that was used. Followed by In: surname, INITIALS. of author of editorial work followed by (Ed.). or (Eds). if relevant. *Title of the book that was used*. Place of publication: Publisher, Page number(s) of contribution.

e.g. Morton, J.A. 1992. The state of the art in linguistic research and standardisation. In: Marais, J. (Ed.). *Quebec's aboriginal languages: history, planning and development*. England: Clevedon, pp. 129-158.

d) Journal article

Elements to cite

Author's surname. INITIALS. Year of publication. Title of article. *Title of journal*, volume number and (part number), page numbers of contribution, Month of publication.

e.g. Granger, S. 1989. Comrades: an armchair critique. *SA Runner*, 12(6), pp. 17-19, April.

e) Newspaper article

Elements to cite

Author's surname. INITIALS. Year of publication. Title of article. *Title of newspaper*, Day & Month of publication, Page number of contribution.

e.g. Paton, C. 1998. Government tackles the issue of aids in the workplace. *Sunday Times*, 19 April, p. 7.

f) Conference paper

Elements to cite

Contributing author's surname, INITIALS. Year of publication. Title of contribution. Followed by *In*: Surname, INITIALS. of editor of conference proceedings (if applicable) followed by (Ed.). or (Eds). *Title of conference proceedings* including date and place of conference. Place of publication: Publisher, Page numbers of contribution.

e.g. Silver, K. 1991. Electronic mail: the new way to communicate. *In*: Raitt, D.I. (Ed.). 9th *international online information meeting,* London 3-5 December 1990. Oxford: Learned Information, pp. 323-330.

g) Publication from a corporate body

Elements to cite

NAME OF ISSUING BODY, Year of publication. *Title of publication*. Place of publication: Publisher, Report number (where relevant).

e.g. UNESCO, 1993. *General information programme and UNISIST*. Paris: Unesco, (PGI-93/WS/22).

h) Thesis

Elements to cite

Author's surname, INITIALS. Year of publication. *Title of thesis*. Designation (and type). Place of publication: Name of institution to which it was submitted.

e.g. Agutter, A.J. 1995. *The linguistic significance of current British slang*. Thesis (PhD). Edinburgh: Edinburgh University.

i) Unpublished works

Elements to cite

Author's surname, INITIALS. Year of publication. Title of source. Followed by Unpublished thesis/book/poem *etc*. Place of publication: Publisher.

e.g. Fouche, S.E. 2008. *Different roof construction methods*. Unpublished thesis. Bloemfontein: University of the Free State.

j) Dictionary

Elements to cite

Title of dictionary. Year of publication. Edition. Place of publishing: publisher

e.g. *Shorter Oxford dictionary*. 1993. 9th ed. Oxford: OUP

k) Encyclopaedia

Elements to cite

Author surname, INITIALS. Year of publication. Article title. *In*: *Title of encyclopaedia*, vol., page numbers.

e.g. Lessing, B.P. 1985. Nuclear energy. *In: McGraw-Hill encyclopaedia of science and technology*, 12., pp. 346-347.

l) Patent

Elements to cite

ORIGINATOR, Year of publication. *Title of patent*. Series designation.

e.g. PHILIP MORRIS INC., 1981. *Optical perforating apparatus and system.* European patent application 0021165 A1.

m) Interview or correspondence

Elements to cite

Name of person interviewed. Date. Description of interview with day, month and year.

e.g. Smuts, D. 1987. Interview with the author on 4 August 1987. Cape Town [Cassette recording in possession of author]

or

Schaie, K.W. 1993. Personal interview. 27 July 1993. Pretoria

or

Preller, J.F. 2000. Correspondence. 15 November 2000. Pretoria

n) Personal communication

Elements to cite

Surname, initials of person with whom the communication was held. Year. Capacity of person with whom the communication took place. Personal communication. Date, Place where communication took place.

e.g. Endeman, L.C.P. 2003. Director of the company. Personal communication. 15 July, Cape Town.

o) Video, film or broadcast

Elements to cite

Title, Year. (For films the preferred date is the year of release in the country of production). Material designation. Subsidiary originator (optional, but director is preferred.) Surname. Production details - place: organisation.

e.g. *Macbeth,* 1948. Film. Directed by Orson Wells. USA: Republic Pictures.

e.g. *Birds in the Garden,* 1998. Video. London: Harper Videos.

Programmes and series:

The number and title of the episode should normally be given, as well as the series title, the transmitting organisation and channel, and the full date and time of transmission.

e.g. *Yes, Prime Minister,* Episode 1, The Ministerial Broadcast, 1986. TV, BBC2. 1986 Jan 16.

e.g. News at Ten, 1996. Jan 27. 22:00.

Contributions:

Individual items within a programme should be cited as contributors.

e.g. Blair, Tony, 1997. Interview**.** *In: Six O'clock News*. TV, BBC1. 1997 Feb 29. 18:23.

p) Government publications

Departments

Elements to cite

Official name of country. Name of department. Date of publication. *Title of document*. Place of publication: Publisher.

e.g. South Africa. Department of Home Affairs. 1980. *Guidelines for chairmen of publications committees.* Pretoria: Government Printer.

Acts

Elements to cite

Official name of country. Date of publication. *Title of act, number and year of act.* Place of publication: Publisher.

e.g. South Africa. 1982. *Atomic Energy Act, act 92 of 1982.* Pretoria: Government Printer.

Government Gazettes

Elements to cite

Official name of country. Date of publication. *Title of government gazette*. (Proclamation number). Government Gazette, no: vol, month day. (Regulation gazette number).

e.g. South Africa. 2001. *Local government: municipal planning and performance management regulations.* (Proclamation No. R, 796). Government Gazette, 22605:434, August 24. (Regulation gazette No. 7146).

White papers

Published separately

Elements to cite

Official name of country. Department. Date of publication. *Title of white paper*. Place of publication: Publisher.

e.g. South Africa. Department of home affairs. 1999. *White paper on international migration*. Pretoria: Government printer.

Published in the Government Gazette

Elements to cite

Official name of country. Department. Date of publication. *Title of white paper*. Government Gazette: no, month day. Place of publication: Publisher.

e.g. South Africa. Department of Transport. 2002. *White paper on national ports policy*. Government Gazette: 23715, August 8. Pretoria: Government Printer.

Green papers

Elements to cite

Official name of country. Department. Date of publication. *Title of green paper*. Place of publication: Publisher.

e.g. South Africa. Department of Communications. 1996. *Labour green paper*. Pretoria: Government Printer.

Bills

Elements to cite

Official name of country. Department. Date of publication. *Title of bill*. Place of publication: Publisher.

e.g. South Africa. Department of Justice. 2002. *Anti-terrorism bill*. Pretoria: Government Printer.

q) Electronic material

No standard method for citing electronic sources of information has yet been agreed upon. The recommendations in this document follow the practices most likely to be adopted on the basis of the Harvard method of referencing, and are intended as a guide for those needing to cite electronic sources of information.

Note that the date in the reference is the date published rather than the date retrieved and you only need to provide the year.

Reference to individual works or normal www pages

Elements to cite

- Author/Editor.
- Year.
- *Title*.
- [online].
- Edition.
- Place of publication:
- Publisher (if ascertainable).
- Available from: <URL> [Accessed date].

e.g. Holland, M. 1996. *Harvard System* [online]. Poole, Bournemouth University. Available from: < http://www.bournemouth.ac.uk/using_the_library/html/harvard_system.html> [Accessed 22 August, 1997].

Reference to E-journals

Elements to cite

Author. Year. Title. *Journal Title* [online], volume (issue), location within host. Available from: <URL> [Accessed Date].

e.g. Korb, K.B. 1995. Persons and things: book review of Bringsjord on Robot-Consciousness. *Psychology* [online], 6 (15). Available from: <gopher://wachau.ai.univie.ac.at:70/00/archives/Psycoloquy/95.V6/0162> [Accessed 17 Jun 1996].

Electronic mail (e-mail)

Elements to cite

Sender (Sender's e-mail address). Day Month Year. *Subject of Message*. E-mail to recipient (recipient's e-mail address).

e.g. Lowman, D. (deborah_lowman@pbsinc.com). 4 Apr 1996. RE>> *ProCite and Internet Refere.* E-mail to P. Cross (pcross@bournemouth.ac.uk).

REFERENCES

Beukes, A.E. 2008. *The Harvard method of referencing: guidelines for students of the Department Quantity Surveying and Construction Management, University of the Free State.* Bloemfontein, South Africa: University of the Free State.

Burger, M. 1992. *Reference Techniques*. 8th revised ed. Pretoria: University of South Africa.

Erasmus, B.J. and Terblanche, C. 1996. *Manual for the writing of assignments*. Revised ed. Technikon Free State: Bloemfontein.

Holland, M. 1999. *Harvard system* [online]. Poole, Bournemouth University. Available from: http://www.bournemouth.ac.uk/using_the_library/html/harvard_system.html#HarvardSyst [Accessed 15 April 1996].

PU vir CHO (Potchefstroomse Universiteit vir Christelike Hoër Onderwys). 1998. *Handleiding vir bibliografiese styl*. Potchefstroom: PU vir CHO (D225/97).

THEME 13
THE NUMERICAL REFERENCING METHOD

Gerrit Jordaan

The focus of this section is to:

- provide guidelines for numerical in-text referencing; and
- compile the list of references for the numerical referencing method.

1. INTRODUCTION

Any research project – and its associated report – should be positioned with reference to related research that has been previously executed and described. It is important therefore that the researcher prove his or her understanding of existing literature on the subject. This necessitates the accessing and studying of a wide variety of related literary sources in the form of books, articles in journals and conference proceedings as well as the Internet. Depending on the topic, reference may also need to be made to acts or other legal documents. The ability of a researcher to identify, access and successfully study relevant literature is an important characteristic of the individual. Though the use of search engines for Internet searches is important, researchers should also be aware of the limitations of many Internet sources and be circumspect in the use thereof.

Personal announcements or correspondence with proven experts in the field of a research project can also be used in research reports. However, the use thereof should be limited as far as possible.

Referencing is a particularly important component of any research report. Thus, great emphasis is placed on the correct way of referring to other sources in a dissertation, thesis or other research report.

There are two main referencing techniques in general use, viz. the Harvard method (see Theme 11) and the numerical method. Although the use of either of these systems is not confined to the human or the natural sciences, the numerical referencing method is used more extensively in the natural sciences.

The numerical referencing method is discussed below in some detail. Even though a very specific system is described, several variations are in general use. However, for consistency, emphasis is placed on a particular subset of the numerical referencing system. Particular care must be taken in the use of punctuation when using this system. Specific guidelines regarding the exact referencing format used by a particular publication should be considered by a prospective author and closely adhered to.

General practices with respect to the manner in which in-text references are made, as well as the layout of a list of references, are considered below.

2. NUMERICAL IN-TEXT REFERENCING

Normally this method requires that the list of references used in a document first be arranged alphabetically and numbered before any literary references can be

documented in-text. This facilitates easy access to the work of any particular author or publisher to whom reference has been made in the document.

Alternatively the references may be sorted and numbered in the same sequence in which they are referred to in the document. If any reference source is referred to more than once, it appears only once in the list of references and the same numerical value is used repeatedly. Even though an alphabetically sorted listing of publications is usually more difficult to compile initially, it facilitates an easier assessment of the range and quality of referenced publications.

2.1 General structure

Since a primary purpose of referencing is to afford the reader easy access to the source information that is being referred to, the reference should contain the following information:

- The number in square brackets that refers to the source in the list of references; and
- the page number of the source wherever possible.

Although the inclusion of the page number of the source document to which the author is referring is preferred, it is quite common not to include it – especially in articles it is often omitted.

2.2 Guidelines

2.2.1 Placement of the reference

The reference is incorporated between square brackets (e.g. [2, p. 74]) in the text of the document. Such references are mostly, but not exclusively, placed at the end of a sentence.

2.2.2 More than one reference in text

Separate citation numbers with commas and without spaces are provided if more than one reference is made, e.g. [2,5,6] or [19-22].

2.2.3 Form of reference in the case of a verbatim quotation

"The growth of libraries meant the growth of library staff" [2, p. 74].

(This refers to page 74 of the second source in the list of references, i.e. *Give the people light*.)

2.2.4 Punctuation

The following aspects with regard to referencing and punctuation must be adhered to:

- The full stop is always placed after the brackets if the reference occurs at the end of a sentence, e.g. [1, p. 60].
- No punctuation is used if the reference occurs within the sentence, unless this is required grammatically, e.g. … [4, p. 72] … .
- No punctuation is used within the brackets when only the number of the source in a list of references is mentioned, e.g. …[7]. However, this practice is strongly discouraged and, if at all possible, the page number should also be indicated.

- A comma separates the number of the source and the number of the page within the brackets, e.g. …. [6, p. 80] …. .
- For reference to more than one page, the abbreviation "pp." is used, e.g. [6, pp. 80-89]. There should be a space between the full stop after the p. or pp. and the actual page number(s) referred to.

3. LIST OF REFERENCES

The list of references is a comprehensive list with complete bibliographical details of all publications that have been consulted in the writing of a document. This is to be differentiated from a bibliography, which is a complete listing of all publications on a specific topic. The list of publications is normally arranged alphabetically according to authors (or titles of the relevant publications in cases where the author is unknown). In the case of a dissertation or thesis, the list of references is normally placed at one of the following positions:

- Right at the end of the document;
- At the end of the text, but before the appendixes;
- At the end of every chapter. In such a case, only those sources referred to in a particular chapter are included in the relevant list of references.

Due to the resultant ease of accessing the details of a particular reference, the author prefers a single, alphabetical list of references, right at the end of the document. However, this is a case of personal preference, without any formal rule prescribing the use thereof. In fact, many institutions are very prescriptive about the format in which their students or other contributors should prepare and submit their work – such prescriptions often run contrary to the above.

An example of a list of five references is provided below:

1. Bic, J.C., Duponteil, D. and Imbeaux, J.C. Elements of digital Communications. Chichester, John Wiley and Sons. 1991.
2. Bohm, B. DSP Implementation and Performance Testing of the Massey-Hodgart MSK Demodulator. Unpublished M Eng Thesis, University of Cape Town. 1995.
3. CCITT Blue Book Data Communication Over the Telephone Network, Volume VIII, Series V Recommendations. Geneva, IXth Plenary Assembly, Melbourne, 14-25 November 1988. 1989.
4. Crouch, S.E.C. and Jedwab, J. Doding in 100VG-AngLAN. Hewlett Packard Journal, vol. 46, no. 4. August 1995. pp. 27-32.
5. Hagiwara, M. and Nakagawa, M. New DSP Type Phase Synchronizer with the Method of Least Squares. Proceedings of International Conference on Acoustics, Speech and Signal Processing, vol. 3. 1988. pp. 1882-1885.

3.1 Books

Every book is an independent unit that must be bibliographically described so as to retain its own identity for subsequent tracking down and usage. The list of references must be compiled according to specific prescriptions – as specified by the relevant authorities. One such a set of prescriptions is described in this chapter.

3.1.1 Components of the bibliographic description

The different components of a reference depend on the nature of the publication. Normally it appears in the following sequence:

- The surname and initials of the author
- Title of the book (and extension of title if applicable) – underlined or in italics
- Edition (if more than one edition was published)
- Place of distribution
- Publisher
- Year of edition

The following is an example of how a book is identified in the list of references:

6. Takasaki, F. T. Applications of Digital Techniques: An Introduction. 3rd ed. New York, Wiley and Sons, 1994.

3.1.2 Punctuation

The punctuation follows a fixed pattern, so that every component is clearly separated by means of prescribed punctuation symbols – as indicated above.

Capital letters in the name of the publication

The use of capital letters is limited to the initial letter of the first word as well as each descriptive word in the title of the book, and also where such usage is grammatically required. Small letters are used for conjunctive words (e.g. "and", "or", "of"):

e.g. Applications of Digital Techniques: An Introduction.

3.1.3 Language used in the description

The description is usually provided in the language of the publication. Any additional information included by the student himself must be in the language of the text.

3.1.4 Determination of authorship

The names of all the authors must be listed. An institution, for example General Motors, can also publish a book. In such a case the name of the writer should be replaced by the name of the publishing organisation (unless the name of the writer does, in fact, appear on the book in which case it is indicated as such).

3.1.5 Title

Components and punctuation

- Official title: i.e., the main title of a publication.
- Other titles or information related to the title: i.e. explanatory titles, extension of the official title, etc.
- A full stop is placed after the title.
- Any other title, or information which has a bearing on the title, must be preceded by a colon (:) and concluded with a full stop.

e.g. The Zambezi Salient: Conflict in Southern Africa.

The title page provides the official title, and the wording of this title must be recorded exactly as it stands. The punctuation and the use of capital letters of the title page, however, are not necessarily followed.

Edition

The particular edition must be mentioned if more than one edition of the work has been issued. This component is concluded with a full stop.

e.g. 3rd ed.

2nd ed.

The place of publication, the name of the publisher and the date of publication must be provided with the following punctuation:

- A colon (:) is inserted between the name of the city where the book was published and the name of the publisher. If more than one city is listed as the site of publication of a book, the name of the first city listed is to be used.
- A comma is inserted between the name of the publisher and the date.
- A full stop is placed after the date.

e.g. Cape Town: Tafelberg, 1976.

Notation of series

A book is sometimes part of a series. The name of the series is mentioned last, and is always placed between square brackets.

Components

- Title of series; and
- Number of the particular book in the series.

Punctuation

The notation of the series is concluded with a full stop.

e.g. [Machines at work].

The numbering in a series is preceded by a semicolon [;].

e.g. [Bibliographies; no. 7].

Unpublished theses or dissertations can also be referred to. Such sources should be identified as unpublished research reports. The following is an example of such an inscription in the list of references:

e.g. Braun, R. Synchronisation of Partial Response Signals. Unpublished D Tech thesis. Bloemfontein: Central University of Technology, Free State. November 2005.

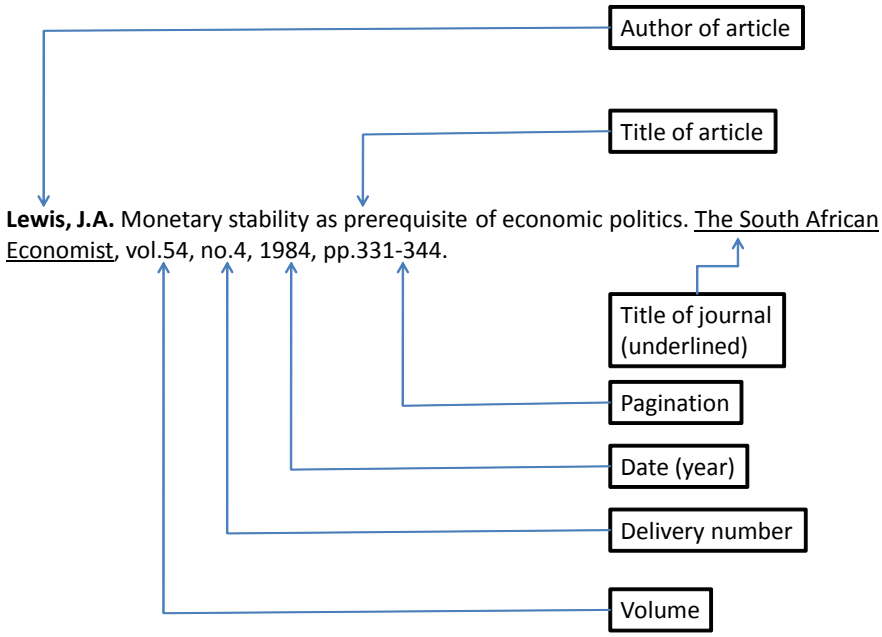
3.2 Articles in periodicals

References to periodicals and newspapers take the form of analytical references. These references must furnish certain particulars, namely:

- the author of the article
- the title of the article
- the name of the periodical in which the article appeared (underlined)

- volume and delivery number, as well as the month and year
- pagination

3.2.1 Reference method



The prescribed principles concerning punctuation and capital letters are also valid here.

The full title, as it appears above the article, must be supplied, as well as the name (underlined or in italics), volume, delivery number, month and year.

The place of publication must only be supplied if two periodicals both have exactly the same name. In such a case, the place of publication must precede the volume number, etc. The volume number, delivery number, month and year must succeed each other in this fixed sequence.

The precise page numbers on which the article appears in the periodical must be supplied.

e.g. vol. 26, no. 6, Jan. 1976, pp. 179-204.

3.3 Reference to Internet sources

In the case of Internet sources, there is often information that is not available. A typical reference in this regard may be as follows:

Author(s). Organisation, Title, Date, Address / URL.

e.g. Born, G. Beyond Logic, Programming the Parallel Port, 2000, http:/www.maxnc.com

These references are identified as comprehensively as possible, considering that the particulars are often not supplied in full. Where possible the correct Internet address should be provided in full.

3.4 Personal interviews or correspondence

Reference can also be made to interviews held with experts in a particular field of study. In such a case, the name of the interviewee and date of the interview should be provided.

e.g. Coetzer, H. Interview with the author on 31 June 2005, Cape Town.

THEME 14

PRACTICAL POINTERS IN PRESENTING RESEARCH

Hesta Friedrich-Nel and Saretha Brüssow

The focus of this section is to:

- indicate pointers in planning a presentation; and
- ensure that both the contents and presentation skills are outstanding.

1. INTRODUCTION

Presenting your research at conferences and scientific meetings is an essential aspect of the research process. The presentation of the research findings has the potential to be used as a platform to reach both expert and novice researchers. The experts in your research field could take cognisance of the work in progress or the completed work, while novice researchers could be motivated and inspired by your presentation. Whether it is a paper or poster presentation at a conference or scientific meeting, it represents an opportunity for researchers to express the results, findings and outcomes of their work in an individual manner. Additionally, it could be used as a marketing tool for your research and your institution. Thus, spending time in planning and preparing the presentation to assure a professional presentation seems more than worth the effort.

This theme provides the researcher with practical pointers in planning and presenting research. The focus is on pointers in planning, the selection of content, rehearsing and presenting your paper. The intention of this theme is also to highlight some tips to grasp and some traps to avoid when presenting your research for the first time. The content is aimed at the researcher who still sees the expert committee or conference audience as a daunting prospect, rather than at the skilled presenter or researcher. The process of 'writing up' the findings of research for presentation to peers can often seem an overwhelming task, especially for novice researchers.

2. POINTERS IN PLANNING

When planning the presentation, the abstract, structure of the presentation, presentation style, the nature of the presentation, the audience, the time available on the programme, the selection of data and rehearsing the presentation all contribute to the success of the presentation. It is for this reason that they are termed "pointers in planning".

2.1 The abstract

Most conference organisers require an abstract that provides a concise overview of all major sections of the paper including key results and conclusions. The abstract is a summary of the research project that usually has to fit on one page. Conference organisers could use the abstract in selecting contributions for the conference.

The abstract outlines the background to the study, summarises the supporting data and indicates the main conclusions of the study. It should include what your research found, how it found this, how it selected its sample and the contribution

it makes to knowledge. Usually the abstract will be made available to all the participants attending the conference or scientific meeting. Thus the abstract is an advertisement that participants in the conference might use in deciding to attend your presentation. Subsequently it must be relevant to your presentation to avoid false advertising.

2.2 The structure of the presentation

A number of possibilities exist in arranging the presentation, among others the traditional and creative approaches. In the traditional approach, the presentation is based on the same sequence as the research project. The format includes an introduction, methods, results, discussion and conclusion. However, a creative approach, by starting with the conclusion and working back to the methodology is possible when it suits the situation and the presentation.

2.3 Presentation style

The next step is to develop and enhance your own individual presentation style that best suits your personality. Such a presentation style will facilitate your performance, because you are comfortable with it. Opportunities to learn from others are always available when attending conferences and/or scientific meetings. Utilise these opportunities to the full to justify the time and money spent to attend the conference or meeting. By doing this, new ideas regarding presentations are constantly explored that have the potential to capture your interest as well as that of the audience. Refrain from being over-ambitious and listen to the more experienced presenters: keep it simple! The style of presentation may vary but there are basic rules to follow; stick to the point and follow a logical flow and structure. The key slides of your presentation should include the title, an outlay or simple illustration of the study design, an outline of the main results and slides on the conclusion.

2.4 The nature of the presentation

The presenter has to decide on the nature of the presentation. The presentation can be done according to a number of methods, with the possibilities relevant to the specific conference usually published in the invitation to the conference. The possibilities generally include the following: oral presentations with PowerPoint slides or transparencies, poster presentations, round-table discussions, and/or interactive workshop sessions. The nature of the presentation will help in determining the way forward with the planning of the presentation. Although each approach in presenting research may have unique considerations in its planning, the focus in this chapter is on common and general factors to consider.

2.4.1 The oral presentation

See Section 7 "Presenting your paper."

2.4.2 The poster presentation

The poster is a visible medium to present research results. The aim of a poster is to create a road map that will guide the viewer through the research process from beginning to end. A poster can display and describe your project without your being present, or it can be used as an aid to expand on information while you explain your research. The poster should include a title, a problem statement, the research

method, results or findings, discussion and conclusion. The more logical the poster design, the more likely the audience will be to understand the project.

Although a poster cannot cover every detail of a research project, it should convey information systematically. A poster should therefore be kept simple and uncluttered. Some guidelines in this regard are to use simple fonts without shadow effects; avoid using all capital letters; and use colour to add emphasis. Information typed in columns is easier to read than text laid out from left to right. Illustrations and graphs should be clear and well positioned. Remember: a picture is worth a thousand words.

2.4.3 Round table discussion

The round table discussion is mainly used to set up a platform where conference participants can establish connections with people who have similar interests. The usual approach for a round table session is to include an expert on a topic to serve as host for a table. It is expected of the host (the expert) to provide a critical insight and perspective into the field under discussion.

The ideal approach is to let all participants have insight into the round table presentations ahead of time, enabling them to prepare and thus make sure that the discussion is active and productive. A clear description as to the nature of the session, audience involvement and an integrated and logical round table theme are crucial elements of a successful session. Visual aids can also be used during these discussions to improve the effectiveness of the initial presentation. Well-planned discussion points that address the essential aspects of the theme will more actively engage participants and also guide the progress of the session.

2.4.4 Interactive workshop sessions

An interactive workshop session usually takes place in a venue that facilitates interaction and informal discussion between the presenter and the participants. It may thus be a more challenging presentation to the novice presenter(s) because you are not 'protected' by the podium, soft lights and the distance between the presenter and the audience. The presenter should be prepared to be interrupted during the presentation and should therefore not rely on reading the paper to the audience. It may be wise to plan and insert specific areas in the presentation that provoke interaction with the audience, giving the presentation structure and a natural flow.

3. THE AUDIENCE

Make it your business to investigate the diversity, knowledge and expertise levels of the audience when you start with the planning of the presentation, poster or round table discussion. The audience could be a group of experts or they may represent a diversity of research areas with no representatives or experts from your field of research. This information could be helpful in determining the depth and level of complexity of the presentation. Even if the audience is a group of experts, it is wise to stick to the rules of simplicity. Presenting the topic in a complex manner to impress the audience may prove to be a recipe for failure.

4. THE TIME AVAILABLE ON THE PROGRAMME

The time allocated on the programme for the presentation is an obvious but generally overlooked matter in the planning of the presentation. This indicates how much information you will be able to convey to the audience in the time allowed for the presentation. One often hears presenters saying that they have so much to say, and that the time allocated to them for the presentation is too short. A golden rule to maintain is that less is best.

5. SELECTION OF DATA

The selection of the data is probably the most difficult part in planning the presentation. Selecting and extracting essentials wisely from a bulky research project consisting of a vast amount of data, remains an art. The following pointers may assist in critically selecting the best-suited content to match the presentation.

Start by asking yourself what the message is that you want to convey to the audience. Additionally, reflect on what exactly it is that you want the audience to remember after the presentation. Think about the impact of the message that you want to linger after the presentation. In addition, imagine the picture that the audience, who attended your presentation, will associate with you and your presentation when they meet with you after the conference or meeting. Then capture this message in a sentence. This sentence will be of value in introducing the presentation to the audience and briefly informing them on the content.

The next step is to identify evidence from the research findings to support this message. Continuously test the selected evidence in relation to the formulated message. Be critical, selective and innovative, while keeping the bigger picture in mind. Keeping the bigger picture of the research findings in mind is useful because it could establish a specific approach to the presentation, and is helpful in selecting the content of the presentation. It therefore has an impact on the nature of the presentation, the level of expertise of the audience and the time allocated for the presentation. Keep it simple and stick to your individual style to secure the relevant impact.

6. REHEARSE

The planning of the presentation is only complete once the content of the presentation is written or typed out. In preparing for the presentation make sure that your work is free of any spelling or grammatical errors - the golden rule of all writing and presenting. Have your work proofread: errors can be embarrassing during a presentation. The next vital step in the preparation of the presentation is the rehearsal. The rehearsal should be a true reflection of the nature of the presentation that you have decided on. Keep record of the time.

Use peers as an audience to provide constructive feedback and comments that could add value to your presentation. Prepare cue cards in extra large print with only key words. If you write everything out and read it aloud it takes longer and will be harder to follow. Keep the level of detail on your visual aids to the minimum, and use the verbal presentation to expand or to provide detail. Rehearse the talk and question session, adjust the details and get the timing right. Keep rehearsing until you feel comfortable with the content and audiovisual aids that complement the presentation.

7. PRESENTING YOUR PAPER

Before the presentation, upload your slides in the venue, display them and see that they are in the correct format. Technology is fallible and cannot always be trusted. Have handouts of your presentation available for a crisis situation. Make sure of the venue, attend a presentation in the same venue to familiarise yourself with the use of the audiovisual facilities and practise during a break in the programme.

Be confident during the presentation. Your body language reflects if you feel threatened and the feeling may show in your body's action. Try the swan effect: the swan floats on the millpond - calm, serene and relaxed but it is actually paddling furiously - but only the swan knows that. Walk confidently to the podium and arrange your notes, adjust the microphone, position pointers and slide changers to your satisfaction. At all times introduce yourself and your topic. Give your name, your job title and a word or two to say how long you have been dealing with the research. In a few words describe the procedure that you are going to follow in your presentation. Give a clear structure to your presentation and keep it simple; it is easier to follow and to remember. Present your research in a logical flow so the audience can follow your ideas and methods and how your conclusions were reached. Know your material inside and out. Keep the words of Shakespeare's Polonius in *Hamlet* in mind, namely "Brevity is the soul of wit" (see Theme 15).

7.1 Opening

Start with a strong opening related to your problem statement; state your problem; list the rationales that support your problem, supporting these with the literature or statistics. The introduction should provide a good reason for the study by identifying the aims or hypotheses that are the centre of the research. Present the few opening sentences without any reference to notes. Make your first point solid - engage your audience or panel immediately with a relevant question: this indicates to them what is to follow.

7.2 Level of abstraction

Provide for the experts in the field of knowledge but also for the general audience member. To prepare for an audience in which there are different levels of knowledge, do what newspapers do: strike a balance by targeting the average participant. Define technical terms and avoid jargon and non-scientific words. Speak as a peer, not as a superior, to avoid annoying your audience.

7.3 Handouts

Handouts can be used to cover both elementary and advanced concepts. Use handouts to provide details to summarise after you have spoken and to break up your presentation. The best handouts are short and only a one-page summary of main points. If the committee or audience has no need to refer to the written handouts during your presentation, hand them out at the end of the session: that way you need not to compete with the handout for the audience's attention.

7.4 Visuals

Use visuals to illustrate a point. Visual devices can hold an audience's attention as a picture or diagram can make a point faster and better. If the slide contains numbers,

then talk about percentages and visa versa. Tables should have no more than four columns and seven rows. A line graph is effective in demonstrating rise or fall and growth or decline, while the bar graph presents comparisons. Always explain the content of the table or graph to rule out confusion.

7.5 Closing

In closing the presentation, always indicate to the audience that you are closing. Interpret your results and summarise your main conclusions. Deliver your closing, preferably one that relates back into your opening theme - the problem statement. Last words linger. Never close by asking for questions. At the end of your presentation, thank your audience for their time.

7.6 Questions

Questions can strengthen a presentation. Most expert committees and conferences have a set period of time for questions. This facilitates engagement with the audience and is thus the most crucial part of the presentation. Some experts in the audience will test you with searching questions, and how you handle them will increase or decrease the impact of your performance. Listen to the question very carefully. If the question is difficult or you think that the audience has not heard it, repeat it clearly and briefly before you respond; this also gives you time to think. Answer the question specifically. Sometimes a 'yes' or 'no' will be enough. If the question is awkward try to redirect it with strategies that include agreeing or admitting differences of opinion. Do not be afraid to disagree with any questioners, however well known, when you are sure of your ground.

In the last section of this chapter, we provide useful tips, and some traps to avoid when presenting research.

8. TIPS AND TRAPS WHEN PRESENTING YOUR RESEARCH

The use of the "Five P's" in the planning and presenting of your research should provide you with peace of mind for your next presentation.

8.1 The "Five P's"

The practical pointers in the planning and presenting of your research may be remembered as the "Five P's". They are:

- *Present,* referring to the nature of the presentation.
- *People,* for the diversity and expertise of the audience.
- *Period,* indicating the time limitation of the presentation and the time allocated on the programme.
- *Pre-select,* for the critical selection of the content of the presentation and presenting the content with innovation and creativity.
- *Peers,* used for informal feedback and comment.

If you can grasp the following tips and avoid the subsequent traps when presenting your research, you are free to focus on the scientific content of your presentation and what your audience need to know.

8.2 Tips

The following tips can add to the success of your presentation. They can also simplify what may initially seem like an overwhelming task.

Tips to grasp are:

- honour all requirements of the presentation
- take the nature of the audience into account
- adhere to the time allocated
- have a clear purpose
- present the research process in a logical flow to hold interest
- begin with a strong opening for immediate impact
- review what you have covered and use a strong close.

The abovementioned tips alone will not ensure success in your presentation. It is therefore wise to be aware of possible traps that could potentially be harmful to the success of your presentation.

8.3 Traps

Common traps or pitfalls to avoid when presenting your research are:

- a vague approach: if you cannot describe the purpose of your research in one sentence you may be guilty of having no focus. The audience will be confused too, and their attention will not be focused;
- having no impact: people rarely remember your exact words. Instead, they remember the mental impact that your words inspire. Combine both intellectual and emotional connections. Intellectual connections consist of the scientific information and arguments while emotional connections come from engaging the audience's thoughts;
- avoid being on the wrong level of abstraction by providing the bigger picture when the audience needs facts;
- too much or too little detail: avoid drowning the audience in detail when they only need an overview. Be enthusiastic about your presentation but avoid rushing on at full speed to crowd in as much as possible because you might leave the audience behind;
- technology support: the fact that visual aids are available does not mean you have to use them. Any aid takes the attention away from you. If you read what is on the visuals, one of you is redundant. Make technology a support to your presentation, not a crutch.

9. CONCLUSION

Bearing in mind that presenting your research could be a valuable marketing tool for your research, it is worth going to the trouble of doing it with excellence. The best advice is to produce the research as well as you can – every time!

THEME 15

VERBAL AND NON-VERBAL COMMUNICATION SKILLS IN PRESENTING RESEARCH RESULTS

Marietjie van Deventer and Mardi Delport

The focus of this section is to:

- communicate effectively during your presentation;
- take note of the non-verbal communication skills; and
- present your research results effectively understand how to ensure that both the contents and presentation skills are outstanding.

1. INTRODUCTION

At present the *lingua franca* for presenting research in South Africa is English. This may present a daunting challenge in terms of verbal communication skills in presenting research results if you must communicate in English and it is not your mother tongue.

An important goal in delivering your research paper should be to communicate with the audience as effectively as possible. Presentation, after all, is a performing art and the presenter should be willing to see him/herself as an entertainer or an actor. For this reason also, non-verbal communication skills are equally important. The non-verbal aspects of presentation provide the glue for your research to be remembered for a very long time. The presenter's diligence, enthusiasm, fluency and appearance play a vital role in the overall impression during the delivery of the research paper. A poor performance may make a poor, or no impression at all, regardless of the many hours you have spent writing your research article. A good performance can provide just the edge you need to strengthen the impact of your research.

A short introductory survey of what to expect when presenting your research results verbally and non-verbally for the first time, is included in this extract.

2. ANXIETY

It is one of the most natural things in the world to feel anxious before presenting your research results in front of an audience for the first time; indeed, even when presenting for a third, fourth or more times you will most probably feel a certain degree of tension. However, rest assured in the knowledge that one of the prerequisites for a good presentation is to feel slightly apprehensive before the time. All this helps to get the adrenaline pumping in order for you to do your very best.

If you have not prepared your presentation adequately, you may be overwhelmed by your anxiety, and this will be exacerbated by the dread you might feel about opening yourself to criticism by academics, scholars, peers and other knowledgeable people in your audience. You will fail miserably in getting your message across if you have not prepared sufficiently, and this will do nothing to alleviate your anxiety.

The golden rule is to be well prepared *before* presenting your research results.

Stress can be reduced by extensive rehearsal (in front of a mirror or close friends and relatives if need be) and by timing yourself. Another good idea is to listen to your presentation on audiotape or to watch yourself on a videotape recording, in order to rectify mistakes.

Make sure that you are acquainted with the venue and that the technological equipment is in good working order. Many speakers require the security of a lectern from which to deliver their presentation. If you are very nervous, request a lectern or high desk on which to put your notes or awkward hands and arms.

If you are tense or nervous, it might affect your voice. Tension usually manifests itself in the upper area of the body, the neck and the shoulders. Because the sound is forced, the listener may be more aware of the high-pitched sound of the voice rather than of what is being said.

The importance of complete relaxation cannot be over-stressed because it is only when the body is relaxed that the mind can be fully creative. The average human being takes about 20 breaths a minute, which revitalises the brain.

The psychological fight-or-flight response of your body to stage fright results in actual physiological changes taking place in your body. For example, your body's response to any threatening situation (such as the research presentation) could be sweaty hands, a dry mouth, and butterflies in your stomach or an increased heartbeat. It is not always possible to eliminate such symptoms entirely, but the following *techniques* (Guffey, 2001:329) could reduce their effects to a large degree:

- Reduce your stress by breathing deeply and holding your breath for up to 10 counts while counting aloud, and repeat while exhaling.
- A good breathing exercise is to stand in a relaxed manner. Place your hands against your lower ribs and breathe in to a mental count of three. Breathe out to a mental count of three (feel the ribs swing). Breathe in to a count of three. Hold your breath without breathing in or out for a count of three. Breathe out to a count of three. Expel the breath while humming "mmmmm", evenly and slowly.
- Be confident. Use positive self-talk by reminding yourself that *you* are the person who has done the research and, as the principal researcher on this specific topic, *you* know the *most* about it at this particular moment in time. It is normal to find your audience intimidating if you are presenting for the first time. However, do not regard them as a threat - tell yourself that they are on your side (because they are).
- Even an experienced presenter can feel stressed. Avoid having the focus on you all the time by shifting the audience's attention to your visuals.
- Don't confess your nervousness or apologise. If you stumble over words, keep going. The audience will soon forget your mistakes.

3. BACKGROUND INFORMATION ON NON-VERBAL COMMUNICATION

People can tell you anything, but their body language will tell you the truth, because the body is the sounding board for the subconscious mind, which is capable of expressing only what is true. Non-verbal communication can be defined as communication behaviour other than written or spoken language that creates

meaning for someone else. Surprisingly, non-verbal communication can comprise up to 80% of the overall information content in person-to-person communication.

Non-verbal communication does not occur in isolation, but rather within a complex communication process. It is continuous, multi-channelled, simultaneous and spontaneous. Like culture, non-verbal communication is learned, passed on from generation to generation and involves understanding. New lovers often mirror each other's body language and with a couple that have been together for many years, it is akin to second nature.

There are seven functions of non-verbal communication:

- It repeats the verbal message.
- It replaces verbal communication.
- It opposes verbal communication.
- It supports the spoken word.
- It informs about mutual understanding.
- It emphasises verbal communication.
- It structures and regulates the verbal message.

4. IMPORTANT NON-VERBAL ASPECTS WHEN PRESENTING

4.1 Facial expression

Facial expression is perhaps the most important form of non-verbal communication. Smiles, grins, smirks, frowns, grimaces and raised eyebrows can all add emphasis or, conversely, suggest that the descriptive words in the message are to be discounted. Unfortunately, one of the beginner's most common reactions to nervousness is failure to use facial expressions. As a result, the anxious speaker often speaks in monotone, sighs a great deal and has a blank expression on his/her face. Expressions convey the mood and current emotional state of the speaker. A speaker's range of facial expression is one of the most important non-verbal communication tools. Audiences tend to remember a speech better if it is accompanied by vivid and effective facial expression.

4.2 Kinesics or body movements and gestures

Kinesics, or the movement of the hands and body, also conveys information. Make use of gestures to emphasise certain points. Gestures attract attention and should therefore be purposeful. In general, gestures should be larger for larger audiences in a face-to-face situation. Try to vary gestures in a natural and spontaneous way and do not use the same gesture over and over again, as these mannerisms may distract the audience from the content of the research paper or article. A speaker should use the kind and number of gestures called for by his personality, the subject matter and the audience. The research paper should be presented confidently and naturally.

Make use of the following body movements and gestures in order to keep your audience interested:

- Smile. Let your audience know you are comfortable and that you are glad to have them listening to you.

- Use eye contact with all sections of the audience. Eye contact turns what you are saying into a conversation and thus helps your audience to concentrate on your message. Eye contact establishes warmth and is an important source of feedback.
- Act confidently.
- Have a firm and secure posture.
- Use enough movement to maintain interest.
- Use strong and appropriate gestures.
- Make gestures relaxed and comfortable.
- Have gestures originate from the shoulders, not the elbows.
- Give your movement a purpose.

4.3 The importance of voice projection

There are a variety of factors that have a bearing on the effectiveness of a speaker's voice, but first we need to determine what an "effective" voice is. An effective voice is one that aids the presenter in the achievement of his objectives. It is not necessarily a beautiful voice, nor do accents really matter, unless they are so heavy that they make the speaker unintelligible to the audience. What is important, however, is that the voice be clearly audible and pleasant to listen to.

Another important aspect with regard to voice quality in delivering a research paper is paralanguage. Paralanguage can be defined as verbal communication that does not involve words themselves. Vocal characteristics such as pitch, volume, rate, quality, pauses and emphasis often are referred to as the "music" of the voice.

Voice quality is an art and perhaps the most important form of non-verbal communication. People assess you according to the way you sound. Your voice reflects your character, mood, attitude, personality and intelligence.

Make use of the following vocal characteristics when presenting your research:

- Have sufficient vocal variety.
- Build points vocally.
- Add quality to your voice, for example, by conveying empathy, firmness and humour.
- Have enough breath to complete each sentence strongly.
- Stress the most important words and phrases.
- Shade the less important words and phrases.
- Make use of a variety in pitch, force, volume, rate and rhythm.
- Have vocal and physical energy – why should your audience be enthusiastic if you don't sound enthusiastic?
- Articulate clearly.
- Add full value to all sounds.
- Avoid "oh", "uh", "ok" and "you know".
- Make sufficient use of pauses.

5. HOW TO PRESENT YOUR RESEARCH RESULTS EFFECTIVELY

- Once you have been called upon to present, pause briefly to establish control over the situation by getting your notes in order and making yourself comfortable.
- Open your presentation from memory in order to establish the necessary rapport through eye contact. If you feel uncomfortable with direct eye contact during your presentation, a good idea is to focus on the forehead or chin of two individuals on the right side and two on the left side of your audience.
- Avoid unnecessary "***ahems***" and "***ahs***" while you are thinking of what to say next. They, together with using hackneyed phrases/words such as "***at this point in time***", "***you know***" and "***understand?***", will interfere with the effectiveness of the communication process.
- Avoid speaking too rapidly. This is a sign of nervousness. Much of your message will be lost in the process – take your time; give the audience (as well as yourself) time to breathe and absorb what you are saying.
- Avoid digressing by telling anecdotes that occur to you on the spot – stick to the main points in your notes so that you are able to finish within the time limit allotted to you and so that there will be time for questions afterwards. Do not irritate your audience (or the next presenter) by exceeding your time limit.

Even if the content of a speech is exceptional, it can be lost on an audience through poor delivery. Spontaneity, enthusiasm, and eye contact are very important. The idea is to make the carefully prepared and well-organised speech sound like a spontaneous conversation.

Here are some useful tips to keep in mind when delivering your research paper:

- Make eye contact with the audience.
- Be well prepared.
- Be well practised.
- Sound fresh to each audience.
- Establish empathy.
- Practise with a microphone.
- Share yourself with the audience.
- Show that you care.
- Start strongly and establish audience expectations.
- Be mentally responsive to the audience.
- Be sincere.
- Be enthusiastic.
- Believe in what you say.
- Concentrate on your strengths.
- Never be boring.

Sometimes it is expected of students to read extracts from their research articles, but only read the article if it is expected of you. If you have a choice, do not read it word for word. When you have to read certain aspects of you article, try to keep the following in mind:

- Believe in your material.
- Familiarise.

- Personalise.
- Emphasise.
- Harmonise.
- Make use of audio-visual material. It gives you the security of having a written structure, and also allows you to look and sound spontaneous.

6. LISTENING SKILLS

Research has shown that students generally remember less than 50% of the information provided during lectures. The reason for this is that the human being speaks at about 125 to 200 words per minute, but his thinking speed is three to four times faster. We have a capacity to listen to 650 to 700 words per minute. This leaves an opening for the listener's attention to be distracted while the speaker is conveying his message (Van Schalkwyk, 1998:20).

You must try to capture the attention of the audience within the first thirty seconds of your presentation. Therefore it is advisable to make use of a strong opening statement. Many speakers use humour as a means of ingratiating themselves with the audience. Try not to speak too long – be brief and interesting, and speak to the audience in a language they will understand.

Research has shown that after 30 minutes people have forgotten 40% of what you have said. At the end of a day people have forgotten 60% of what you have said, and at the end of a week people have forgotten 90% of what you have said. What is left is the impression. People remember the examples, not the headlines – and if someone is sitting with his/her arms crossed during a negotiation he/she is only likely to absorb a maximum of 40% of what you are saying.

7. TECHNIQUES OF DELIVERY

7.1 Memorisation

How will you be able to establish *rapport* with the audience? Inexperienced speakers often feel obliged to memorise their whole presentation. However, unless you are an experienced speaker, well trained in the art of rhetoric, a memorised presentation may not sound very spontaneous or convincing and could come across as being very wooden and unnatural.

The advantage of the memorised presentation is that it will help you to establish and retain *rapport* with your audience, since you will be able to maintain eye contact with them all the time. However, imagine how disastrous it would be if you were to forget your words and get stuck in the middle of your presentation, and have to search in your notes for the place where you left off. It is therefore not recommended that you memorise your presentation in its entirety. Instead, rather memorise only relevant sentences/words in your introduction and conclusion, with a few salient points/quotes in between, should you be fearful of forgetting the significant parts of your presentation.

7.2 Reading from a manuscript

Even well established researchers often fall into the trap of reading their research results to the audience. Although reading from a manuscript allows one to repeat

beautifully constructed sentences, free of grammatical and other errors, and is advisable when split-second timing is called for, it rarely is the most effective way of presenting your research results. Still very popular at research symposia (after all, we still speak of "reading" a paper at seminars or conferences), this type of presentation is to be discouraged. Unless you have accomplished the art of effective reading through proper vocal technique and training, reading can be very boring and ineffectual. Very often reading from a manuscript can suggest to your audience that you do not know your topic very well and they may even start doubting your research expertise.

7.3. The "notes" or prompt card method of delivery

In our modern age, the "notes" or prompt card delivery is by far the most popular method of presentation. It allows you to be spontaneous and natural, while maintaining eye contact with your audience, which is essential in establishing rapport.

This kind of presentation is prepared carefully in advance, with the major points and key sentences entered onto the prompt cards. If you get stuck or forget what you wanted to say, you merely have to refer to your notes. Supplemented by modern technology, this could prove to be the most effective way of presenting your research results. It allows the speaker to focus on his main points, not words only as in memorisation. It also retains the attention and interest of the audience the longest, for the presenter will appear confident and relaxed.

The final wording of the presentation is left for the occasion itself, and the speaker as s/he progresses. (A word of warning regarding the latter, though – this type of presentation is not advisable for the person who is not well versed in the particular language in which he is presenting, for example, if English is his third language). If you should choose this type of delivery for your presentation, make sure that what you have to say is grammatically sound and that your pronunciation and enunciation of words are acceptable. Should you fail to do this, it could influence your message negatively and your credibility as a researcher could suffer.

8. WHAT IS THE PURPOSE OF YOUR PRESENTATION?

Before presenting, you will have to decide what the purpose of your presentation is. Is it to persuade your audience? Is it to inform your audience? Do you want to impress or entertain your audience?

Most researchers would most probably answer (correctly) that their main purpose is to inform and/or persuade their audience. (In all truthfulness, we think that a combination of all four of these aspects would be a more correct answer). Admittedly, one wants to inform and persuade one's audience that the content of one's presentation is on track and meets all the requisites of scientific research. By the same token, one cannot listen to a presenter hammering away intellectually for hours on end without his providing some form of emotional relief: whether it be in the form of humour; or by involving the audience, for example, by evoking some form of response such as non-verbal or verbal feedback.

Verderber and Verderber (2002:428-437) identify 5 principles of informing:

- **Credibility** – is the level of trust that the audience will have in the presenter. The bases of credibility of the presenter are knowledge or expertise, personality and trustworthiness. Audiences are more likely to listen to a presenter if they have confidence in, like and trust him. Demonstrate your expertise by speaking fluently, knowledgeably and coherently. Look and sound enthusiastic while taking their needs into consideration.

- **Creativity** – Eysenck (in Verderber and Verderber, 2002:430) defines creativity as "a person's capacity to produce new and original insights". Contrary to popular belief, creativity is more a matter of perspiration than inspiration. In other words, creativity requires of you to gather enough high quality information to provide a broad basis from which to select the content that is the most applicable for your specific research presentation.

- **Emphasis** – Audiences are more likely to remember and understand information that has been emphasised or reiterated during your presentation.

- **Intellectual stimulation** – When information is conveyed that most of the audience is not familiar with, or if "old" information provides new angles and twists, it will be intellectually stimulating.

- **Relevance** – Relevance is the "personal value" people attach to information that relates to their interests and needs; it also relates to the individual's "need to know" (Verderber and Verderber, 2002:430). Most people do not listen to everything that the presenter says. In other words, the audience will not absorb like a sponge every bit of information you convey; rather, they will filter only the information that they perceive as being relevant .

Before attempting to present, there should be no doubt in your mind as to where you are going with the presentation. Because you as researcher are the one that will know the most about your research topic, you will have to narrow down the purpose of your presentation, as you certainly will not be able to inform the audience about *everything* you have done in your research in the specific time allotted to you (the time for a short presentation usually ranges in the vicinity of 20 or fewer minutes, depending on the occasion).

To narrow down your presentation, you could focus on three main ideas or themes of your research or concentrate on the findings; or its contribution to existing knowledge; the who, what, why, how, where and when of your research; a description of what you did, whether it be qualitative or quantitative research, and so forth.

After you have selected, narrowed down the content and defined the general as well as specific purposes of your presentation, it is time to develop the thesis statement of your presentation. Wood (2003:360) defines the thesis statement as "the main idea" on which the whole presentation rests, that captures "the key message in a short and precise sentence that listeners can remember easily". She continues by stating that "A good thesis statement is one that listeners can grasp at the beginning of your talk and remember after you have finished" (Wood, 2003:360).

9. ANALYSING YOUR AUDIENCE

You will have to determine the size of your audience: its average age, gender, experience, attitude and expectations. All these aspects will no doubt influence your presentation, and you will have to anticipate your audience's reactions and adapt your presentation strategy, vocabulary, level of detail, illustrations and so forth, accordingly. For example, if you are to present to undergraduates who do not have much previous knowledge on your topic of research, you will have to adapt your presentation and relate the information to meet their needs. However, if your audience consists of experienced academics, knowledgeable in your field of research, you will have to make sure that your presentation meets *their specific academic expectations* in order for them to learn something new, or to motivate them to share their own expertise with you or to give advice where called for.

The larger your audience, the more formal your overall presentation approach will be; conversely, the smaller your audience, the more personalised and informal it will be. You should also determine whether statistics, graphic presentations, case histories, demonstrations, analogies or cost figures, for example, would be the most effective in getting your message across.

10. ORGANISING THE CONTENT OF YOUR MATERIAL

You are now ready to collect the relevant information for your presentation, and to organise the content of your material in a logical manner. Your ability to organise your work coherently and consciously repeat the focus of your research content, are key elements in fostering audience comprehension and retention.

Guffey (2001:321) suggests the following oral presentation outline or summary, which could prove helpful in organising your research material coherently:

- **Introduction**
  - Capture the audience's attention.
  - Involve the audience.
  - Identify yourself to establish credibility.
  - Preview at least 3 main points.
- **Body**
  - Establish main points.
  - Develop coherence with planned transitions.
- **Conclusion**
  - Summarise main points.
  - Provide final focus.

In the preview of your introduction, your proposition (thesis statement) should be stated clearly, followed by the transition to:

- the body of your presentation in which the main points of your proposition should be repeated and elaborated on; and
- your conclusion, in which the main points should be repeated/summarised and/or recommendations reiterated.

In short:

- tell your audience what you intend to say;
- say it;
- summarise what you have said.

11. STAGES OF THE PRESENTATION

11.1 Introduction of your presentation

In the introduction of your presentation you should strive to attain the following:

- Capture the attention of your audience. For example, appeal to your listeners by involving them in what you are saying and eliciting some sort of verbal/ non-verbal response from them. For example, give a startling revelation, a quotation, a question that requires an answer from them through a show of hands, standing up or inoffensive humour that suits your personality and the content of your presentation.
- Identify yourself and establish your credibility through, for example, referring to what qualifies you as a presenter. Describe your experience, knowledge and position in your specific field. Connect with the audience by, for example, revealing something about yourself, telling a joke or anecdote, and identifying with the needs of the audience.
- Identify the main points of your presentation through some kind of visual or other aid. Skilled presenters would make use of popular visuals such as:
    - the overhead transparency (might be regarded by the audience as being "low tech" and give the impression that the speaker is not up to date);
    - computer visuals such as PowerPoint presentations (over-exposure to this medium could also become tedious, and sometimes leaving your PowerPoint at home and just "communicating" or speaking to your audience in a natural, spontaneous manner would do);
    - freelance graphics, charts, tables, slides, etc.

Aids help to create a dynamic, memorable presentation. However, they should supplement, but never supplant the oral presentation itself, for this would make your presentation very impersonal. In most cases it is the "engaging delivery style" (Wood 2001:283), the charisma and warmth of the presenter himself that are remembered, and thus associated with the specific research contribution that has been made. In other words, very often the presenter himself is the visual aid that will enhance the reliability of his content. Larson (2001:278) elaborates on this when he says that "delivery and charisma are related to sincerity and dynamism" and that a presenter who is dynamic seems "to take up a lot of psychic space" and has "stage presence"

11.2 Body of your presentation

- Develop the main points (not more than 3-4, depending on your time limit) without too much detail, to prevent obscuring the main message.
- Keep the presentation simple and logical (remember that your audience can always refer to the references in your written rendition, should they wish to glean more information on the topic).

- Keep in mind that most people are not very good listeners and most probably will not be able to separate main points from supplementary information. Therefore be wary of drowning them in a sea of information. Stick to your principal ideas.

11.3 Conclusion of your presentation

Your conclusion should be prepared carefully in advance, since this is your last opportunity to drive home the main points of your argument. It is fatal to end with an anti-climax such as: "I hope I haven't bored you too much and that you have learned something." Such a lame ending greatly undermines your credibility as presenter as well as the content of your presentation. The skilled presenter would utilise this opportunity to review the main points of his presentation and focus on the goal of his research. Important ideas should be repeated.

12. VERBAL SIGNPOSTS

Presenters will lose their listeners if they do not adhere to the verbal signposts of their presentation, for example, previews, summaries, or transitions:

- **To preview**

For example:

The next segment ... presents three reasons for ...

Let's now consider the causes of ...

- **To summarise**

For example:

Let me review with you the major problems ...

... the most significant factors are ...

- **To switch direction**

For example:

Thus far we've talked solely about ...; now let's move to ...

I've argued that ... and ..., but an alternative view ... (Guffey, 2001:322-323)

13. QUESTION TIME

After a lively, invigorating and convincing presentation, and if the above guidelines have been adhered to, most listeners would be motivated to ask questions. Repeat the questions asked to clarify any misunderstanding before answering it. Should the audience be reticent about asking questions, the presenter could attempt to evoke a response by saying something such as: "I am often asked ...". Should silence ensue after your presentation, you could always say that you will be available afterwards to answer questions individually (during breaks, lunches, for example). During question time (usually 5 –10 minutes) *handouts* could be distributed to the audience.

When you have answered the last question, it is wise to thank the audience for having given you the opportunity to share your research findings with them.

14. CONCLUSION

Without solid content and valid sources, nothing is worth communicating, but without effective delivery, information cannot be clearly and vividly presented. Because your audience is the ultimate judge of your effectiveness, you must use your delivery to involve them in your speech. Each audience member likes to feel as if s/he is being addressed personally. Therefore, try to think of your presentation as a conversation and your audience as your partners in dialogue. Then use your voice and body to create this impression.

Our contention is that a good presenter is made, not born. Therefore the best way in which to ensure effective verbal communication skills when presenting your research results is through practice. The natural or inborn reticence, which you may feel because you are presenting in your second or third language, will soon disappear after thorough practice and preparation.

By following the aforementioned guidelines, the verbal/non-verbal presentation of your research need not constitute the envisaged *nightmare* that was anticipated, but could be a rewarding and enriching exercise for both presenter and audience.

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THEME 16

QUALITY ASSURANCE OF THE RESEARCH PROCESS

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The focus of this section is to:

- outline the quality assurance procedures in postgraduate studies; and
- describe methods for improving the quality of postgraduate work.

1. INTRODUCTION

Research comprises a variety of activities and services, which are carried out exclusively in accordance with accepted scientific rules. It includes various types of research and projects as well as postgraduate studies. Due to the complexity of the research process, students and/or clients are not always in a position to fully assess the quality of the services they receive. They therefore have to depend to a high degree upon the expertise and competence of the study leader or promoter and/or project leader. Documented standards for the quality assurance of the individual steps in the research process as well as for postgraduate studies can make a substantial contribution towards maintaining and improving the necessary trust that students place in the services rendered by the research office and/or supervisor.

In this theme good practices for quality assurance in research and postgraduate work are described, representing a frame of reference for research officers, supervisors, promoters and postgraduate students, encompassing the entire research process. This frame of reference describes the requirements towards the individual steps in the research process that are relevant to quality. Although it will not always be possible to achieve all of them at a given time, they provide us with useful quality assurance mechanisms and procedures that can be implemented and revised from time to time.

Some of the issues discussed are more applicable to the institutional, faculty or departmental levels. It is, however, important for the postgraduate student to acquaint him/herself with broader perspectives of what constitutes quality in research and postgraduate studies. Postgraduate students should not forget that they have a role to play in the enhancement of postgraduate practices.

2. QUALITY ASSURANCE IN POSTGRADUATE STUDIES

We need to understand that the responsibility for quality in research outputs lies on different levels. First of all the institution needs to formulate a clear vision of what it would like to achieve. A catalogue of quality assurance standards/criteria is helpful in contributing towards creating a deeper understanding of quality in the research process and expressing the necessity for exceptionally high quality in research results. In the form of a "checklist", it allows all role players involved to identify the underlying quality of research in general.

2.1 Institutional quality management

Quality usually begins when there is an effective institutional quality management system in place. Part of such a management system should be the setting out of clear processes and strategies to oversee the overall implementation of quality assurance. The way in which research steps are conducted, and hence the quality of the research results, must be constantly monitored and safeguarded. This calls for a system of quality management and practices specific to the particular research office and/or faculties and departments. Such a quality management system determines and monitors the quality-related steps and precautions that are taken within research practices. Ideally a quality management plan should be drawn up in such a way that it describes in detail the way in which the individual steps of the research and/or postgraduate studies are to be conducted and assessed.

2.2 Responsibility for quality assurance

The responsibility for quality management and safeguarding and the scientific quality of the research activities must ultimately be an institutional and shared responsibility that includes the postgraduate student and industry as partners. Regarding contract research, this is obviously the responsibility of, for example, the research officer. This person is usually endowed with the necessary formal competence and authority to bring the organisational structures within the office into line with the quality-related requirements of the research process. In terms of postgraduate studies the promoter/supervisor obviously has a major responsibility to ensure quality in collaboration with heads of departments and deans. The student has the responsibility to see that his/her final product is of high quality, demonstrates a logical development, is in a perfect format, has a critical tone, utilises sound methodology, shows no evidence of errors in statistics and data, meets the set objectives and reflects impartiality.

2.3 Management of quality research

In order to manage research effectively and to enhance quality it is obvious that the following elements form an intrinsic part of the quality of research:

Policy framework

The institution should adopt a research policy, which will spell out the approach towards research as well as the procedures (practical execution) to conduct research and the execution of research-related activities. In terms of postgraduate studies a "postgraduate code of conduct" is a useful and directive way of setting high standards of achievement for both supervisors/promoters and students. Part of the policy framework are the institutional admission criteria according to which the institution is expected to formulate students' qualifications and experiences required to enrol for postgraduate studies.

Other aspects that should be in place are policies regarding supervisor qualifications/accreditation, supervision guidelines, the use of half-yearly reports and other forms of interim assessments, amongst other things.

Organisational support

Strategies for supporting academic staff and maintaining excellence in research should be embedded in the management structure of the institution. Faculties must

also be provided with adequate resources and should make workload adjustments to support supervisors and other researchers in the performance of their duties. The same support should be provided to postgraduate students regarding a variety of aspects, e.g. research design, conducting of research, academic writing and critical thinking.

Staff development

The value of providing training and support for supervisors and other researchers has been recognised in higher education and most institutions now provide the same form of staff development in this area (Whittle, 1994:45). Staff development programmes range from short workshops and supervision to systematic, ongoing support programmes.

Induction programmes are another method of introducing new staff to research policies and supervision, as well as to key issues and concerns relating to research degree study.

3. REQUIREMENTS FROM THE HIGHER EDUCATION QUALITY ASSURANCE COMMITTEE (HEQC) (see Theme 2)

Apart from knowing what an institution's responsibility is in ensuring quality of research outputs, it is imperative to familiarise oneself with what is happening on a national level.

The White Paper on Higher Education (1997) and the National Plan for Higher Education (2001) place strong emphasis on the need to develop research capacity and to increase research productivity to ensure both open-ended intellectual inquiry and the application of research activities to social development. However, the current capacity, distribution and outcomes of the higher education research system, including graduate throughput rates, remain causes for concern. The Department of Higher Education and Training has set an increase in postgraduate enrolments and research outputs as a strategic goal for the South African higher education system. The HEQC includes research quality management in its audit system to ensure that research as a core function of higher education is conducted within an integrated quality framework and that it is included in institutional planning and resource allocation as a key mission area indicated by the institution.

The following criteria are regarded as important indicators of the quality of an institution's research. It is therefore necessary for institutions to make sure that they have (inter alia) the following in place (criteria for the HEQC's first cycle of audits: 2004 – 2009):

- A research management system that allows for planning, implementation and monitoring of researcher participation, research output and to increase the pool for the funding of research.

The following are examples of what is expected from institutions:

- A research policy that makes provision for support for the different types of research (e.g. basic, strategic and applied) and for the different stages of the research cycle (proposal development, evaluation, funding, reporting, dissemination).

- A research information system that monitors research production and researcher participation throughout the process.
- Indicators to evaluate the effectiveness of the research management system.
- Strategies in place to increase research funding.
- Institutional policies, structures and programmes that are conducive to the development of new researchers, with due attention paid to race and gender considerations.
- A research policy that encourages and supports collaborative research at the regional/national level and the dissemination of research outcomes to potential users.

4. THE IMPROVEMENT OF QUALITY IN POSTGRADUATE STUDIES

In order to improve the quality of research an institution should reflect critically and continuously on aspects such as the following:

- financial policy/guidelines for students and staff;
- the existence of a programme to improve staff qualifications;
- procedures for the dissemination of research outputs (e.g. implementation or publication of research outcomes);
- policies to reward and recognise research;
- sufficient research facilities for both staff and students;
- evidence of partnerships with industry/commerce that support projects;
- research committees;
- evidence of what percentages of staff are actively involved in research;
- Doctoral and Master's qualifications of academic staff;
- current student enrolment on Master's or Doctoral level;
- examination policy for research qualifications;
- training in research methodology provided to research supervisors and students;
- external supervisor involvement in guiding research students.

Examples of research outputs are:

- the number of articles in accredited journals,
- the number of scientific articles which do not earn subsidy,
- the number of popular scientific articles,
- the number of articles published on CD Rom and/or the www,
- the number of contributions to books and monographs,
- the number of international conferences (outside South Africa),
- the number of international conferences (inside South Africa),
- the number of national conferences,
- the number of published conference proceedings,
- the number of artefacts and patents,
- the number of staff serving on editorials,
- the number of international visits,
- the number of staff furthering their studies (M & D degree qualifications),

- the number of staff supervising students (M & D degree qualifications),
- the number of research projects supported through external funding,
- the number of NRF-rated researchers,
- contributions to (inter-) national reports,
- contributions in refereeing research (in various categories).

The postgraduate student should be invited from time to time to provide feedback to the institution on issues such as the guidance received from his/her supervisor, the infrastructure provided by the institution, financial assistance received as well as the effectiveness of administrative processes. In doing this the institution will become aware of the gaps in its practices and will then be able to implement the necessary procedures.

5. CONCLUSION

Research is one of the three core activities of higher education institutions. It is therefore imperative that the quality of research be of such a standard that it is nationally and internationally recognised. Institutions therefore need a research quality plan, which will lead to continuous improvement in the quality of research. In ensuring the quality of research and postgraduate outputs all stakeholders involved should take ownership to enhance continuously the research practices of the institution.

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DOING RESEARCH was written by authors with a passion for research development with the purpose of giving novice researchers a holistic view of what they will encounter when 'doing research'. The interplay between scientific theory, academic research and professional practice has been highlighted as these are considered the cornerstones to be mastered as early as possible in a young researcher's career.

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- the necessity of doing research in the current day;
- the quest for academic integrity;
- the research cycle;
- writing research proposals;
- managing and applying empirical research;
- scientific writing and critical reading;
- presenting your research, through a report or verbally;
- applying the Harvard or Numerical method of referencing within your text and bibliography; and
- applying quality assurance throughout the research.

The editors, Profs Laetus Lategan, Liezel Lues and Hesta Friedrich-Nel, have put their experience in research development into practice in the production of this book. It is trusted that they have succeeded in conveying their enthusiasm for research and its vast possibilities to future researchers.

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